



iCMR

7th INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY RESEARCH 2022

*"Navigating through Turbulence:
Role of Research and Innovation for Sustainable Future"*





Building Careers – Transforming Lives

Vision

To become the
premier private university
in the region

Mission

Produce quality human
resources with ethics and social
responsibility, having innovative
thinking and analytical skills to
serve humanity



**7th INTERNATIONAL CONFERENCE ON
MULTIDISCIPLINARY
RESEARCH 2022**

*"Navigating through Turbulence:
Role of Research and Innovation for Sustainable Future "*

20th December 2022 (Tuesday)

8.30 am to 5.00 pm

@ Hotel Sapphire
Colombo 06

ISSUE 07 - DECEMBER 2022

Subject – Disclaimer

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YEARS OF
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BCAS CAMPUS

Established in 1999, British College of Applied Studies (popularly known as BCAS Campus) has rapidly grown into a leading educational provider in Sri Lanka with a large number of students more than 3,500. BCAS Campus has strong international collaboration, especially, Solent University Southampton (UK), Oxford Brookes University (UK) and Pearson (BTEC) UK.

Besides the main campus in Colombo (City Campus), BCAS Campus has branches in other cities in Sri Lanka, namely, Kandy, Jaffna, Kalmunai and Galle.

Having won 17 awards nationally & internationally, the institution is highly esteemed for its exceptional quality, international recognition and market relevant training. To top it all, BCAS Campus was selected as the First of the Five Top higher education providers in Sri Lanka in 2013 by an independent survey conducted by an organization hired by Sri Lanka's pioneering business magazine LMD. Currently more than 3,500 students follow their chosen courses of study at BCAS Campus - Quantity Surveying, IT, Law, Business Management, Civil Engineering, Biomedical Science, Software Engineering, Cyber Security, Accounting & Finance, Tourism and Hospitality management and Project Management etc . These courses are delivered at various level including foundations, HND, Degree as well as at Masters.

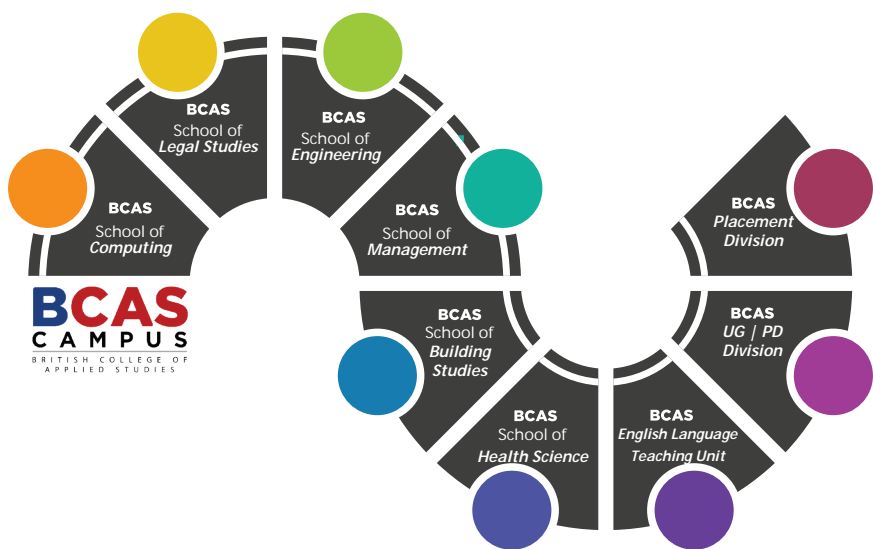
Building Careers - Transforming Lives

BCAS in Brief

1999	• Founded as IT/English training institute in Kandy
2000	• BCAS Placement division, placed the 1st batch of students to UK institutions.
2001	• Established 1st BCAS Centre in Colombo
2002	• Setup the main branch in Colombo • Launched BTEC HND in IT/Computing
2004	• Vocational Courses in Construction, placed students in Industry. • MoU with UK Colleges and Universities • Expanded Kandy Campus /launched HND Computing /IT

2005	<ul style="list-style-type: none"> • Launched BTEC HND in QS • Launched Vocational Programme – ‘CAD and Building Studies’
2006	<ul style="list-style-type: none"> • Articulation agreement with a UK University for students’ progression • Launched Vocational Programme – ‘Teacher Training’
2007	<ul style="list-style-type: none"> • 1st batch of students transferred to Uni of Wolverhampton(UoW) • Established HND QS Centre in Dehiwala Campus
2008	<ul style="list-style-type: none"> • BTEC HND in Business Management
2009	<ul style="list-style-type: none"> • BTEC HND in Electrical / Electronic (Telecom) • BTEC HND in Law
2010	<ul style="list-style-type: none"> • QS Top-Up Degrees in Dehiwala Campus - Bsc (Hons) QS- UoW
2011	<ul style="list-style-type: none"> • BTEC HND in – Biomedical Science - UoW • Established Batti Campus • EDEXCEL UK Award - Fastest/Most Outstanding BTEC HND Centre • ISO 9001 – 2008 Certified
2012	<ul style="list-style-type: none"> • BM Top-Up Degrees in City Campus - BA (BM) - UoW • LLB Top-Up Degrees in City Campus - LLB - UoW • Established Wayamba Campus • MBA – Launched in City Campus - UoW
2013	<ul style="list-style-type: none"> • BTEC Level-7 Strategic Management – MBA Pathway- UoW • BTEC HND – Civil Engineering • Recognized by LMD Magazine as the “No.1 Private Education Provider
2014	<ul style="list-style-type: none"> • Established Kalmunai Campus
2015	<ul style="list-style-type: none"> • MSc Construction Project Management
2017	<ul style="list-style-type: none"> • Partnership with University of East London • Launched Top-up Degree in Civil Engineering in Colombo
2018	<ul style="list-style-type: none"> • Partnership with Solent University in UK
2019	<ul style="list-style-type: none"> • Launched Global MBA and other Top-up Degrees in Colombo and Kandy
2020	<ul style="list-style-type: none"> • Partnership with Oxford Brookes University in UK • Launched Top-up Degrees in Jaffna

Divisions / Academic Schools



Quality Management Structure

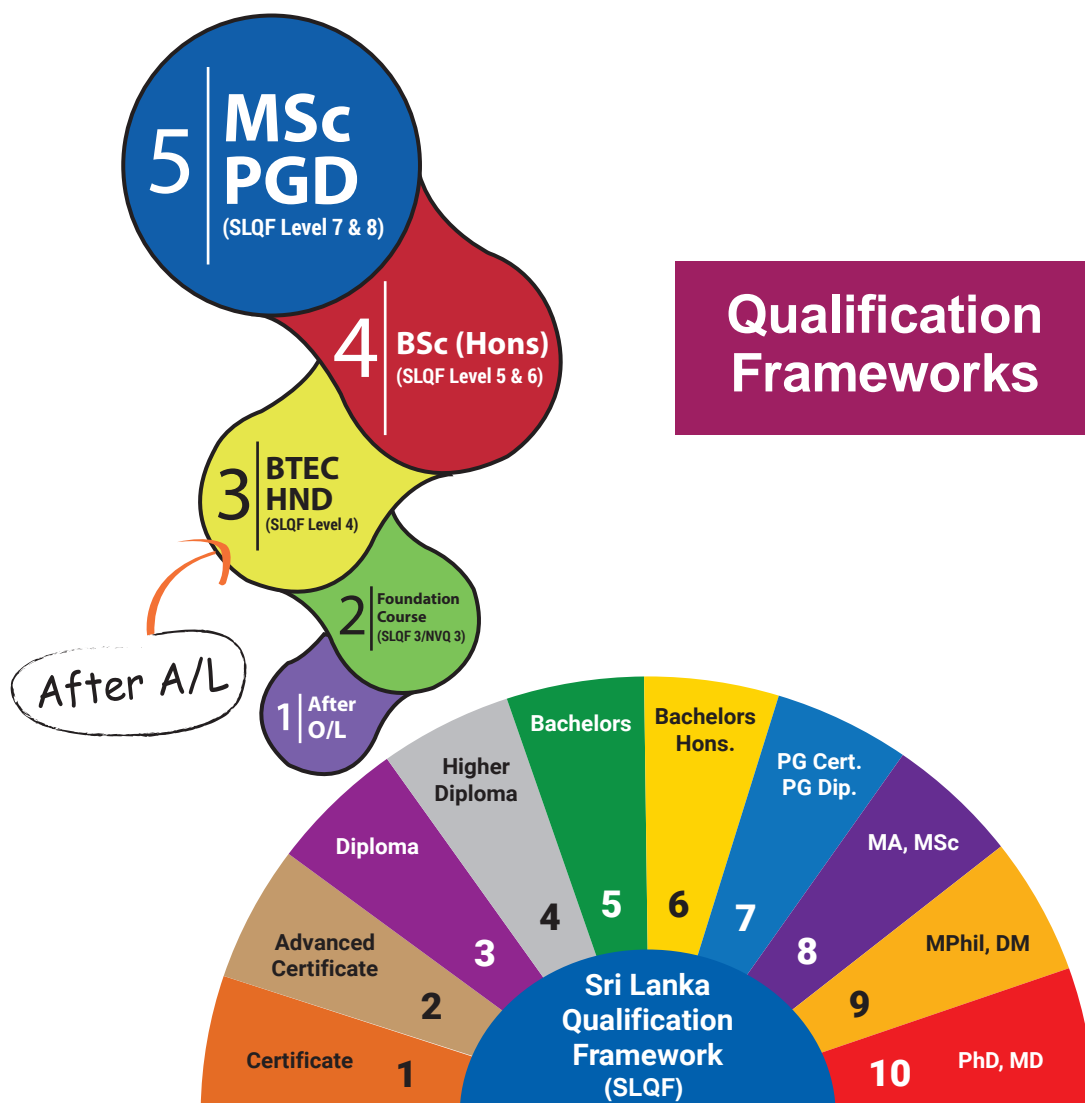


Service Divisions

Student
Placement &
Study Abroad
Division
(Located in BCAS)

PAC Asia

Student
Counselling Division
(Located in BCAS)



Sri Lankan National			BTEC/UK	
	SLQF	NVQ -	BTEC-QCF (UK)	
Doctorial Degree, MD	SLQL-10		QCF-L8	PhD/DPhil
M.Phil., Masters (Research)	SLQL-9		QCF-L7	Master's degrees
Master (Taught + Research)	SLQL-8			
Master (Taught), PG-D, PG-C	SLQL-7			
Honours Bachelor	SLQL-6		QCF-L6	Bachelor's degrees, eg BA, BSc
Bachelor Degree	SLQL-5	NVQ-7		
High Diploma	SLQL-4	NVQ-6	QCF-L5	BTEC HNDs (Higher National Diplomas)
Diploma	SLQL-3	NVQ-5	QCF-L4	BTEC HNCs (Higher National Certificates)
Advanced Certificate	SLQL-2	NVQ-4	QCF-L3	BTEC National Diploma
Certificate	SLQL-1	NVQ-2, 3		BTEC National Extended Diploma

Quality Assurance



Approval, Recognition Partnership



TERTIARY AND
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2015 RELEASE



2016 RELEASE



2017 RELEASE

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MULTIDISCIPLINARY RESEARCH

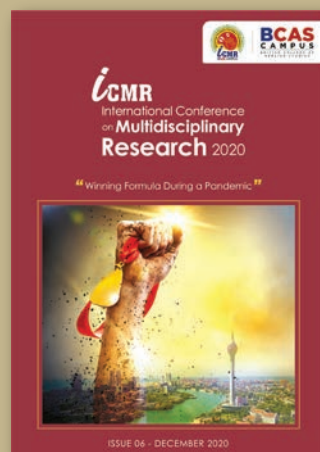
iCMR 2022



2018 RELEASE



2019 RELEASE



2020 RELEASE

INTERNATIONAL & LOCAL AWARDS



Gold Award
Pearson, UK
2019



Excellence in
Training Award
Overall Award based on
results based training
Asia Pacific HRM Congress
2019



> Best Employer Brand Award
> Outstanding Contribution
to the Cause of Education
> Award for Excellence in Training
World HRD Congress
13th Employers Branding Award
Le Meridien, Singapore
2018



BTEC
Gold Award
2018



Platinum Partner
No.1 BTEC Centre
in Sri Lanka
2017



Asia's Training
Excellence Award
2017



Best Employer
Brand Award
2017



Platinum Partner
No.1 BTEC Centre
in Sri Lanka
2016



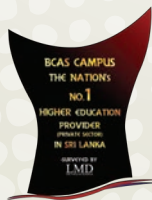
Educational Institute
with Best Academic
& Industry Interface
2016



Visionary Leadership
Award for
BCAS Chairman
2016



Academic
Impact Winner
2016



Ranked as No.1
Higher Education
Provider
2014



BTEC
Gold Partner
2013



Performance
Excellence Award
2011



Fastest Growing
BTEC Centre
2010

EDITORIAL PREFACE

It is a great privilege for us to present the proceedings of the 7th international conference on Multidisciplinary Research 2022. The first of this annual series of international conference was held in 2015 and the last of which was in 2020.

This time, taking a step forward from the last six events held, the coverage of speciality areas in this conference has been diversified. This volume contains the manuscript of research works from many sub specialities. These manuscripts will be presented at six parallel sessions on 20th December 2022 at hotel Sapphire, Colombo 6, Sri Lanka.

I take this opportunity to express my appreciation to Her Excellency the Ambassador of Federal Republic of Germany to Sri Lanka Manori Unambuwe who is gracing the occasion as Chief Guest and the Guest of Honour and keynote speaker Professor Ranjith Dissanayake. My sincere thanks are due to all academics and participants for their invaluable contribution for the development of a sustainable world. The Editorial Board should be failing in our duty if we do not thank the authors for presenting high quality research papers.

The manuscripts in this Volume of Conference Proceedings were reviewed double-blind by a panel of academics and professionals whose expertise is above reproach in their respective fields. The innumerable work carried out by these reviewers are gratefully appreciated. We are pleased to acknowledge the advice and assistance provided by the Board of Directors of BCAS, the Chairperson and Members of the Editorial Board along with many others who volunteered to assist to make this significant academic event a grand success. At the same time, we must acknowledge the financial sponsorship provided by the organization and their relentless support throughout for the success of this annual BCAS Symposium 2022.

It is the earnest wish for the editors that this precious volume would be used by the research community and all other participants who are directly and indirectly involved in the research work and studies.

Dr. Mihira Wanninayake
Editor-in-chief



The Conference Chair

**Dr. Susil Kumara Silva,
Executive Director/ CEO,
BCAS Campus**

Dr Susil Kumara (PhD) , the Chief Executive officer, Executive Director, BCAS Campus and he also a Management consultant, Lecturer, Accredited Director, Management Consultant, Lecturer, and Accredited Director (SL), Member of Chartered, CIPM, MSLIM, AMITD.

Dr Susil Kumara De Silva Holds a Master Degree in Human Resource management from University of Colombo, Masters of Business Administration from Buckinghamshire new University and PhD from University of Sri Jayawardenapura. He who is having more than 25 years' experience as a management professional in the sectors of Construction & Engineering, Trading, Apparel and Education, has hold positions such as CEO, Sr. Vice President, and Head of Group HR in large Corporations.

Dr Susil's areas of expertise include HRM, HRD, Business Administration, Marketing, Operation Management, People Development. He is the Gold Winner 2015 & 2016 and facilitated many such accolades. He also actively engages in research in the field of Management and is having many publications in locally and internationally recognized journals.

Message from The Conference Chair

Dr. Susil Kumara Silva,
Executive Director/ CEO,
BCAS Campus

It is a pleasure for me to welcome the presenters and the participants to the 7th International Conference on Multi-disciplinary Research - 2022 in Colombo, Sri Lanka. The theme of this conference is "Navigating Through Turbulence: Role of Research and Innovation for Sustainable Future" which is extremely relevant in the context of today's world for the vision of promoting innovative and sustainable research for tomorrow's development. I as the chairperson of this year's conference can say there have been six conferences on different themes successfully conducted by BCAS for in the past.

BCAS Campus organize this conference every year to get the talented, knowledgeable and dedicated people to meet and interact at one place. In that sense, we trust that this year's conference will help generate great ideas from a variety of researches and exchange with one another the outcomes and expertise from professionals, colleagues and friends who are working round the clock for the world's sustainable development.

This year's conference focuses on seven different sectors in the role of research for a sustainable future. Such as (1) Biomedical and Health Sciences, (2) Information and Communication Technology (3) Legal Studies, (4) Finance and Business Management, (5) Engineering and Quantity Surveying, (6) Hospitality and Facility Management and (7) Humanities and social sciences. The abstracts of the researches are screened through a process of double-blind review and the extended papers are published in this Volume of Conference Proceedings.

The dedication and hard work of the organizing committee and the sub committees that contributed immensely towards making iCMR2022 a reality is appreciable. Indeed, it is a significant landmark in our pursuit for excellence. I consider it as a great honour to be selected to the chair of the organizing committee. As for me, working closely with the colleagues from different schools and departments of BCAS is a unique and enriching experience.

I place on record my deepest appreciation on my personal behalf and on behalf of the organizing committee to all those (the editor-in-chief, the editorial committee and the panel of reviewers, et al.) who contributed tirelessly towards this endeavor for their unstinted and untiring efforts.

Further, as a chairperson I wish to express my sincere gratitude to our Chief Guest, Guest of Honour, keynote speakers, authors, members of the editorial committee, financial sponsors and many others who volunteered to assist to make this event a great success.

I sincerely hope that iCMR 2022 will be a rewarding experience for the presenters of research papers and the participants.

Best wishes and thank you,

Dr. Susil Kumara Silva
Chairperson, iCMR 2022



The Chief Guest

**Ms. Manori Unambuwe,
Former Ambassador of Sri Lanka to Germany and Ambassador of Asia
Berlin Forum**

Ms Manori Unambuwe was the Ambassador of Sri Lanka to the Federal Republic of Germany with concurrent accreditation to Switzerland, Croatia, North Macedonia and Montenegro from 2020 to August 2022.

Prior to her appointment as Ambassador, she was the Country Sales Manager in Sri Lanka for SAP India (Pvt) Ltd., a global technology company, headquartered in Germany.

Ms. Unambuwe has 20+ years of experience in the field of Information Technology, having worked as Head of Software Sales and Head of Marketing, at IBM World Trade Corporation, Sri Lanka and as Regional Sales Manager for Oracle Corporation, responsible for APAC Region. She was also Head of Sales and Marketing at Just-In-Time Holdings, a renowned Sri Lankan Systems Integrator.

She also served as a Board Director, at Information and Communication Technology Agency of Sri Lanka (ICTA) and at Sri Lanka Computer Emergency Readiness Team (SLCERT).

Ms. Unambuwe is currently the Ambassador of the Asia Berlin Forum, an initiative by the Berlin Senate in Germany to promote tech startups and also the Founder/CEO of Accentae Consulting, which supports Sri Lankan tech startups and scale-ups to enter the EU market with their innovative solutions.

Ms. Unambuwe holds a Master of Business Administration from Australia.

Message by **The Chief Guest**

Her Excellency Ms. Manori Unambuwe,
Former Ambassador of Sri Lanka to Germany
and Ambassador of Asia Berlin Forum

It gives me great pleasure to send greetings and best wishes on the inauguration of the 7th International Conference on Multidisciplinary Research 2022. I take this opportunity to congratulate and commend the British College of Applied Studies for organizing the 7th iCMR, popularly known as the "BCAS Annual Symposium". It is a great opportunity for researchers, scholars, academics, and students, in varied fields such as management, computing, legal studies, biomedical science, language studies, facility management and engineering, to share their innovative work.

Research, curiosity, and discovery have existed ever since man was present on this planet and has been the cornerstone for the evolution of civilizations. The curiosity to explore what will happen, how it happen, and experimenting different and better ways to do something, has been the driving force behind all research efforts. Recognition of such outstanding research achievements among the staff is a tremendous motivating factor, while appreciation of the student's research project achievements by academic and professional bodies, are a great encouragement for their future success.

In today's highly volatile, turbulent, and fast-paced world, it is essential to focus on research that solve existential challenges of humanity, meet demands of the marketplace and be applicable, while keeping sustainability at its very core. Such development oriented multidisciplinary research will provide the competitive advantage for nation building and contribute positively to the progress of mankind in a sustainable manner.

Once again, I congratulate the BCAS Campus and the organizing committee headed by Dr Susil Kumara Silva, for their untiring efforts and perseverance in building this excellent platform and for the remarkable international and local recognition the conference has gained over the last 7 years.

Manori Unambuwe

Former Ambassador of Sri Lanka to Germany
and Ambassador of Asia Berlin Forum



The Keynote Speaker

Professor Ranjith Dissanayake
University of Peradeniya

Prof. Ranjith Dissanayake is a Senior Professor in Civil Engineering at the University of Peradeniya. He is a Chartered Engineer and a Fellow of the Institution of Engineers, Sri Lanka (IESL) and holds membership from several other prestigious institutions.

He was a Fulbright Scholar in the USA, Endeavour Fellow in Australia, and JASSO Research Fellow in Japan. He was awarded the Young Scientist Award in 2007 for Excellence in Scientific Research by the National Science and Technology Commission (NASTEC) of Sri Lanka. He received the Overseas Prize of the Institution of Civil Engineers (ICE) in the UK in 2007 and the Australia Alumni Excellence Award in 2012. He has published over 150 papers in reputed journals. He has also chaired more than ten international conferences.

He is the Chairman of the Green Building Council of Sri Lanka (GBCSL), the President Elect of the Institution of Engineers, Sri Lanka (IESL) and a Vice President of the Chamber of Construction Industry (CCI). He is also the former Secretary to the State Ministry of Rural Roads and the State Ministry of Urban Development.

He is the founder of several companies, including Lego International (Pvt.) Ltd, ICB (Pvt.) Ltd, Lanka AAC (Pvt) Ltd, GAP (Pvt) Ltd and WSP Pvt. Ltd.

Message by **The Keynote Speaker** Professor Ranjith Dissanayake University of Peradeniya

I hope that this conference will allow the participant to productively discourse not only in aspiring excellence in research but also in managing all education discipliners. Some of the underlining issues in the research today's world is facing will be covered in depth in a conference along with all other guest speakers and keynote speakers. As a keynote speaker, I know that the success of the conference depends ultimately on many people who have worked in planning and organizing the conference. Most of all, I thank the presenters for enriching the conference by your presence and bringing your research outcome to this forum.

As the tradition with conferences, I hope you will enjoy the content that is being provided and renew all fellowship and make new fellowships, get new ideas and above all have a great deliberation. I do trust that this conference will provide some valuable opportunities on researches and showcasing the innovative and commercially oriented research that are utilized in a revolutionary technology. With a record number of participants seen in this year's annual conference, I hope that it will get larger and sustainable in the forthcoming years.

I believe that during the past few decades, the BCAS campus has taken a number of initiatives to reorient the university machinery to play leading roles in the industrial development process. This has further strengthened the integrated multidisciplinary team to develop a number of appropriate technologies that the traditional system with crisp boundaries among departments have failed to produce decided outcomes from our talented graduates

I extend my heartfelt appreciation to the organizing committee for inviting me as a keynote speaker at this great occasion.

Professor Ranjith Dissanayake
University of Peradeniya.



Panel Member
Mr. K. V. Kuganathan
Group Chief Information Officer
Janashakthi Group –JXG

K V Kuganathan is a seasoned business, digital & IT strategist with extensive experience in Banking Finance, Insurance & Capital market sector. With over 24 years of experience, with 9+ years at C-level, Kugan is known for his innovative, creative and results driven leadership. He builds and transforms financial models into dynamic digital businesses with an acute focus on achieving exceptional results.

Kugan is currently working as Group Chief Information Officer at Janashakthi Group of Companies which includes Banking, Capital Market, Insurance, Real Estates and Health Sector. Additionally, Kugan is holding a number of IT related board positions, Chairman of British Computer Society for IT Chartered Institute Sri Lanka Section and is on the Board of British Computer Society for IT Chartered Institute UK. He was serving as a Non-Executive Director for UPAY Payment Solution Ltd,

Prior to working at Janashakthi, whilst Heading Digital & IT strategy, Kugan transformed National Development Bank PLC as Sri Lankan's Leading Mobility Banking solution providing the markets best customer experience for its loyal customers. Further to this, he initiated and led the Digital Banking division at Hatton National Bank PLC.

Along with ICTA – Government ICT Agency formulating framework for digitally inclusive country in advisory positions for Digital Hub initiatives, Digital index, Lighting Digital programme and empowering Government Chief Digital officer's skills development programme. Kugan graduated with distinction in MSc in IT Consultancy as well as a degree in Computing and Information Systems. Chartered IT professional from BCS Chartered institute for IT UK. With many prestigious accolades in recognition of his contribution to the IT industry, since 2011, Kugan has Judged NBQSA National ICT Awards & Asia Pacific ICT Awards known as APICTA in many countries. Additionally, Kugan shares his enthusiasm for Digital Financial Infusion at many International conferences, focusing on Channel Optimization, where he is a renowned public speaker both local & International conferences.

Message by **Panel Member**

Mr. K. V.Kuganathan

Group Chief Information Officer

Janashakthi Group –JXG

Distinguished Participants, Ladies and Gentlemen and My dear friends,

It gives me a great pleasure to send my greetings and best wishes on the inauguration of the 7th International Conference on Multidisciplinary Research - "Navigation through turbulence: Role of research and innovation for sustainable future", organized by the British College of Applied Studies which is now affectionally known as the BCAS Annual Symposium.

I am sure this platform will focus on the business landscape which is constantly evolving, forcing enterprises to accelerate their digital transformation initiatives to remain relevant and future ready.

This is a great opportunity for the participants to interact with the scientists, researches and entrepreneurs who will share their knowledge, experiences and research outcomes in the areas of their interest, in the fields of Engineering, Quantity Surveying, Business Management, Information Technology, Law and International Relations, Science, Social Science and Education.

Research is "creative and systematic work undertaken to increase the stock of knowledge". It involves the collection, organization and analysis of evidence to increase the understanding of a topic, characterized by a particular attentiveness to controlling sources of bias and error. These activities are characterized by accounting and controlling for biases. A research project may be an expansion on past work in the field. To test the validity of instruments, procedures, or experiments, research may replicate elements of prior projects or the project as a whole. Recognizing of outstanding research achievements of students and staff by academic and professional bodies is a great encouragement for the future.

Thus, I extend my congratulations to the BCAS Campus and in particular to the organizing committee and chairperson for their tireless efforts and perseverance in creating this platform as well as for the remarkable recognition and reputation gained on an international and local level over the past seven years.

K V Kuganathan

Group Chief Information Officer – Janashakthi Group –JXG

Board Council Member – British Computer Society for IT Chartered Institute UK.



Panel Member

Dr. Anuradha Iddagoda

Senior Lecturer

Management Science Unit, Faculty of Applied Sciences

University of Sri Jayewardenepura

Dr. Anuradha Iddagoda (PhD.) is a Senior Lecturer from the Management Sciences Unit – Department of Mathematics, Applied Sciences Faculty in the University of Sri Jayewardenepura Sri Lanka. Her research focuses on Human Resource Management, employee engagement, green human resource management and green employee engagement. She holds a PhD from the University of Sri Jayewardenepura Sri Lanka, an MBA in Human Resource Management from the Postgraduate Institute of Management, University of Sri Jayewardenepura, a Master of Information Technology (MIT) post graduate degree, Bachelor of Information Technology (BIT) both from Charles Sturt University, Australia. She has been a guest researcher as well as a visiting lecturer at the Department of Sociology and Work Science in the University of Gothenburg Sweden. And also she served as a guest lecturer in Rzeszów University, Poland.

Message by **Panel Member**

Dr. Anuradha Iddagoda

Senior Lecturer

Management Science Unit, Faculty of Applied Sciences

University of Sri Jayewardenepura

Bill Gates once said that "I believe in innovation and that the way you get innovation is you fund research and you learn the basic facts.". Without research, there is no innovation. Without innovation there is no future development.

It is a well-known fact that all organizations, excluding charitable ones, are interested in improving their financial performance. Unquestionably, the triple bottom line of the organizations is impacted by the Covid-19 pandemic, particularly profit. Therefore, it is crucial to prepare for life after the COVID-19 pandemic. Making "innovative ideas" for any problem in a "systematic and scientific manner" is made possible through research.

Sending greetings and well wishes for the 7th International Conference on Multidisciplinary Research in 2022 gives me tremendous joy. I would like to take this opportunity to thank the British College of Applied Studies for hosting the 7th iCMR, also known as the BCAS Annual Symposium.

I would like to extend my congratulations to the BCAS Campus and the organizing committee, which is led by Dr. Susil Kumara Silva, for their tireless work and perseverance in creating this superb platform and for the impressive national and international recognition the conference has attained over the past seven years.

Dr. Anuradha Iddagoda

Senior Lecturer

Management Science Unit, Faculty of Applied Sciences

University of Sri Jayewardenepura



Panel Member

Dr. Sameera Maheepala

**General Manager Materials Development and Innovation
MAS Kreedaa**

Dr. Sameera Maheepala (PhD.) currently served in MAS KREEDA as a Head/GM Material Development & Innovation. His currently overseas after the Overall Material development and Material innovation functions at MAS KREEDA. Lead the material development team. Train and develop the skills of material developers. Work on seasonal material collections, onboarding suppliers, sourcing & supply chain functions. Dr. Maheepala has vast range of experiencing by working on the field of Deputy General Manager Material Management, in MAS Active Trading (Pvt) Ltd and SE/Manager Material Development. Textured Jersey in Executive Research and development. He holds a PhD (2018) from the University of Sri Jayewardenepura Sri Lanka, University of Moratuwa, Sri Lanka. He obtained B.Sc. Engineering in Textile and Clothing Technology specialized in Textile and Process Engineering from University of Moratuwa, Sri Lanka. He gained BA in Business and Management studies in Leeds Metropolitan University, UK. Further, He received Master of Business studies in Management and Master of Business Administration in Marketing Management in University of Colombo, Sri Lanka and Australian Institute of Business respectively. Also, he is qualified with Post Graduate Diploma in Applied Statistics and ACMA/CGMA From University of Sri Jayewardenepura, Sri Lanka and Chartered Institute of Management Accountants (CIMA), respectively.

Message by **Panel Member**

Dr. Sameera Maheepala

General Manager Materials Development and Innovation

MAS Kreedaa

I am privileged to send greetings and best wishes on the inauguration of the 7th International Conference on Multidisciplinary Research 2022. I take this opportunity to thank the British College of Applied Studies for organizing the 7th iCMR Symposium. This is a great opportunity for local and international scholars, practitioners and academics to share the knowledge and best practices among the peers, students and the industry. Multidisciplinary Research provides the opportunity for cross functional fields to come together and share new knowledge. Fields such as management, science, engineering, art can create groundbreaking findings which are required to the country to come out from the current crisis.

Since the 1970s, natural and social scientists initiated multidisciplinary research addressing practical problems related to the environment. Multi-disciplinary research involves collecting and analyzing information with the purpose of gaining new knowledge or new understanding with subjects being researched. It is a rigorous activity and is usually based on the existing knowledge of other researchers aiming at generating new ideas and knowledge.

In today's highly volatile environment the existing knowledge is getting outdated very fast. The pandemic highlighted several trends in research and practice that need to be the focus in future studies as well in business. Only way to capture the new requirements and address them would be through research. Research would help to identify the existing gaps, problems and disseminate new knowledge with establishing the new gaps. In the context, British College of Applied Studies campus has taken the initiative of organizing the 7th International Conference on Multidisciplinary Research Symposium. I would like to congratulate the organizing committee for their hard work in building this platform for local and international scholars to disseminate the knowledge.

Dr Sameera Maheepala

PhD, MBA, MBS, BSc(Eng), BA, ACMA, Pg dip (stat),

General Manager- MAS Holdings.



Moderator

Dr. Chamara De Zoysa

Dr. Chamara De Zoysa is a well-known Senior Lecturer, Clinical Embryologist, Public Speaker, Business Consultant, Corporate Consultant and a Corporate Trainer. Dr. Chamara has completed his studies at St. Sylvester's College and Dharmaraja college- Kandy and offered a full scholarship from the Indian Government for his graduation from University of Delhi. He completed graduation specialized in Clinical Embryology from University of Delhi with a 1st division & I was the topper of Delhi University. After the graduation he worked as a Clinical Embryologist in Apollo Hospital – New Delhi and contributed to the Clinical Research in the areas of Infertility, IVF and the pregnancy complications. He holds a Diploma in Sports Medicine and Clinical Embryology from University of Delhi with Distinctions.

Dr. Chamara holds MBA (Master of Business Administration) Specialized in Marketing with a 1st Division in 2009 & he was the Batch Top of Faculty of Management Studies (FMS) – University of Delhi. Dr. Chamara has been awarded as “Student of the Year” of Delhi University in 2005 and 2008 based on his excellent Academic and the extra-curricular activity performances. He has awarded Dr. Abdul Kalam Gold Medal for the “Best Overall Performance” in 2009 being the most outstanding student of Delhi University. Dr. Chamara has completed LLM (Master in Law) in International Business, Specialized in Finance from University of Cardiff Metropolitan University (UK) in 2015 and he topped the batch.

He has worked as a Consultant for many organizations in different sectors such as Banking, FMCG, Pharmaceutical and Manufacturing. Further he has delivered guest lectures for many organizations including leading Government/State Universities in Sri Lanka and abroad. Currently he is lecturing for the areas of Bio Medical Science, Business Management and Law in different local and international Universities and Institutes. He is contributing as a Consultant and a Trainer for many organizations. Dr. Chamara demonstrates a diversified knowledge, Teaching Experience, Research Experience & Industrial exposure in all functional verticals.

Message by

Moderator

Dr. Chamara De Zoysa

It is indeed my great pleasure to be a part of international Conference on Multidisciplinary Research 2022.

Congratulations and wish you continued success and happiness to those who participate in the Research Conference and your accomplishments are even more impressive as you carried them out during a worldwide pandemic and major issues in Sri Lanka.

Believe in yourselves and it will make competent, empathetic, and trusting during the Research Conferences. It has been an honor to see you all grow personally and professionally in the area of Research which is indeed a global need.

With immense pride, I congratulate to all the participants and the Team of BCAS international Conference on Multidisciplinary Research 2022.

I believe that you will go out into the world with confidence in your abilities to communicate and analyze the world you encounter and with faith that you will affect great change in the world as a Great Future Researcher.

I am wishing the best for all during this pivotal time in your lives. Take time to celebrate as your hard work on Research and determination has led you to this point. It is the time for seize the future as you venture in a new normal as there are a number of opportunities available to you all. I look forward to seeing of your future successes and accomplishments. The Research has significant number of Research papers in diverse research areas and issues.

I am truly confident that the international Conference on Multidisciplinary Research 2022 will bear a fruitful result and lay the concrete foundation for the future development of diverse research areas beyond our walls in this virtual era.

Wish you all the very best and Good Luck.

Dr. Chamara De Zoysa

Moderator- international Conference on Multidisciplinary Research 2022

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Session 01
Building Studies

Green building rating systems in Sri Lanka

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Abstract

Globally and locally, a number of green rating systems have been developed to assess the sustainability of building construction projects. Their categories and criteria have a similar appearance but significantly affect the ratings in order to keep up with the sustainable building development trend. This research aims to develop a systematic review of the green building rating systems in Sri Lanka. The specific objectives are: (1) to discover how interest and research in green rating systems have developed in Sri Lanka; then (2) to identify the similarity, differences, strengths, and weaknesses of green rating systems; and finally, (3) to compare the green building rating systems with regards to their influence and popularity, performance criteria and the rating score. Specifically, GBCSL (Green Building Council of Sri Lanka) and BGSL (Blue Green Sri Lanka) were analyzed in this paper. The comparison was done based on the grounded theory method. Since these two rating systems were initiated based on the international rating system LEED, they almost have the same standards; Sustainable site management, Water efficiency, Energy efficiency, and Material are core common assessment criteria for both. Further in-depth this research is anticipated to focus more on economical capability and formal factors to improve sustainability purposes.

Keywords: Green Building Ratings, Sustainability, LEED, GBCSL, BGSL

1. Introduction

In Sri Lanka, there is a high necessity for residential and commercial buildings because of the country's rapid urbanization and growth in population. Traditional building materials and techniques may not always be acceptable because some of them release harmful greenhouse gases (GHGs), produce dust, use more energy, and require more water. In comparison to a typical building, a green building uses less water, increases energy production, protects common resources, produces less trash, and offers renters better areas. Environmental effect is reduced by using innovative materials and nonrenewable energy sources when developing green or sustainable buildings. A green building promotes the efficient use of recycled or recyclable materials as well as natural resources. [1]

Traditional buildings meet people's needs for well-being, but they waste energy and other natural resources. Green buildings use a variety of eco-friendly ideas to offer

the same level of comfort in a healthy atmosphere. In recent decades, the demand for green buildings has rapidly increased on a global scale. Tools for benchmarking and assessment became more necessary as the demand for green buildings increased. [2] In view of the extent of green measures embraced, credits are granted to a project, and after applying the required weightage; a final score is calculated to determine the certification Level of the building. This helps to know the range of utilization of green practices in building development. The Building Research Establishment's Environmental Assessment Method (BREEAM) was launched in the UK in 1990 and the first guide was published in 1996, after BREEAM every country started developing their own rating system. The Hong Kong Building Environmental Assessment Method (HK-BEAM) was introduced in the same year in Hong Kong in 1996. In the year 1998, the Leadership in Energy and Environmental Design (LEED) green building rating system was introduced in the US. In 2002 Green building council of Australia introduced Green Star rating system (GSRS). In 2003 the Indian Green Building Council was introduced BY CII. In 2005, the Green Mark Rating (GMR) system was introduced by the building and Construction Authority of Singapore.

In 2010 Green Building Council of Sri Lanka (GBCSL) developed and administrated Green Rating in Sri Lanka which was adopted as a national rating system for green buildings from 2013.

2. Background

Sri Lankan construction industry is witnessing highest growth rate from last 10-15 years, which is having a negative impact on the environment and natural resources available for construction. Following this problem of carbon imprint, concept of sustainable development in construction industry is the need of an hour. With increase in demand of sustainable buildings or Green buildings, demand of Green rating and assessment tools is also increasing. Rating tools set benchmark for green building measurement, which are helpful in reducing negative impact on environment by promoting quality green buildings.

Sri Lanka has two main green building rating systems i.e. Green SL Rating System for Built Environment implemented by Green Building Council of Sri Lanka and Blue Green Sri Lanka Green Building Guidelines for Sri Lanka implemented by Urban Development Authority. The latter was designed locally, whereas the former was evaluated against international standards. This research aims to provide a comprehensive knowledge of the evaluation criteria for the GBCSL and BGSL rating systems, which must be taken into account before certification.

3. Research methodology

The data compiled in this research paper are through a literature review and information collected from the available green rating system guides from both Green Building Council of Sri Lanka and Urban Development Authority of Sri Lanka. This research compares and discuss about the ways and strategies that has been used by the ratings in order to ensure the sustainability. Comparative analysis was done based on grounded theory emerging code method. Principle behind grounded theory is the most appropriate method to conduct a comparative analysis between these kind two ratings.

4. Findings

Green Building Council of Sri Lanka

- Developed and administrated by Green Building Council of Sri Lanka since 2013.
- Originally based on LEED 2009 rating system.
- Currently 61 certified projects in Sri Lanka and 1 certified project in Maldives.
- Almost 1500 Associate and Accredited professionals have been trained since 2011.
- Current GreenSL version is, V2.1

Blue Green Sri Lanka

- Developed and administrated by Urban Development Authority of Sri Lanka under their Environment and Landscape division since 2007.
- Mandatory for all public buildings both government and semi-government.

5. Comparative Analysis

Popularity and Influence

Popularity is measured in terms of number of projects registered under each rating system and their contribution towards green footprint.

Table 1- Influence of each rating system

	GBCSL	BGSL
Year	2022	no information given
No. of projects registered	62	
Green footprint	4.5 million sq. ft.	

6. Assessment criteria

A total of 100 points are available under the set criteria for ratings covering eight major aspects namely management, sustainable sites, water efficiency, energy and

atmosphere, materials and resources, indoor environmental quality, innovation and design process and social and cultural awareness.

Table 2- The set of criteria and available points for the rating of GBCSL

CRITERIA	
Management	4
Sustainable sites	25
Water efficiency	14
Atmosphere	22
Material and Resources	14
Indoor environmental quality	13
Innovation and Design process	4
Social and Cultural awareness	4
Total	100

Table 3- The set of criteria and available points for rating of BGSL

CRITERIA	
Energy efficiency	27
Sustainable site management	23
Material and Resources	20
Quality of Internal environment	13
Water efficiency	10
Green innovation	5
Social and Cultural awareness	2
Total	100

7. Rating Score (Benchmark)

Benchmark is a set of norms, utilized as a perspective for assessing performance. Benchmarks for both the rating systems are given below.

Table 4- Certification levels of each rating systems

GBCSL		BGSL	
<i>Rating</i>	<i>Points</i>	<i>Rating</i>	<i>Points</i>
Certified	40-49	YES Certified	40 -49
Silver	50-59	Silver	50 – 59
Gold	60-69	Gold	60 – 69
Platinum	70 or above	Platinum	70 or above

It is clear that the rating score of both rating systems are the same. As they are both implemented and developed in Sri Lanka to the local standards.

Table 5- Comparison of rating systems

	LEED	GBCSL	BGSL
Difficulty of Certification (Rigor)	Hardest	Harder	Hard
Prerequisites – minimum requirements	Yes	Yes	no
Site visit by certifying body	No	Yes	Yes
Building simulations required	Yes	Yes	No
Integrational Recognition	High	Same	None
Certification Fee	Highest	Lowest	Medium
Is it mandatory?	No	No	for government
Local Accredited Professionals	Few	Many	None
Local Certified Projects	62	61	Unknown

Conclusion

To rate the green building both the rating systems GBCSL and BGSL are prominently used in Sri Lanka, where the former is according to international standards while later is indigenously developed. GBCSK is backed by Confederation of Sri Lankan Industry and uses global standards norms of LEED. Meanwhile BGSL is especially developed according to Sri Lankan Condition and supported by the Urban Development Authority. No enough information was available to conclude on the popularity and influence of BGSL. But according to the assessment criteria and rating score BGSL is a convenient rating system while GBCSL has high standards that will aid in the growth of the construction industry. Overall, GBCSL suits and fits Sri Lankan Conditions while good market strategy and international standards are helping in maintaining its position as the most preferred rating system in Sri Lanka.

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ADOPTING NET ZERO ENERGY BUILDING CONCEPT AND ITS ROLE IN THE FUTURE SRI LANKA

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Abstract

As a result of a variety of causes, today's operational cost of a building is significantly higher than in previous decades. Typically, the Electricity bill for a building took a larger portion of the overall utility expense. However, it was found that the major problem in fulfilling the energy requirements of the building leads to producing more energy consumption. Even though energy production is increasing, it is insufficient to meet the building's existing energy requirements. As a result, in the recent past, everyone switched to the Net Zero Energy Building (NZEB) Concept to reduce the cost of energy. Therefore, it is environmentally beneficial since it makes use of renewable energy sources such as solar energy, wind energy, and geothermal energy. As it is an environmentally friendly approach the impact of this concept is higher in the future. This is a proven method to reduce energy consumption and greenhouse gases in developed countries such as the USA, and the UK. Therefore, this paper aims to critically review the adoptability of the NZEB concept by finding the barriers and its role in the future. Furthermore, the case study approach was chosen under qualitative methodology since this research required a thorough investigation. Three cases were undertaken as two different kinds of buildings such as commercial and industrial to collect data to find the adoptability of the NZEB concept and further in-depth analysis of the role of this concept in the future. The study looked at four main types of barriers to implementing the NZEB Concept: financial, legal, social, and technical. Finally, From the in-depth analysis, this paper shows us the impact of implementing the concept plays a major role in increasing energy production, lowering unwanted energy consumption, sustainability for future generation and mainly improving the country's economy by reducing the production of energy from fossil fuels when the requirement of energy decreases by moving to NZEB concept and more greenery.

Keywords: Net Zero Energy Building; Barriers; Future role of NZEB; Solutions; Impact of NZEB approach in future

1. Introduction

Commercial and residential buildings consume around 40% of the primary energy in the United States. When compared to primary energy sources, Renewable

energy utilization was regarded as a reasonable solution to fulfill the energy requirements in an environmentally friendly way through the use of the NZEB concept (Deng, et al., 2014). According to Sun (2015), NZEB has an energy-generating system in addition to an ordinary building energy-consuming system which depends on a renewable energy system. The Sri Lankan energy sector is still somewhat unaccustomed to the NZEB concept. As a result, since the majority of buildings get their energy from the national energy grid, adapting this idea has become a significant difficulty. According to Alirezai, et al (2016), the goal of the NZEB concept is to fulfill the building's electricity requirement by producing electricity onsite and mitigating Carbon dioxide emissions from the building sector. Pan & Pan (2021) stated that the barriers to the implementation of NZEB are economic, legislative, cultural, geographical, skill and knowledge. Furthermore, there are some strategies for implementation of NZEB mentioned by Oh, et al (2017) Passive and Active strategy, Passive strategy mainly focuses on energy saving techniques (EST) while the active strategy makes sense in moving to renewable energy such as sunlight, geothermal, and wind. Therefore, this research aimed to change towards the NZEB concept which helps to reduce spending from foreign reserves on crude oil to produce energy.

2. Literature review

2.1 Net Zero Energy Building Definition

In recent years, the subject of zero energy buildings (ZEBs) has drawn more attention and is now included in various countries' energy policies. According to the revised EU Directive on Energy Performance of Buildings (EPBD), All new buildings must be "virtually zero energy buildings" by the end of 2020. The strategic objective of the US Department of Energy's Building Technologies Program is to develop "marketable zero energy residences in 2020 and commercial zero energy buildings in 2025." (Sartori, et al., 2012). As stated by Deng, et al (2014) the definition of Net Zero Energy Building concept means “where a building that satisfies its energy requirement by producing energy on-site from renewable energy sources”. Simply where energy demand is fulfilled by energy supply from its site. However, when energy production exceeds energy consumption it is called “Positive Energy Building” as shown in Figure 2.1.1. Even though this appears logical, Task 40 of the International Energy Agency is still looking at this matter. They claim that the "net zero energy," "zero net energy," "net zero carbon," or "Equilibrium" structures are currently being proposed by a major vision.

$$\text{Total Energy Consumption} = \text{Total Energy Production}$$

Figure 2.1.1: NZEB Concept

Total Energy Consumption < Total Energy Production

Figure 2.1.2: Positive Energy Building

2.2 Sensitivity analysis of Macro-Parameters

In contrast to a standard building, an NZEB contains energy generating systems in addition to typical building energy-consuming systems. Further, its ability to generate electricity is mostly dependent on the renewable energy system it has installed. Power generated by an NZEB does not always match building power demand in real time since renewable energy is intermittent and unreliable. Consequently, an energy storage system is typically constructed to address such real-time power inconsistencies. The systems must be effectively constructed to achieve net zero energy economically.

It takes more than just combining the designs of different systems to create a successful NZEB system for this intricate relationship between various systems is necessary. However, the macro-parameters of an NZEB might have more nuanced effects than they would in conventional structures. For instance, the parameter relating to the internal load of a typical building may only affect the maximum cooling load and, thus, the size of the air-conditioning system. In contrast, such a parameter in an NZEB affects both the cumulative annual energy load and the maximum cooling load. In other words, the parameter affects the size of energy storage and renewable energy systems in addition to the size of the air conditioning system. (Sun, 2015)

2.3 Drivers and barriers in the implementation of NZEB

Pan & Pan (2021) stated that numerous drivers and barriers when implementing the NZEB concept which mainly categorized as economic, legislative, and cultural. This exactly suits the case study which was undertaken in this research. For example, economic factors act as a barrier when considering the initial cost to move towards NZEB while economic factors act as a driver where it helps to save a large portion of spending on the electricity bill during the operational period of the building.

2.4 Strategies to follow

Solutions for the implementation of NZEB have primarily been split into two categories as passive and EST. The passive sustainable design calls for minimizing the energy demand of buildings while considering their geographic and climatic context. Second, when it comes to passive techniques, EST means lessening the energy demand for buildings by improving their insulation and sealing qualities by using better building materials. (Oh, et al, 2017)

3. Research methodology

Yin (2009) asserts that a case study technique is better suited to aid in understanding a complicated problem or object in depth rather than breadth, therefore the study has been chosen under qualitative methodology while it requires thorough investigation. Three cases were chosen under each two different kinds of buildings named commercial and industrial. Furthermore, Semi-structured interviews and observation methods were chosen as suitable data collection methods. Twelve Semi-structured interviews were conducted among the top-level designated employees who work in the particular building to identify the barriers and drivers which affect the adoption of the NZEB concept. The interview profile is illustrated in Table 3.1.

Table 3.1: Interview Profile

Case	Designation
CASE A (Commercial Building)	Manager
	Assistant Manager
CASE B (Commercial Building)	Manager
	Second Officer
CASE C (Commercial Building)	Manager
	Marketing Manager
CASE D (Industrial Building)	Manager
	Assistant Manager
CASE E (Industrial Building)	Manager
	Production Head
CASE F (Industrial Building)	Branch Administrator
	Quality Inspector

According to research findings, the barriers categorized into four main factors. Figure 3.1 depicts the barriers as per the findings.

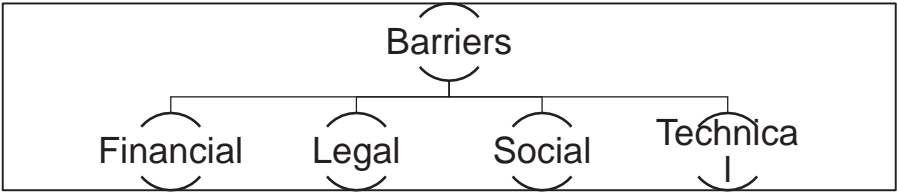


Figure 3.1: Barriers to adopting NZEB concept

4. Results & discussion

Results obtained from this study shows the number of barriers are there in the adoption of the NZEB concept, especially in commercial and industrial building. Mostly in those building lower-level employees who work in those buildings have no idea about the NZEB concept except the middle and top-level employees. Therefore, it is required to give awareness regarding the NZEB concept for all the employees in that organization. Moreover, the analysis of the data collection report shows financial, legal, social, and, technical as the common barriers when adopting the NZEB concept. Indeed, Commercial buildings are not ready to invest a vast amount of money as an initial cost in renewable energy systems installation since they are focusing on making more profit like if they make that huge investment in their business, they can able to get the return in a short period. Some commercial building uses fluorescent bulb instead of CFL or LED which consumes more energy and low efficiency to maintain the colour theme of their firm. Even though some reputed firms started changing towards renewable energy as they installed solar panels. When looking at the industrial building their main goal is to produce more products at low cost. Since they have this goal NZEB concept can reduce major expenses on energy. Even though they are financially capable but they were lack of knowledge about the NZEB concept is considered the major barrier to the adoption, which is a social factor. Also, they don't have the required amount of technical help for implementation as per the particular industrial building design.

Increasing awareness among people and educating people who are willing to work in this field cause a good impact on the adoption of the NZEB concept. It increases the employment rate by creating an opportunity by fulfilling the technical requirement which leads to a circular economy. However, Government should take legal action to promote this NZEB concept by implementing laws that help to make it easier to adopt the NZEB concept as they can lift or reduce taxes on renewable energy systems and provide loan facilities with the lower interest rate to invest in the NZEB concept. Moreover, some commercial buildings earn money from the net metering concept which sells electricity produced by the solar panel on their site to the government. This is a good step implemented by the government to be aware of renewable energy sources. The suggestions to overcome were listed in the following table according to each criterion. Based on observations from commercial and industrial buildings, Table 4.1 offers some general recommendations for reducing energy waste and making intelligent energy use.

Table 4.1: Strategies to reduce energy wastage

Active (Taking control of energy use)	Passive (Avoid unnecessary use of energy)	Structural
Continuous monitoring using a power measurement device	Switching to CFL and LED (LED is best)	Proper placement of windows
Taking action to reduce energy wastage according to the results from the measurement device	Switching to A++ appliances	Proper arrangement of ventilation way
Using variable speed fans	Use renewable energy sources	Use sunlight for natural daylighting

Table 4.2: Suggestion to overcome barriers & benefits by adopting them

Criteria	Suggestion to overcome	Benefits when adopting the suggestion
Financial	<ul style="list-style-type: none"> Introducing a new loan system with low interest rate for the investment in the renewable energy system Reducing the equipment price by lowering tax levels 	<ul style="list-style-type: none"> Due to the low interest rate, commercial buildings will invest a significant amount in renewable energy sources By making huge investments, industrial buildings can lower manufacturing costs, which reduces the price of the finished product
Legal	<ul style="list-style-type: none"> Establishing regulations for off-site energy production Lifting tax on equipment used to generate energy from the renewable energy source Government can take steps to provide discounts on income tax to be paid by commercial & industrial buildings which move 	<ul style="list-style-type: none"> Commercial & industrial buildings focus on investing in renewable energy sources because of discounts provided in income tax Implementing the law increase awareness among common people

	towards renewable energy sources	
Social	<ul style="list-style-type: none"> • Explaining the benefits of the NZEB concept in future • Conducting awareness programs among employees • Encourage the use of renewable energy • Explaining the impact of carbon production when generating energy from non-renewable energy sources 	<ul style="list-style-type: none"> • Energy wastage will decrease due to awareness among employees • Interest in the green concept will increase once people are aware of the carbon footprint • Decrease in the amount of foreign reserve used to import crude oil
Technical	<ul style="list-style-type: none"> • Importing specialized equipment and system from foreign • Introducing technical related courses to youngsters • Increase in supply in technical aspects cause lower initial cost due to competition among suppliers 	<ul style="list-style-type: none"> • Decreases the rate of unemployment • Boost the country's economy • Technological knowledge of youngsters improves day by day • Increases circular economy

5. Conclusion

As Sri Lanka is committed to an extreme financial crisis and lack of foreign reserve to perform importing goods from other countries. The major portion of the foreign reserve is used for importing fossil fuel which helps to generate energy since Sri Lanka has more energy requirements to be fulfilled and it majorly depends on non-renewable energy sources. If the energy requirement is not satisfied, the impact will be so hazardous. An example could be experienced from what happened when the government stopped importing crude oil. All sectors get affected as lack of fuel causes power cuts which leads to the shutdown of schools, hospitals, and universities. If we move towards the NZEB concept which utilizes the energy requirement of buildings, we can produce the energy required for the building on its own and able to reduce energy wastage. As this concept is eco-friendly it is sustainable for Sri Lanka's future because energy production is done from renewable energy sources. Therefore, we don't need to depend on fossil fuels to produce the energy that we need.

When implementing this concept in an industrial building we can be able to decrease the price of a product by reducing the production cost as we reduce spending on energy which required for production. In commercial buildings, if the concept is implemented, we can improve the efficiency of using energy because in Sri Lanka

commercial buildings spend a large portion of their expense on the electricity bill. Therefore, indeed changing towards the Net Zero Energy Building concept would help to reduce the changing complication of the Sri Lankan financial crisis as spending less amount of money in foreign reserves for producing energy. Several barriers are there when changing toward the NZEB concept as the research findings show but when looking at the benefits, those are limitless and this is a proven method to reduce the energy cost of building in a developed country. For the adoption of the NZEB concept, the building required design changes as this is one of the main reasons rather than financial factors this concept is easy to adopt in new building construction in the initial phase than in existing buildings.

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DEVELOPMENT OF MODEL FOR COST OVERRUNS DURING ECONOMIC CRISIS IN CONSTRUCTION INDUSTRY IN SRI LANKA

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Abstract

The main cases of cost overrun in construction projects are errors in project design and project performance failures. To avoid this causes building model development is very important. The model serves to compile the costs, direct and indirect, necessary to project completion and according to the adopted planning in order to step up the budget necessary enough to project completion. There are lot of tips to avoid cost overruns of projects in this economic crisis. Mainly and easily building information modelling (BIM) can be avoided cost overruns in construction industry. Building information modelling is an innovative concept which has been using in the construction industry to increase the productivity by creating object based multi-dimensional parametric models. During this economic crisis in Sri Lanka, construction materials are very expensive. Then construction sectors are handling the projects with lot of problems, in this time if there are some changes or whatever the problem in design of the construction after the construction contractor and client have to face cost overruns. Because these types of cases construction sectors are facing many cost overruns. Cost overruns are coming with different ways. These all cases can avoid using building modelling. Using the building modelling we can identify what cases we will have face. Early stages of every project create more and more uncertainties because most of the decisions are made on early stages.

The concept of building information modelling (BIM) is slightly practiced in Sri Lankan construction industry. In construction project a main thing is construction cost. Nowadays however if we have to add additional cost for construction project. There are lot of things we have to avoid in this process. Then there are some advantages when we are working with building information modelling. As a visual database of building components, BIM can provide automated qualification, avoid cost overruns and assist in significantly reducing variable in cost estimates.

Key words: *Construction industry, Sri Lanka, Building information modelling, cost overruns, economic crisis*

1. Introduction

Construction industry plays a major part in the development of a country. Construction industry is one of the prominent sectors in Sri Lankan context which has contributed approximately 6.8 % to the GDP (Annual Report 2018, Central Bank of Sri Lanka). Due to various reasons the main problem which Sri Lankan construction industry currently is facing is poor cost performance and cost overruns. The construction management is a challenging task to project managers. To complete the project within given cost parameters & timeline, corrective actions are needed whenever it's required.

In most of the construction projects, the final completed cost is almost always higher than the pre estimated cost which is calculated at the initial stage. Factors for cost overruns differ from country to country depending on economic, political, cultural, as well as internal and external factors of the industry.

Cost estimated at the initial stage is the most important factor. Real cost estimate is a crucial factor because it determines financial competence of the project and provides a basic idea for cost control of the project.

For this there are development models for cost overruns in this economic crisis. There is necessity for interesting the work of construction and decrease the cost at the same time. Experts in the industry have to have theoretical as well as practical knowledge on cost control techniques and project control software available regarding cost optimizing, but still not accomplish the basic target requirements of a construction project. Even with various cost control techniques, cost overruns are not uncommon all over the world.

There many reasons for cost overruns in the construction industry. The large amount of cost overrun, there are same amount of cost control and reduction techniques available at industry. One thing is development models. That is called building information modelling (BIM). Though they were plenty but still we face the problem of cost overrun means there is a need of find modern cost reduction methods. To achieve those targets, this paper aims to get the base knowledge by identifying the impact of this cost reduction methods which currently practiced at projects over cost overruns and what are the methods can we use for reduce the cost overruns, on selected management approaches (pre construction, post construction, human resource, material and change management) in Sri Lankan construction industry.

2. Finding and Discussion

The total cost should be carefully assessed at the initial stage before signing on a contract. the tight control among project can limit variations which directly affects to the cost overrun. As a new technology building information modelling (BIM) is a very important thing in construction industry during economic crisis.

Building information modelling (BIM) is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places. BIM is used for creating and managing data during the design, construction and operating process. BIM integrates multi-disciplinary data to create detailed digital representations that are managed in an open cloud platform for real time collaboration.

BIM is always touted to save time and money, the more general ways are through better communication and fewer misunderstanding however in this blog post, some of the not so obvious ways that BIM can help reduce the cost construction and make our industry more sustainable.

BIM allows more effective use of resources during design, construction and operation ultimately reducing costs. BIM also has to ability to minimize material wastage and, as a result assist to lower the cost of building while also protecting the environment.

We can dig into some specific ways in which BIM can help reduce the cost of construction during economic crisis.

1. BIM based Thermal building simulation
2. Space optimization
3. Optimization of construction site logistics
4. BIM based cost management and reduction of material wastage through need-based purchasing
5. Avoidance of profit loss due to timely completion
6. BIM for owners- optimization of facilities maintenance work

Building information modeling (BIM) technology can help cost estimating in a number of ways. First, BIM-based estimates can be more accurate than traditional estimating methods because they account for a greater level of detail. Additionally, BIM can help to streamline the estimating process by providing a central repository for all project data that is automatically updated with each version of the model, making it easier to track costs and revise estimates as required. Finally, BIM-based cost estimation can help improve communication between project stakeholders by providing a clear and visual representation of the project budget.

3. Conclusion

As addressed in my analysis of recent research, the advantages of a later starting time for university students significantly outweigh the disadvantages. A later starting time would allow teens more time to sleep--something that is important for their physical and mental health--and ultimately improve their academic performance and behavior. The added transportation costs that result from this change can be absorbed through energy savings. The beneficial effects on the students' academic performance and behavior validate this decision, but its effect on student motivation is still unknown. I would encourage an in-depth look at the reactions of students to such a change. This sort of study would help determine the actual effects of a later start time on the time management and sleep habits of students. There are lot of things to get from this and I would like to thank who helped me to do this research paper.

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MODULAR CONSTRUCTION

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Abstract

Modular construction could be a method within which a building is made off-site, under below-controlled plant conditions, victimization an equivalent material and planning to equivalent codes and standards as conventionally designed facilities – however in concerning half the time. Buildings square measure created in “modules” that once placed along on the site mirror the identical style intent and specifications of the foremost subtle site-built facility – while not compromise. GREENER - The factory-controlled method generates less waste, creates fewer site disturbances and permits tighter construction. FASTER - Construction of standard buildings happens at the same time as site work, permitting comes to be completed in 0.5 the time of ancient construction. SMARTER - Modular buildings are designed with the same materials and to constant building codes and discipline specifications as ancient construction. Once assembled, they & just about indistinguishable from their site-built counterparts. Modular construction shows its price and even additional therefore in countries with potential markets placed off from industrial centers. Australia and components of Africa square measure sensible examples. Building structures in remote locations square measure generally rather pricier however standard construction may modify that. Among others, standard buildings square measure helpful in providing medical and hygienic facilities wherever time, area and funding could also be a difficulty. Modular construction corporations these days will work with superior levels of style and class surpassing all expectations. Architects, developers and business house owners alike, concentrate as standard buildings square measure serious competition to site-built construction corporations.

Keywords: Modular construction, Greener, Faster construction

1. Introduction

Since the Second war, and also the desperate have been compelled to deliver new housing quickly, and modern methods of construction (MMC, or 'smart construction') have been promoted as some way of operating additional effectively to realize additional while not mistreatment additional. It centers on the use of off-site construction techniques that may benefit plant conditions and production techniques. In the Gregorian calendar month 2005, once more within the interior of a housing crisis, The National Academy of Construction (NAO) revealed 'Using

modern methods of construction to make homes additional quickly and efficiently. it had been commissioned by the workplace of the Deputy Prime Minister and also the Housing Corporation and was indented to spot ways in which of obtaining the best price once mistreatment MMC. It outlined MMC as '...a method to provide additional, higher quality homes in less time.' A parallel report revealed in February 2006 by the Barker thirty-three Cross-Industry cluster, created to look at why the uptake of MMC was low, prompt that; 'Modern ways of construction are concerning higher merchandise and processes. They aim to enhance business potency, quality, client satisfaction, environmental performance, property and also the foregone conclusion of delivery timescales. modern methods of construction are, therefore, additional generally primarily based on a selected concentrate on the product. They interact with folks to hunt improvement, through higher processes, within the delivery and performance of construction.'

2. Methodology

The NAO prompt modern methods of construction included:

Paneled units are created in a very plant and assembled on the spot to provide a three-dimensional structure, Volumetric construction to provide three-dimensional standard units in controlled plant conditions before transport to the website, Hybrid techniques mix each panelist and meter approaches, Floor or roof cassettes, pre-cast concrete foundation assemblies, pre-formed wiring looms technology composites and innovative techniques like tunnel type or thin-joint block work.

The NAO prompt that if modern methods of construction were adopted in situ of additional ancient methods:

It ought to be the potential to make up to fourfold as several homes with identical on-the-spot labor, On-site construction time may be reduced by over, Building performance may be a minimum of pretty much as good, Cost ranges would be comparable to betting on specific project circumstances, though they might be higher on average, Risks accumulated at the early stages of the event method therefore smart risk management would become even additional vital, Tight liaison with coming up with authorities would be important, Benefits would be wasted if comes weren't properly planned.

Generally, but it had been thought that uptake was poor. Richard Jones, a partner at European Community Harris, said, "...for years the trade tried to push modern methods of construction and it ne'er very took off as a result of it needed a unique approach and at the time the housebuilders did not want a unique approach. They were doing okay the method things were." The Barker thirty-three cluster knows a variety of barriers to uptake, including; approval delays, regulative quality and alteration, inadequate certification and also the coaching desires of website and

skilled employees. Dr Ashley Lane, chair of the Barker thirty-three cluster said: "The issue isn't concerning the merchandise. It's concerning skills: supply and coming up with and project management, coaching labor, education."

However, a study by the NHBC foundation, revealed in June 2016 found that ninety-eight of the organizations had used or thought of the utilization of the associate degree MMC approach on a minimum of one among their developments within the previous 3 years. over seventy-fifth cited a quicker build programmer and over five hundredth prompt there was improved build quality. However, the bulk of organizations thought of themselves as 'late adopters' or 'followers' of the meter construction, pod and penalized kinds of MMC, not 'market leaders' Neil Smith, Head of Analysis and Innovation at NHBC said: "This report shows the high hopes invested within MMC, as a method of delivering transformational modification to the house-building trade, haven't however been realized on the size anticipated by its champions. It conjointly illustrates that though cautious concerning over-commitment, the trade is withal held MMC in several guises, and stands able to explore new choices and innovations."

3. Results and Discussion

Pros and Cons of Standard Construction

Pros:

Thanks to the flexibility of the project to run at the same time on-the-scene and in-factory, standard construction may be up to five hundredths faster than ancient construction, As major elements of construction are handled at intervals a work, the climate is usually immaterial throughout the bulk of the project, The factory-based producing method permits not just bigger internal control throughout the producing method except for several health and safety risks to be significantly reduced, if not eliminated, The process aims to minimize waste and cut back the project's carbon footprint, as fewer folks ar travel to the location and modules are made on to verbal description victimization laptop motor-assisted producing, The impact on the community encompassing the development website may be considerably reduced, because of a lot lower levels of noise and traffic throughout the project amount, The ways used in standard construction will usually profit the energy potency and airtightness of the ultimate construction

Cons:

Access to the location should be thought-about from the start because it can get to afford the delivery of enormous modules, Traditional construction permits for later style changes, whereas standard construction is unlikely to be ready to issue these in, thus early complete style log-off is crucial with

shoppers, The provision and coming up with individual module assembly can be like rigorous attending to guarantee a sleek project.

Modern methods of construction outperform traditional construction at every level: following are the reasons:

They're factory-made in less time.

They're simple in very management surroundings.

As they're designed in very controlled surroundings, there are low probabilities of errors and quality compromise.

They're low-cost as compared to ancient ways.

Because of the speedy demand for infrastructure. It is the long run of industry.

Less labor is needed.

It's simply assembled and may be simply re-assembled.

It offers great alternatives and adaptableness.

It's the economical and economical methodology.

4. Conclusions

In short, MMC is extremely smart to be adopted as a result it reduces time and saves energy second the structure is extremely economical rather by adopting previous cultural techniques. In most developing countries MMC is adopted like in European countries, China, Japan, America etc. In the fashionable methodology of construction, the structure will simply be placed and removed once new changes are needed however masterly labor is required for operation.

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TRANSFORMING CONSTRUCTION THROUGH LEAN AND BIM

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Abstract

Efficiency rates have increased rather slowly in the construction sector during the past few years. Building information modeling (BIM) and lean construction have improved building efficiency rates. The intelligently designed building connects people. While BIM aims to enhance team member engagement, lean construction strives to reduce and eliminate waste in the construction processes. These concepts add value for public and private clients by using forward technologies and lean design. These ideas and principles make the best use of resources. They simplify each step of the design and construction process. This increases the project's overall efficiency because everyone can communicate with each other directly. These benefits are especially true for BIM, as this method creates a consistent data model that displays all of the specific design and planning at each construction phase. It aids from design calculation to construction and even in interior fitting through to operating the building. BIM covers the entire lifecycle of the project. BIM implementation and application demonstrates that it can be utilized to support the Lean construction goals. The elimination of waste, a rise in client value, and teamwork are among the goals of lean construction. When BIM is used, all of these objectives have been met. With the advancements of BIM and lean construction helps to shape the building sector. These requirements are achievable with continuous learning and real-world experience. Greater transparency in the collaboration amongst all projects participants lead complicated projects to comprehend more simply. The next step for BIM should be to incorporate Lean Construction principles into the planning process because doing so will result in an organized method from the design phase through the production phase. BIM has evolved to make use of new computer technology. When BIM or Lean are used separately, the benefits are not as great as when they are used combined. BIM has a long way to go before it becomes an industry standard, therefore ongoing testing and improvement of this strategy are crucial to reaping its full rewards. These concepts clearly define any potential deviations, which the combined database will make easier to spot. Investors, clients, architects, subcontractors, operators, and users are brought into a large team to encourage good collaboration and increase

the likelihood that projects will be realized successfully, as well as to implement lean design and lean construction practices.

Keywords: Building information modeling, lean construction, data base and transparency.

1. Introduction

Engineering-based information sharing issues are one of the major factors influencing diminishing construction project performance. Traditionally, the implementation of the construction process begins after the designer has completed the drawings, which leads to the creation of various types of disputes. Making many selections throughout design and construction results in the production of several wastes; waste production during design is complicated. Lean and BIM work together to eliminate many of these wastes. Following is a summary of the five pillars of lean theory: (value, value stream, flow, pull, and perfection). The goal of lean manufacturing is to increase customer value while eliminating waste.

BIM is said to be a procedure as opposed to a device or program. BIM is a modeling system and related collection of procedures for creating, exchanging, and evaluating building models. The adoption of BIM and awareness of its advantages could greatly improve project performance and productivity.

If the construction processes have been integrated with BIM ideas, BIM technology would be effective in managing projects at any step during the project lifetime. The implementation of BIM software in project management was found to ultimately improve the project management procedure and evenly cover all management domains. BIM improves any company's or project's lean results by cutting waste and reducing the inefficiency of producing a unique set of detailed drawings. Many studies emphasized how employing 4D CAD modeling aids in the planning of a steady workflow and provides the team with consistent methods. They note that BIM also aids in the timely delivery of materials and boosts design confidence through enhanced project team communication.

2. Methodology

This study is based on research to show that BIM results in leaner construction projects and to explore using BIM as a lean tool, or, to put it another way, BIM increases lean values and decreases waste in the building processes. A project was chosen that did not employ BIM or Lean management techniques throughout the design or construction phases. This decision was made in order to better grasp the

inherent practical challenges associated to the simultaneous use of BIM and Lean, and to determine whether or not we can use BIM as a lean tool.

This essay concentrated on incorporating different lean and BIM interactions into a project and investigated any potential advantages of doing so.

3. Results and Discussion

The initiatives that adhered to conventional information flow (2D CAD). The preliminary design was the first step in the design process. This was followed by the owner's evaluation and a repeats (rework) period. The schematic design is initiated once the owner reads and approves the concept design. For schematic design, a review and iterations period come next. After completing the schematic design stage and gaining the owner's approval, the design team transitioned to the next level, detailed design. Many wastes can be eliminated and the new 3D model can benefit much by comparing the BIM-based model to the traditional 2D CAD method;

Full design model: Directly derived from the fully equivalent 3D model, the detailed designs will include all necessary information for shop drawing or site installation.

Improved visualization: 3D models with physical models were created and saved to 3D Revit, allowing the owner and contractors to access, view, and visualize the project's specifics quickly and with the option of using the relevant information.

Waste of waiting time: Using the freshly created BIM model, the design team won't hold up progress by waiting for one another. So that the interdisciplinary teams (Architecture, Structural, and MEP Engineers) can concurrently build designs, early and simple data will be provided through the model before data completion.

Reduce steps: The traditional 2D CAD paper-based process can be made more consistent by eliminating pointless processes. Additionally, it did away with transportation, printing, and overhead associated with drawing layout. Utilizing the BIM model collaboratively can open up opportunities for time savings, such as clash detection and off-site prefabrication, which may greatly aid in avoiding numerous complications that may arise during implementation. continuous flow of information by exchanging information early on between participants, a BIM-based design will keep the information current. This enables the design to be developed, adjusted, and modified in the shortest amount of time. Communication between many players will be facilitated and a continuous flow of information will be possible thanks to the clear depiction of the design.

With the new BIM model, the owner may get involved early in the design process, preventing judgments about the design from being made too late. In the event of rejection, this will prevent numerous wastes of rework. Additionally, involving the owner frequently as the design evolves will optimize value over the course of the project by getting early feedback from the owner.

Collision detection

To manually identify incompatibilities, design consultants typically use superimposed drawings. When projects are implemented using this way, there are numerous disagreements between distinct aspects that must be resolved, which takes a lot of time and money. This conventional approach, especially when using 2D CAD designs, does not allow for the early finding of problems.

Several conflicts were found when construction carried out. For instance, there have been collisions between mechanical work and fire alarm and extinguisher work as well as between mechanical work and conditioning ducts with significant skeletal elements. During execution, there were numerous disputes between various aspects, ranging in severity from minor to substantial.

For projects, the collision and clash detection tools Revit and Navisworks were used. Over 100 incompatibilities between various project aspects and components, including the architecture, the concrete structure, the mechanical, electrical, and plumbing systems, can be found and corrected.

Because the design of a building is performed by several and diverse participants, including architects, civil engineers, and MEP engineers, design errors are frequent. These design mistakes may lead to rework and construction waste. By removing design flaws found during construction, design reviews and clash detection are BIM-based strategies to reduce construction and design waste.

4. Conclusions

Building information modeling helps eliminate many wastes during the construction process, such as design errors/inappropriate design, poor communication, and unexpected changes in designs during execution. BIM enables creating an accurate model, rich in information and free of clashes, which helps to make the right decisions during different construction stages.

This study shows that implementing lean using BIM in the design works contributes significantly to project efficiency. Approximately BIM helped reduce the time required for the design progression to nearly 50% by reducing the waiting time waste. On the other hand, design reviews, and clash detection are the BIM-based technique to minimizing construction and design waste by eliminating design errors detected in construction.

Even though eliminating all change orders that can arise at any project will be almost impossible, it seems that BIM can reduce the cost and the time of change orders as a result of this study. The most significant reduction in change order was discovered when BIM was implemented on the project.

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Study and Analysis of Pad foundation and Design Construction

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Abstract

As it connects the key frame superstructure toward the soil, the lower foundation of a building remains a highly important component. Foundation is the name given to that bottom base. In this essay, we'll talk about pad foundations utilized in the building industry, their designs, and alternative materials that may be used to create foundations that are more stable, long-lasting, and environmentally friendly. When building a structure, it is essential to provide a solid foundation that can support the superstructure in all climatic circumstances without collapsing or deteriorating. It is crucial to understand what materials are best, what designs should be employed, and what sort of foundation is required for a certain superstructure. There is a great chance of the construction collapsing if any improper material is employed for the pad foundation. Pad foundation base used in many sorts of structures; each one has a special design and configuration that increases a structure's resiliency and stability. High rise structures and bungalows each need a different kind of foundation. This research outlines the pad foundations, which are used for which superstructures, which designs are appropriate, and more specifically, how we can make the foundation base environmentally friendly, cost-effective, and strong enough to endure natural disasters. Building a foundation base, which will support the weight of all beams, columns, walls, slabs, and other building materials, is the first step in the construction of any project. Basically, foundation is classified into two categories such as shallow foundation and spread footing foundation, pad foundation under the shallow foundation.

Keywords: Superstructure, environmentally friendly, Shallow foundation, Spread footing foundation, Pad foundation

1. Introduction

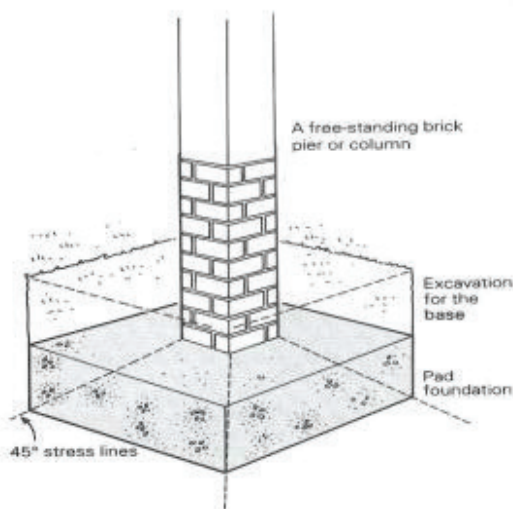
One of the earliest human activities is construction. Neolithic people of Switzerland more than 12000 years ago were knowledgeable about deep founding. They built their house on long wooden piles high above antagonistic neighbors and deadly wildlife burrowed into the soft bottoms of small lakes. The Babylonians, who are discovered atop the deep alluvium, settled beneath the weight of the building many years later. The biggest advancement in foundation engineering was in ancient Rome, where pozzolan concrete was employed and specific regulations were put in place. Later, due to wars, earthquakes, and other tragedies, many structures were

destroyed; those that survived now have cracks and other issues. From that point on, having a solid foundation became crucial.

2. Background

Having a firm foundation is therefore essential. According on the sort of structure that will be used, foundations may be split into two main groups and a number of subcategories. Shallow foundations are utilized for bungalows and low-rise homes whereas deep foundations are used for homes and high-rise structures. Below is a categorization diagram that helps you comprehend the many sorts of foundation. There are several types of footing for every foundation. There are both on-ground and subterranean foundations, each with its own unique building methods. Each type of foundation has a specific equation that aids in foundation design on the ground. Depending on the height of the structure, some foundations have an underlying depth of 3 meters while others have an underground depth of 10 meters or more. Additionally, a systematic considerate of the earth and soil conditions is essential for building a foundation since they have a significant impact on how the structure will behave, what materials should be utilized, and if it will be stable for a lengthy dated of time. Therefore, it is crucial to understand the type of soil present before building any foundations and to determine whether or not the region is earthquake-prone.

3. Discussion



A shallow foundation type that securely settles and extends across the earth is called a "pad foundation." Pad foundations are chosen if the local soil is not too deep and has adequate strength. The base of the pad is typically homogeneous in thickness. The bearing stratum is safely covered by the pad foundation since it disperses the concentrated strain. Therefore, the foundation's design should be rigid to ensure that loads are distributed evenly throughout the soil without causing the foundation

pressure to exceed the allowed bearing stress. This is accomplished by either increasing the pad deeper or by strengthening the pad, both of which disperse the force out at a certain angle.

Fig 1: Pad foundation

The booming volume of the subsurface soil and the strength of the concrete are used to calculate the angle of spreading. The proportions of the pad should be planned such that the stress within the concrete is prevented; this will prevent cracking, which will lead to failure. The placement of this foundation is mostly determined by the soil's ability to sustain loads, the amount of space that is available, the loads that must be supported, and the building itself. Cast in-situ concrete and reinforcing are materials that may be utilized in pad foundations.

Advantages:

- constrained locations may be accommodated by the design
- It is possible to add reinforcement for stress and shear.
- Economical because of foundation size management.
- Little excavation is required for a shallow foundation.

Disadvantages:

- To handle high point loads, foundation sizes might be quite huge.
- Limited ability of foundations to support the point loads of framed structures.
- This design is vulnerable to potential building settling due to the separate foundations.
- Support would be necessary to keep foundations from collapsing during deep excavations.
- weak in the face of uplift, wind, and earthquake stresses.

Design principle:

The pad foundation's stated purpose is to disperse the focused weight to the bearing level safely. Therefore, the foundation is essential to constructed stiffly to ensure the weight is spread evenly throughout the soil lacking to the foundation compression to top the allowed bearing stress. Either the pad is reinforced or the pad is made deeper to satisfy this need. Both techniques aid in dispersing the stress at a specific angle. The carrying capacity of the subsurface soil and the strength of the concrete are used to estimate the position of distribution. In order to prevent rapid, which will main to letdown, the pad's size essential to the internal concrete strain is avoided.

The determining factor for the deepness of “reinforced concrete” foundations is their capacity to resist punching shear. The capacity to resist bending is a significant feature that affects the deepness of pad. The construction to be stayed, the available space, the imposed loads, and the load bearing capability of the soil all play a role in the pad foundation layout.

Pad foundation types:

- Plain Concrete: These are modest loads that don't have reinforcing. The most cost-effective choice is this.
- Reinforced concrete: The extra strength provided enables the use of shallow but wide pad foundations. Additionally, it lessens the thickness needed.
- Combined Column Foundation: When an outside column is near to a site border or wall, two pad foundations are joint into one longer one.
- Continuous Pad: This technique combines several pad foundations to support columns that are positioned near together.
- Pad and Ground Beam: While this is comparable to a constant pad, it varies in that ground beams link the isolated pads.

4. Conclusion

Every form of foundation and footing has a unique application in a given location for a certain weather condition. Understanding the foundation work is crucial for carrying out building tasks. This is the first and most important phase in the construction of any superstructure. The main goal line of this page is to present comprehensive and in-depth information on the various foundation types, their benefits and drawbacks, ideal circumstances, and design and construction. This page covers all the primary foundation types to provide a general understanding of the different foundation kinds.

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Investigation of sustainable materials to partially replace cement in concrete mixtures

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Abstract

Through this research paper, we can learn about producing concrete without using cement. Cement is the binding agent in concrete and mortar an important in construction materials. Due to the rising need for concrete, more and more innovative techniques and materials are being developed for its manufacture. It occasionally has different additives added to it to enhance or change specific qualities. Therefore, as a Civil Engineer, one should be thoroughly familiar with all the components that go into making good concrete. Making concrete using cement causes some harm to the environment. Usually, we use Portland cement for concrete. However, it's not an environment-friendly material. So, we have discussed the disadvantages of using cement and the materials that can be used instead, and why we use these instead of cement. Due to these researchers have started finding alternatives to cement that are environment-friendly materials That are, including fly ash, silica fume, limestone, and alternative fuels that can be used as cement substitutes to make concrete without the use of cement. They are compatible with cement's chemical and physical characteristics. It can therefore totally replace cement. Fly ash is a byproduct produced when coal is burned to make energy is called fly ash. To achieve adequate strength and durability, 25% of Portland cement is typically substituted by fly ash in concrete. Silica fume is a by-product of the manufacture of silicon. It is an extremely fine powder and therefore it is used in concrete production in either a densified or slurry form. The most used proportion of silica fume in the UK – produced combinations is 10% by mass of total cementitious content. Limestone fines can be used as a constituent of cement to produce Portland limestone cement. The most used proportions of limestone fines in the UK-produced combinations is 6- 10% by mass of total cementitious content. Alternative fuels are not only diverting waste from landfill and saving on the need for fossil fuels but reducing the need for raw materials. When we consider this concept Fly ash is the best of the alternative types of cement.

Keywords: - Concrete without Cement, Fly ash, Silica fume, Limestone & Alternative fuels.

1. Introduction

The amount of cement produced increases by around 3 % annually. It is projected that this rate would rise as quickly emerging countries grow rich and invest disproportionately more in infrastructures that need a lot of cement (Aprianti,2017). One ton of CO₂ is released into the environment during the manufacturing of one ton of Portland cement. About 2.5 billion tons of carbon dioxide, or 7 % of the world's carbon dioxide emissions, are released during the manufacture of Portland cement. Utilizing waste products such as fly ash in Portland cement is one way to make concrete that is more environmentally friendly. High-volume fly ash concrete, which uses up to 60 % fly ash while still having excellent mechanical qualities and better durability performance, is a remarkable advancement in this industry (Badur S,2018). This research is focused on finding an alternative material for replacing cement in the concrete mix.

2. Methodology

2.1 Fly ash

Coal is first processed into a fine powder before being used in a power plant. The boiler of the power plant is filled with this coal powder, which is then burned to produce molten particles rich in silica, alumina, and calcium. These non-combustible particles condense into small, glassy spheres that resemble ball bearings and are gathered from the power plant's exhaust before they can escape. Fly ash is the remaining ash from burning coal. Fly ash is a pozzolan chemically (Mehta P,2014). Pozzolans interact with lime (calcium hydroxide) to create cementitious compounds. Concrete with fly ash in it is more durable, chemically resistant, and stronger overall. The fundamental advantage of fly ash for concrete is that it transforms non-durable calcium hydroxide (lime), which is used to make concrete, into calcium silicate hydrate (CSH), the toughest and most resilient component of the paste (Barbuta M,2014).

2.2 Test on the ingredient of fly ash concrete

The particle size distribution can be found through sieve analysis. 1kg of dry fly ash is sampled and placed on the largest of several brass sieves in a sieve shaker. Cover the pan with the top of the sieve shaker and set it down. Started the 10- to 15-minute shaking process. Table 1 displays the findings.

Table 1-Results of sieve analysis

SN. Sieve		Weight retained (g)	Percentage weight retained	Cumulative Percentage weight retained	Percentage finer
	size (mm)				
1	4.750	45	4.5	4.5	95.5
2	2.360	65	6.5	11.0	89.0
3	1.180	84	8.4	19.4	80.6
4	0.600	95	9.5	28.9	71.1
5	0.300	123	12.3	41.2	58.8
6	0.150	205	20.5	61.7	38.3
7	0.075	383	38.3	100	00.0

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2.3 Specific gravity

Fly Ash sample is dried in an oven for 16 to 24 hours at a temperature of 105°C to 1150°C after being received. Fly ash has an average specific gravity of 1.87. The test results are given below in Table 2.

Table 2-Specific gravity using the density bottle method

SN.	Observation Number	1	2	3
1	Weight of Bottle (W_1)	594.2	594.2	594.2
2	Weight of Bottle and Soil (W_2)	744.2	744.2	744.2
3	Weight of Bottle, Soil, and Water (W_3)	1552.6	1550.1	1553.3
4	Weight of Bottle and Water (W_4)	1482.0	1482.0	1482.0
	Specific gravity	1.89	1.83	1.90

2.4 Silica fume

Cement, silica fume, fine aggregate, coarse aggregate, and water make up silica fume concrete. Concrete made with silica fumes has better fresh and hardened qualities than regular concrete as it has greater flexural and compressive strength.

2.4.1 Experimental work

Samples of both OPC and SFC were cast in the shape of cylinders and subjected to compression tests. Concrete samples with the dimensions required for flexural testing were cast in molds (30 x 20 x 90 cm). The reinforcement bars that were inserted into the samples had a diameter of 12 mm and a length of 80 cm. The bars were strengthened by the addition of wires to help them stand upright while being cast in concrete. For the casting process, ready-mix concrete was used. After being cured in water for 28 days, the samples were examined. The samples were tested with both an ultrasonic pulse velocity analyzer and a rebound hammer. These samples were then subjected to destructive flexural stresses using standard testing equipment. Reinforcing bars corrode at a faster rate due to electrical current. In order to determine the quality of the corroded bar samples, experts used both a rebound hammer and an ultrasonic pulse velocity instrument. The corroded bar samples were analyzed with the help of reflexive forces. The results of both destructive and nondestructive tests were compared. Correlation equations between the results of various tests are provided.

2.5 Lime concrete

Concrete made from a mixture of lime, sand, and gravel is said to be lime concrete. It was widely used before lime was replaced by Portland cement (Meyer C, 2019).

3. Result and discussion

3.1 Result of Fly ash test

BRE method of mix design was adopted to procedure (C20/25 Grade concrete)

Target Strength determination

$$F_{\text{target}} = f_{\text{ck}} + 1.65 \times S = 20 + 1.65 \times 4.0 = 26.6 \text{ N/mm}^2$$

Where,

S = standard deviation in $\text{N/mm}^2 = 4$

f_{ck} = Characteristic Compression Strength at 28 days.

Water/cement ratio selection

Water Cement Ratio $1200/2000 = 0.6$

Maximum water-cement ratio used = 0.55

Adopting water-cement ratio as 0.5.

Water content selection

The maximum water content required for 20 mm nominal maximum size of aggregate is 186 Kg.

Selection of cement content

$$W/C = 0.5$$

Therefore, water content (corrected) = 191.6 kg/m^3

$$\text{Cement content} = 2 \times 191.6 = 383.2 \text{ kg/m}^3$$

Minimum cement content required (Type of exposure condition mild) = 300 kg/m^3

$$383.2 \text{ kg/m}^3 > 300 \text{ kg/m}^3 \text{ (OK)}$$

Maximum cement content required = 450 kg/m^3

Calculation of coarse aggregate proportion

For size of aggregate (max.) = 20 mm, and $w/c = 0.5$

Coarse aggregate volume per unit volume of total aggregate = 0.62

The results of the study indicate that fly ash can be used as a cement substitute, which is especially useful for lower-quality cements like C20/25. There is evidence that using 25% fly ash in place of cement greatly improves the material's strength. It has been suggested that using fly ash as a replacement for sand in concrete production could help the coal and thermal industries save money on waste disposal. The expense of utilizing mineral admixtures is drastically reduced because mechanical vibrators and viscosity-modifying admixtures are not required. The strength of concrete initially decreases when the amount of fly ash is increased, but then recovers as the amount of fly ash is further increased.

3.2 Result of silica fume test

The table below provides a quick summary of the differences in compressive strength between SFC and OPC concrete. A 13.7 % increase in compressive strength was observed between SFC and OPC, with an average of 35.7 MPa versus 31.4 MPa. This proves that silica fume does an excellent job of boosting the

compressive strength of concrete. The relationship between load and compressive extension in one of the OPC and SFC tests is shown in Table 3.

Table 3-Results of compressive strength determinations

Test	Compressive strength (MPa)	
	SFC	OPC
1	36.2	33.7
2	42.3	29.1
3	31.6	31.5
Average	35.7	31.4

A comparison of ultrasonic pulse velocities in OPC and SFC over 7, 14, 21, and 28 days of curing is shown in Figures 1 and 2, respectively. According to OPC findings, the pulse velocity of concrete samples increases with increasing curing time. Following a 7-day increase, the pulse velocity reached 4741 m/s; after 28 days, it had increased to 4920 m/s, a 3.8 % increase. The same findings were made using SFC as were previously obtained using OPC. After 7 days, the pulse velocity reached 4743 m/s, and after 28 days, it reached 4944 m/s, an increase of 4.24 %. It can be concluded that the velocity of ultrasonic pulses can represent the increase in concrete's compressive strength with curing time. The results of the rebound hammer test for OPC and SFC after 7, 14, 21, and 28 days of curing are shown in Tables 4 and 5, respectively. The OPC rebound hammer reading was found to increase from a 7-day reading of 36 to a 28-day reading of 39, representing an increase in hammer reading of 8.3%. In contrast, SF's rebound number grew from 36.4 at 7 days to 39.8 at 28 days. To put it another way, the percentage of improvement in rebound hammer number is 9.3 %.

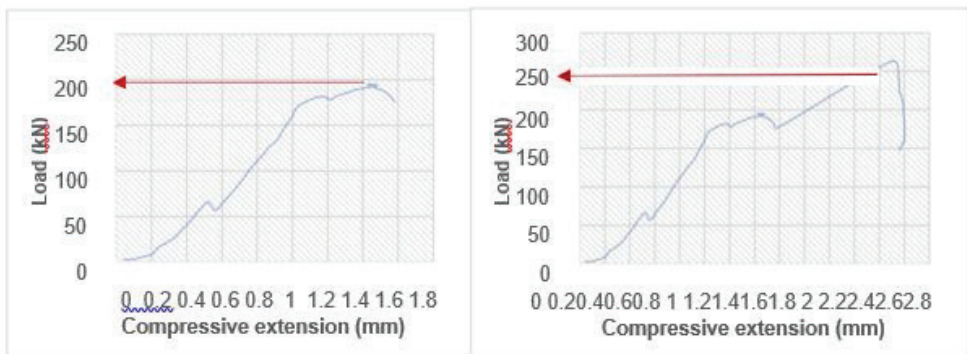


Figure 1-Experimental of compression test of OPC

Figure 2-Experimental of compression test of SFC

Table 4-Results of ultrasonic pulse test

Curing Period	Velocity (m/sec)	
	OPC	SFC
7 days	4741	4743
14 days	4793	4849
21 days	4874	4878
28 days	4920	4944

Table 5-Results of rebound hammer

Curing Period	Rebound Number	
	OPC	SFC
7 days	36	36.4
14 days	37	37.7
21 days	39	38.3
28 days	39	39.8

4. Conclusion

By substituting fly ash, silica fume, lime, and alternative fuels for cement, it is feasible to create concrete using partially replacing sustainable materials instead of cement. It shares cement's chemical and physical properties. It might therefore entirely and partially replace cement in construction projects. SFC has better compressive strength than OPC concrete due to the existence of fine particles. Compared to OPC, the average increase in compressive strength of SFC samples is 13.7% after 28 days. Hence silica fume amounting to 15 % to 25 % by mass has been used as a cementitious material in concrete.

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Study to evolve engineer's contribution to resolving the economic crisis of Sri Lanka

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Abstract

As everyone is aware, the situation in the country is becoming worst day by day due to the crisis currently prevailing and as a result, almost all sectors of the society have been badly affected. The economy is struggling due to a heavy reduction in the nation's exports. As an Engineer, potential short-term and long-term solutions for the present economic difficulties should consider alternative ideas, make use of the resources at hand and employ creative and integrated ways. The Engineering industry is one of the major contributors to the development of economies in Sri Lanka, it faces significant challenges and difficulties such as Currency Inflation, Job insecurity, Lack of employment opportunities, Mental and Financial stress, and Lack of Training and Personal Development. Around 90% of the infrastructure developments have been terminated since January 2022 to date. The National Budget Circular (No.03/2022) has informed the suspension of local funded projects. Due to this survival of 650,000 workers directly and 325,000 indirectly is at a questionable stage in the construction industry. Therefore, skilled workers are getting migrated to foreign employments and the other level laborers also are moving to farms. Investigate the difficulties that the engineering profession and related companies confront in the civil engineering sector of the nation, which is suffering from the current financial crisis. Importantly, civil engineers should help to develop the physical infrastructure we all depend on - buildings, transport networks, roads, bridges, water and energy supplies, and waste management. The construction industry job opportunities are reduced and tarnished. The civil engineers have been migrated. Civil engineers can play an important role in the Country's infrastructure development projects and overcoming power crises for making the economy strong and sustainable. In conclusion, there are some possible solutions such as reimbursement of price escalations in the traditional method, introducing alternative cost-effective, locally available materials and systems in construction works, and appointing an advisory committee comprising experts in a relevant sector.

Keywords: - National Budget Circular, Significant challenges, Alternative ideas, financial crisis, Mental and Financial stress.

1. Introduction

The country's growth mainly depends on the economic crisis of any country. A financial crisis is any of a wide range of situations in which some financial assets lose a big chunk of their value for no apparent reason. Look at the challenges that the engineering industry and allied businesses face in the nation's construction, which are all being impacted by the present financial crisis. Importantly, civil engineers should help build buildings, transportation systems, roads, and bridges, incorporating human safety, the

environment, and sustainability into the equation. Many financial crises in the 19th and early 20th centuries were linked to banking panics, and these panics were often followed by recessions. Financial crises are also often used to describe things like stock market crashes, the popping of other financial bubbles, currency crises, and sovereign defaults. While there is a direct loss of wealth on paper as a result of financial crises, there aren't always noticeable changes in the real economy. A lot of economists have made guesses about why and how financial crises happen and how to stop them. But there is no agreement, and financial crises still happen occasionally. The purpose of this research paper is to answer how engineers can contribute to the economic crisis in Sri Lanka. In addition, the paper outlines a comprehensive analysis of the issue as well as the causes of the economic crisis.

2. Methodology

The methodology applied is the "Keyword Research Methodology." Using keyword research is the most efficient method of gathering indexed online content. So, the goal of this research is to use the basics of keyword research methodology to gather keyword-related content from web services. First, Google was used to search for the keywords "Sri Lanka economy," "Lanka economy," and "engineers' contribution to the economic crisis in Sri Lanka," and all articles from January 1, 2010, to today were filtered. Only 45 popular news stories were used in the study. Duplicates and sources that couldn't be trusted were taken out. However, since no winning news has been reported internationally for the past two years, the cues "Sri Lanka economy," "Lanka economy," and "engineers' contribution to the economic crisis in Sri Lanka" has only produced negative news. It is also a noteworthy observation when searching for information on web content.

3. Results and Discussion

Engineers come up with high-quality designs that make use of the proper technology to handle the challenges at hand, and some of the solutions they provide are beautiful and others are inspired. The contributions engineers have made to Sri Lanka today are listed below. Using cutting-edge technology, engineering solutions are improving the quality of healthcare for people who don't have access to medical facilities because they live in remote areas. Engineers could make a big difference in the health sector by helping with technology and infrastructure to make the health system available to everyone, especially the poor. As an example, Figure 1 shows how the corona affects the financial crisis, and this mainly expresses that income has been reduced considerably but they continue working. Science and math are used together in engineering to solve problems in the real world and make people's lives better. Engineers from many different fields are important to the development of utilities, industry, services, and infrastructure, as well as other things. Any nation's economy

is dependent on infrastructure growth. Hydrological engineers may be quite helpful in Pakistan when it comes to designing and building dams. Alternative energy sources may also be used to address the energy dilemma. Even though engineers are often thought of as people who design infrastructure, they can also have a big impact on how things are run. Some engineers go on to head technology-based businesses and work in government, or in manufacturing, construction, or service-related fields that call for a distinct set of abilities (Naqvi, 2018). The majority of initiatives require their assistance with planning, research, and development. Engineers are very important when it comes to both making big plans for development and making decisions about public policy. Engineers must put in a lot of effort and complete tasks of the highest caliber for our society to profit from this enormous duty. (Bielefeldt, 2018).

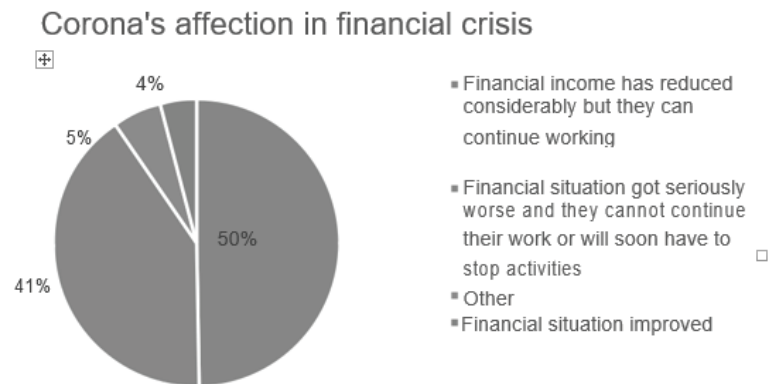


Figure 1 – Corona's affection during the financial crisis

Sri Lanka can regain its former glory. Engineers must be proactive and creative to discover answers to the present economic situation. Sri Lankans are proud that they have made great inventions and buildings for the world for more than 3,000 years. We were ahead of the rest of the world as a nation. We invented irrigation systems and earth dams first (Fernando, 2022). Currently, the Sri Lankan economy is heading in a different direction. After 30 years of gruesome civil war, our nation is now among the most stable and peaceful nations in the world. The tsunami, the civil war, and the Easter Sunday attack are just a few of the problems that our nation has recently faced. Our current opponent is COVID-19. We all have a responsibility to collaborate with development, as Sri Lanka has earned a wide-ranging and far-reaching economic development trust. An engineer plays a critical part in this. Infrastructure, utilities, industry, and services all benefit from the work of engineers. Engineers must help bring about the shift in public opinion that Sri Lanka requires, as they frequently serve as thought leaders in both their industry and many other industries. Sri Lanka wants to make progress, but this will only be possible if we can change old ways of doing things. s. In this situation, engineers in our society have a significant leadership role to play. Every level of society and every sector of the economy needs strong leadership.

Recently, there has been more interest in engineering for growth in the United States and around the world. Concerning how technology affects community development, many engineering-for-development programs share unsettling presumptions. Global and North American interest in "Tech for growth" has increased recently. Numerous educational engineering institutes support growth by funding initiatives abroad. Non-governmental organizations (NGOs) that stress the importance of engineering for development have grown in the past few years. A secondary goal of these initiatives is to give people chances to learn about other cultures and other things. As shown in Figure 2, an economic stimulus should make the recession less bad and help countries get back on their feet faster. The international data point to the possibility that economic growth may wind up being stronger than it was before the crisis if the fiscal stimulus were to last beyond the crisis. (Ashvin A. Shah, 2015).

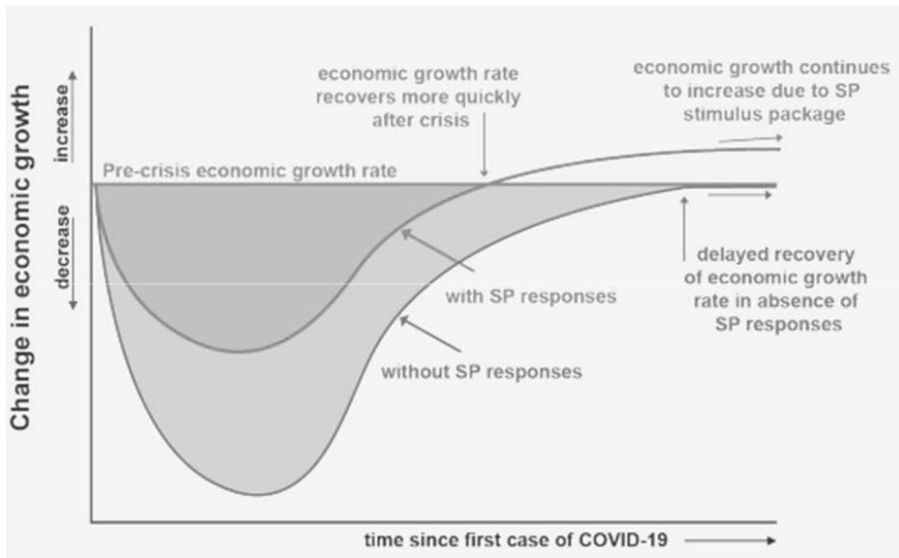


Figure 2 - Economic growth

4. Conclusions

A significant portion of Sri Lanka's progress has been contributed by engineers. In this period, like in earlier periods, they have made every effort to improve Sri Lanka's economy. There have been numerous projects completed and carried out in the fields of development and invention. Engineering is everywhere. Engineering (electrical, electronic, mechanical, biomedical, and mechatronic) has seen technical advancements in both knowledge and tools. Engineers have a thorough knowledge of everything around them and extensive experience. Enticing gifted young people to pursue engineering professions and creating educational frameworks that guarantee a thorough understanding of the fundamentals while encouraging creativity and an inquiry-based mindset

Engineers will be able to keep their skills up to date if they have access to learning opportunities throughout their careers. Finally, industries and the inventions of engineers have contributed a lot to Sri Lanka's 'economy. Their help is much important to Sri Lanka as a third-world country.

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Environmentally responsible material selections and their effects on building design and construction practices

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Abstract

Buildings and building materials consume nearly 40% of global energy annually in their life cycle stages from production to demolition. The present study experimentally investigated the effects of environmentally responsible materials selections and their effects on building practices briefly. Sustainable architectural design is necessary for future generations to live in a healthy environment. There are many things we can do to produce sustainable architecture and one of them is to select materials. The selection of sustainable building materials has been identified as an important strategy in the design of buildings. The proper use of building materials helps in increasing the healthy life, and a healthy environment, reducing the negative environmental impacts, improving environmental quality, and accruing subsequent savings through improved productivity and waste reduction through using renewable energy, minimizing waste, and recycling. These materials have the highest life cycle with the lowest amount of waste. Points are derived from previous studies and experts' opinions. Discussed with construction practitioners which is more sustainable material' and select some materials for comparing between each them, such as green concrete, timber, bamboo, straw, asphalts using plastics, etc. A questionnaire survey is prepared to ask for the opinion of construction practitioners on material selections and their effects on building practices. collected data are analyzed. We got a result such as which is environmentally responsible materials and they are more effective and it gives positive effects on building practices. We discuss the behaviors of materials such as durability, carbon dioxide, thermal gain, losses, etc., and the advantages and disadvantages of this type of material. We identified the main disadvantages are a high initial investment, unavailability of workers with experience, and a long time to build. Finally, this study will help decision-makers to select sustainable materials for their future projects. This paper concludes with suggestions that can help give to sustainable green buildings.

Keywords: Sustainable building materials, green building, environmental impact, the selection of materials.

1. Introduction

Sustainable development is one of the most important things to talk about, especially in the building and construction business. Building materials have a big effect on the long-term viability of structures because they have a big effect on how much energy a building uses and how it affects the environment. This research looks at the effects that building materials have on the environment and other academic research to

come up with criteria for choosing sustainable building materials. When materials are taken out of the ground, changed, used, and thrown away, there are costs to the environment, such as habitat damage, resource depletion, energy use, air pollution, water pollution, and solid waste problems. When choosing green building materials, products, parts, and assemblies, it's important to think about how they affect the environment at all stages of their life cycle. Material is scarce. As the world's population grows, demand for housing, workplaces, health services, education, cars, refrigerators, and televisions will raise strain on resources such as electricity, water, steel, concrete, copper, aluminum, plastic, and many others. Construction uses 3 billion tons of raw materials annually. From manufacture to demolition, buildings and building materials absorb 40% of global energy annually. This study tested the influence of environmentally responsible material selections on building practices. Future generations must live in a sustainable environment. The sustainable architecture includes choosing materials. Buildings should be designed with sustainable materials. Proper building material use promotes a healthy lifestyle and a healthy environment, reduces negative environmental impacts, improves environmental quality, and saves money through increased productivity and waste reduction through the use of renewable energy, trash reduction, and recycling.

2. Methodology

This research is conducted utilizing a questionnaire emailed to students, civil engineers, and all members of the construction sector, who were only requested to complete it after being assured that no personally identifying information will be made public via this platform. This questionnaire was faxed to them, and they subsequently forwarded it to students and employees in the construction industry. Finally, responses were collected from a number of them. One form may be filled out at a time. This survey has twelve questions meant to learn more about sustainable materials and their effects. who are working or studying, such as their age range, why they chose the materials, what their good and bad effects are, and if they have run into any problems while using them. How they selected the materials, how much they spent, the obstacles they encountered, and the solutions they discovered. They are provided with seven or more potential responses to each question. This report was created based on their responses, and the option with the most votes was chosen.

3. Results and Discussion

This is a research study based on a survey methodology. The primary data were gathered from a variety of sources. We acquired secondary data from websites, books, periodicals, and scholarly journals. The sample consisted of 150 respondents between the ages of 18 and 60. Students, laborers, and businessmen in the building industry provided information.

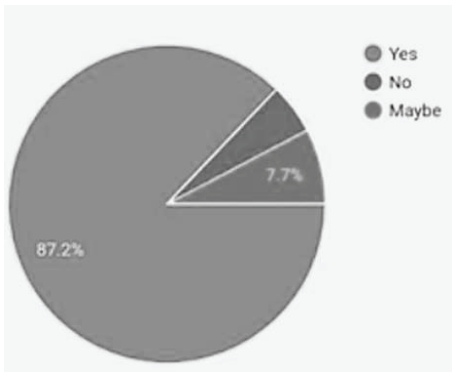


Figure 1-Knowledge about the sustainable materials

According to Figure 1, the number of people who understand sustainable materials and their impact is based on the available data. The results indicate a significant association between social influence and the purchase of green products by young, educated consumers. shown that social influence has a direct and big effect on whether or not people buy sustainable products. Multiple individuals demonstrate support for sustainable items. About 90% of individuals prefer to use or purchase green items. The largest number of people are aware of sustainable products and their effects.

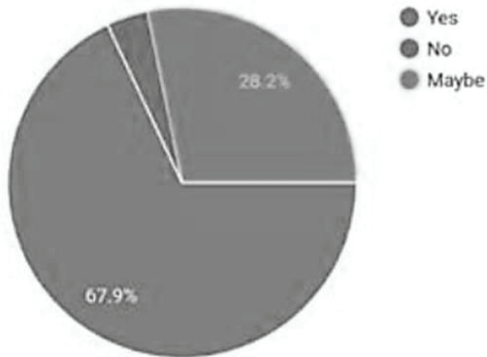


Figure 2-Amount of minimizing the environmental negative impact

According to Figure 2, the quantity of minimizing negative environmental impacts is illustrated. Previous research on the questionnaire showed that there wasn't a strong link between environmental knowledge and behavior, but other studies have shown that you need a higher level of environmental knowledge to take important steps to protect the environment. Those in the Sri Lankan construction industry who know more about the environment are more likely to act in a way that is good for the environment. The construction industry has bad effects on the environment in many

ways. For example, it uses a lot of energy and natural resources and hurts the quality of the air, land, and water. The effects of construction on the environment are becoming a growing concern, but not enough has been done to deal with them. However, outdated old building methods can't solve the problems that are happening in the building industry right now. Sustainable construction or the use of environmentally friendly products has become a global priority, intending to minimize the consumption of natural resources and their impact on ecological systems. The greatest material selection demonstrates the building industry's commitment to sustainable development. It should be a priority to teach contractors and students more about the environment to get them to take part in sustainable activities and reduce the damage their consumption habits do to the environment. The results also showed that young, educated users were more likely to think they were responsible for the environment.

Green buildings have a big effect on the environment, economy, and society, and they also have many benefits. The building's design is based on how it uses renewable energy, bioresources, and materials that can be reused or grown again. Sustainable buildings improve the environment and the quality of life by increasing the health and comfort of their occupant through the use of sound and heat insulation techniques and by enhancing the management of lighting and energy construction industry uses up nonrenewable resources, makes waste, pollutes air and water, and fills up these problems and effects of building operations can be fixed by using sustainable methods or green materials. Sustainable construction or employing green products prioritizes minimizing resource depletion, and environmental degradation, and creating a healthy built environment. Economic development and environmental protection are mutually exclusive; both would be prioritized. Sri Lanka's unsustainable development in recent decades and now has caused environmental, economic, and social difficulties. This urgent requirement has been discovered, reported, and a sustainable technique [using green resources] has been acknowledged. Sri Lanka's Ministry of Environment and Natural Resources (MENR) made a plan for developing in a way that is good for the environment. Sustainable products minimize carbon dioxide emissions, give a healthy environment, reduce negative environmental consequences, avoid pollution, improve environmental & air quality, save maintenance costs, and increase sustainability. Sustainable items are recyclable. Thus, Sri Lankan building companies value green products. Sustainable products aid Sri Lanka's economy, ecology, and society. Sri Lanka, an island nation, is vulnerable to climate change. Climate action is critical for all vital industries and the nation as a whole. Sri Lanka's top apparel businesses have converted garment factories with high walls and tall smokestacks to eco-friendly facilities with green

products, sustainability, and modern designs, featuring open spaces that attract fresh air and lower carbon and water footprints.

4. Conclusions

In the end, "going sustainable" has become a phrase that people from all walks of life talk about. The current study shows that six factors social influence, attitude toward the environment, environmental knowledge, a sense of being responsible for the environment, government action, and exposure to environmental messages in the media are important for getting people to buy more sustainably. People pay a lot of attention to eco-friendly items right now because of problems like diseases and the environment, as well as the way people live and the economy. Therefore, market segmentation is essential for the success of marketers in this competitive business environment. This analysis will assist future project decision-makers in selecting sustainable materials. Sustainable construction is based on the materials and methods used to build a structure, as well as how it will be used after it is built. Green construction was once significantly more expensive than conventional construction, but it now saves businesses money over time and can help them qualify for grants, tax breaks, and rebates.

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Assessment of mobility issues of female travelers in Sri Lanka

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Abstract

This research tries to know the issues faced by female travelers. According to the World Bank's collection of development indicators compiled from officially recognized sources, gender equality in Sri Lanka was reported at 0.66667% in 2020. Nowadays women do not get proper protection. Despite this challenging environment, women are forced to go outside for their needs. Due to various reasons, women are now going out and traveling as much as men. However, women cannot travel as normally as men. For that, we have collected data from female travelers in different vehicles such as bicycles, bikes, cars, buses, and trains in a specific area. Women are also seen traveling on foot without vehicles. They also travel through some problems. We have also collected and analyzed data from them. We have considered them as well. We collected data from women through interviews and questionnaires. This phenomenon is greatly influenced by important factors like accessibility, availability, affordability, family and peer support, decision-making in the home, security, and gender norms. Generally, in Sri Lanka, there is a custom of following the culture by gender norms. Women have less access to private vehicles than men. Society doesn't allow women to travel like that. We have also collected data by interviewing women who travel for their needs despite these. Women (Female drivers) are also seen driving restricted vehicles such as threewheeler, and taxis in the name of culture. From this, we got to know the reasons why female travelers travel, the issues they face, how they overcome them, and what they need to travel without any problems. Based on this data, this article was prepared by carrying out a small analysis of the issues that occur and their consequences, how they affect women's lives, which of them have the most and least impact, and compare them with each other to avoid problems and how to reduce the issues that have a high impact. Women are also seen traveling by walk. They also travel through some problems. These data were also collected, analyzed, and considered from them as well. We hope this research will be motivating and consider female travelers.

Keywords: - female travelers, gender equality, gender norms.

1. Introduction

The study was conducted to identify the mobility issues that female travelers in Sri Lanka face. According to a World Bank report, 90% of women who use public transportation experience sexual harassment. Women today do not receive adequate protection. Even though the situation is hard, women must leave the house to meet their needs. Compared to men, women travel for a wider range of reasons, such as discovering new places, looking for job opportunities, or just taking a break. However, there is a significant difference between men and women when it comes to health and security, as well as how visitors are impacted by the religious and cultural views of the foreign countries they visit. The truth is that women confront more challenges, particularly when traveling alone. For that, all the women have to come out because they are using different vehicles for their different needs. For that, we have collected data from female travelers in different vehicles in a specific area. The primary data for this paper was collected through a questionnaire. This trend is greatly affected by important things like how easy it is to get to, how much it costs, how much help you get from family and friends, how decisions are made at home, how safe you feel, and how gender norms work. Generally, in Sri Lanka, there is a custom of following the culture's gender norms. Women have less access to private vehicles than men. Society doesn't allow women to travel like that. Based on the results, this research paper is prepared by carrying out an analysis of the issues that occur and their consequences, how they affect women's lives, which of them have the most and least impact and comparing them with each other to avoid problems and how to reduce the impact of the issues that have a high impact.

2. Methodology

This research is carried out using a questionnaire that has been sent to female travelers, who have been invited to complete it only after being assured that no personally identifiable information about them would be made public via this platform. Over the phone, this questionnaire was sent to female travelers, who then forwarded it to more female passengers. Finally, answers were gathered from many female travelers. One form may only be completed at a time. In this survey, there are 18 questions designed to learn more about the females who are traveling, such as their age range, the purpose for which they travel, the vehicle they travel in, and whether they have any difficulties along the way. how much time they spent traveling, how far they went, the challenges they encountered, and the answers they found to those challenges. They are given five or more possible responses to each question to choose from. This report was made based on the answers they gave, and the option that got the most answers was used.

3. Results and discussion

A sample of more than 100 women was drawn out randomly for the field study to facilitate a deeper understanding. According to Figure 01 the available data, women who travel the most are between the ages 20-29 it's 60 percent, and 20 percent of women between the ages of 16-19. Figure 02 revealed that more than 50 percent of women are faced traveling issues before and Figure 03 covers more than 50 percent of women traveling for their education and others traveling for their family income (Employees), shopping (Housewives and single mothers), relaxing, and passion.

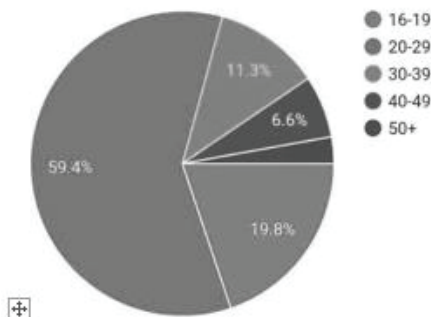


Figure 1-Age group of female travelers

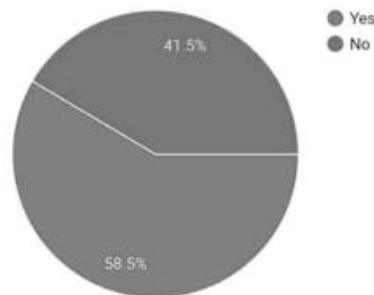


Figure 2-female travelers who faced issues before.

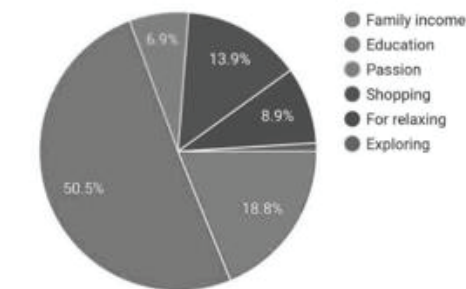


Figure 3-Reasons of travelling

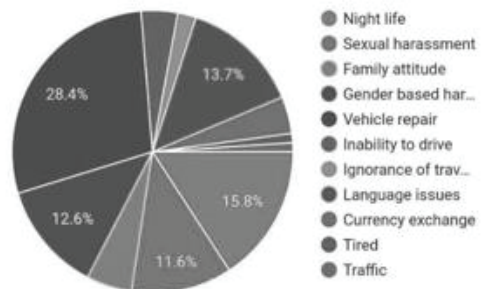
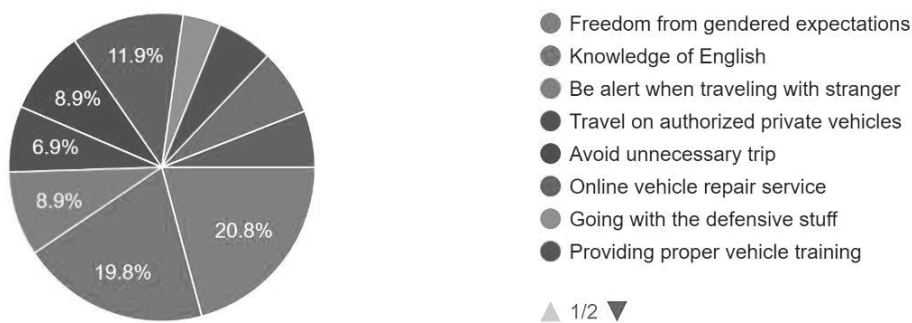


Figure 4- Issues faced by female travelers

This result shows that although women travel by various vehicles such as bicycles and two-wheelers, Figure 4 shows that 15% of female travelers are facing issues, etc. Figure 04 shows that 15% of female travelers have nightlife travel issues, among other things. The female travelers indicate solutions for the issues. Figure 05 shows that more than 20% of people are free of their expectations, etc. According to the results, difficulties faced by female travelers were unexpected vehicle repair, nightlife, language issues, gendered-based harassment, and sexual harassment, and solutions to issues faced by female travelers are avoiding gendered-based expectations, avoiding unnecessary trips, vehicle repair service, and being alert when traveling with strangers.

The language conveys messages about our gender-based expectations. For instance, when people make remarks about how strong boys are or how attractive girls are, we are conveying our expectations for children depending on their gender. Boys should be made aware of their obligation to combat violence as part of being an ally to girls and women. Show them how much you value and support the ladies in your life (Perera, 2021). Connect girls to important leadership opportunities. Help girls develop specific leadership skills. Talk to the girl about her fear. Encourage girls to work with and lead different girl groups. When traveling alone, women should avoid unnecessary journeys where embarrassing events occur or travel is difficult. Knowing that we are the problem, it is better for those who cannot avoid it too often to inform the family that they are going out. Vehicle repair is a big problem for people who travel in their vehicles, especially women. Due to this, women must seek help from others. One way to make it easier to fix cars is to require that there be a repair shop every 1 km and make it possible to find the closest one through the internet and phone calls.

Women’s safety should be the last thing on their minds when they are traveling. Unfortunately,



even while traveling in a group, a traveler still faces several risks. If some women are not careful, they can end up in a risky or uncomfortable scenario. Being alert is one of the most crucial things women can do when traveling with a stranger. This entails being constantly aware of their surroundings and taking note of who or what is nearby. If something seems strange, act on your instincts. Sit close to other individuals and keep an eye on their possessions if women are in a public area. If women are out and about, try to stay on well-lit, busy streets. And if women ever feel threatened, don't be afraid to yell for help or flee. Never trust strangers with their food or drink while women are unsupervised. Be cautious when taking snacks, drinks, and gum from strangers. Spiking is always a possibility, and drug-assisted rape occurs frequently all around the world. So-called "date-rape medications,"

which are usually prescription sleeping pills, have no taste or color and can make them helpless. The drug that is most frequently used in sexual assault is alcohol alone (Nasrin, 2021).

The local language is only understood in some places. Similarly, we cannot force the people working there to speak our language or ask them to put up a reading board in our language. The English language is common for all. Women mostly travel for education. So, women learned English. English is already a compulsory subject in Sri Lankan schools. Since most people are under 30 years of age, language is less likely to be a big problem for them. However, it may be difficult for school-aged students. There is no chance that students will have the opportunity to go alone to places where women don't know the language. They should learn them to learn the language for their future. English classes are now held in many places for people who don't know the English language. Those who can't get them can travel with someone who knows English. Now everyone can learn English online. The solution to this problem lies in the own efforts of women themselves.

4. Conclusion

This research investigated the mobility issues of female travelers in Sri Lanka. Quantitative research using a structured questionnaire has been prepared to find the issues faced in sharing the responses received from female travelers. Everyone knows that it is difficult for women to leave home and return in these times. It is an effort to find these obstacles and make it easier for more women to travel safely. At the end of the research, unexpected vehicle repair was found to be the problem faced by most women while traveling, so providing them with the facility to contact the nearest vehicle repairer via the internet would be the solution. Similarly, the problem of traveling at night is also faced by many female travelers. Sri Lanka doesn't have a safe environment for women to go alone at night. Therefore, it should be changed as a favor to them. Therefore, use a common approach with ride-sharing apps like Uber and Lyft. Such apps can be quite beneficial for efficiency and comfort. To track their location, share these with family members or guardians.

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DEGRADATION OF WI-FI SIGNAL STRENGTH THROUGH DIFFERENT TYPES OF COMPOSITES AND NON – COMPOSITE BUILDING MATERIALS

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Abstract

Today, the wireless Fidelity or the Wi-Fi technology is widely used in many types of residential, commercial, industrial, and other buildings to access the internet efficiently. When the Wi-Fi signals are propagated to mobile and other fixed devices through different building elements such as walls, slabs, partitions and other barriers that consist of different materials, their strength is degraded. This study aims to determine the degradation amount in the Wi-Fi signal strength through different types of composite and non – composite building materials used in walls, slabs, partitions etc. in various types of buildings. The testing procedure was conducted by observing the signal strength of a Wi-Fi router that has a fixed frequency of 2.4GHz, in which a laptop was used as the susceptible device for the signals while the readings were recorded with a Wi-Fi signal strength monitoring software called NetSpot. During the testing, a fixed distance of 2.0m was maintained between the router and the laptop without any barriers and the initial reference reading was taken. Thereafter, the relevant building material was used as the barrier between the router and the laptop, and the final readings were taken by maintaining the same distance. The average values from every set of the readings were calculated and the results were analyzed. According to the results of ten tested materials, the composite of steel and reinforced cement concrete used in slabs and floors has the highest degradation amount of Wi-Fi signals and the lowest amount was recorded in non – composite timber.

Keywords - Wi-Fi, Signal Strength, degradation, building materials, building design

1. INTRODUCTION

Wi-Fi (Wireless Fidelity) is a wireless technology used to connect computers, tablets, smartphones and other devices to the internet. They are radio signals sent from a wireless router to a nearby device, which translates the signal into data that

can be seen and used. The device transmits a radio signal back to the router, which connects to the internet by wires or cables.

A Wi-Fi network is simply an internet connection that's shared with multiple devices in a home or business via a wireless router. The router is connected directly to the internet modem and acts as a hub to broadcast the internet signal to all the Wi-Fi enabled devices. This gives the flexibility to stay connected to the internet as long as it is within the network coverage area. (Anon., 2022)

When a wireless network is set up, the coverage is seldom even. Various obstacles, such as furniture and walls, weaken the signal as it passes through them, and so does interference cause by other wireless networks nearby. Wi-Fi signals also get progressively weaker the further away it travels from the source (i.e., from the router).

Only have a reasonably strong signal can you enjoy fast download speeds, lag-free Skype conversations, and web browsing without constant waiting for pages to load. To have a strong signal everywhere you need, it's critical to choose an optimal place for the router and configure it in a way that will give the best results.

But selecting a good place for a router and configuring its settings is impossible without access to the right information. Namely, a visual map of the router's wireless coverage and information about other Wi-Fi networks in the area.

Wi-Fi signal strength meter apps detect and analyze wireless networks, displaying information about their configuration and security, and some can also visualize the signal strength of wireless networks as convenient heat maps, helping to decide where it would be best to place your router. (NetSpot, 2022)

2. METHODOLOGY

In here, the NetSpot software was selected to measure the Wi-Fi strength. NetSpot is both a Wi-Fi signal strength visualizer and a Wi-Fi discovery and analysis tool. Changing between these two distinct modes of operation is as simple as flipping a switch and the same ease of use is characteristic for the rest of the software.

It collects all current data from surrounding networks it shows such data for access points as

- o channel info
- o transmit rate
- o vendor
- o security type
- o band
- o mode
- o last seen

The signal level chart is not only customizable but displays the changes in real time.

3. Datasets

There will be two types of data collected whenever testing a material

1. Initial data (ID) - collected data before the building material is placed as a barrier between the Wi - Fi source and the laptop
2. Final data (FD) - collected data after the building material is placed as a barrier between the Wi - Fi source and the laptop

This method is used because the connection is different place to place. This was done in different areas and internet connectivity vary from area to area. By taking the difference between ID and FD, that problem can be avoided. Also, errors may occur in distance measurement in every also changes in proportion to the change in distance. Therefore, the distance measurement must be very precise. To solve that problem, the same measurement was repeated and an average value was obtained.

4. DATA COLLECTING

First, the application (NetSpot) was activated and the corresponding Wi-Fi connection was identified. After, the connected device was placed in a fixed position and the place was made free so that there would be no unnecessary disturbances. Then it was kept for a time about a minute and the strongest and farthest signal of the respective & the average Wi-Fi obtained by the application was recorded. Then the building material was set up as a barrier between the Wi-Fi source and the device (Laptop) with the application. For the accuracy of the data, the distance between the Wi-Fi and the device was kept unchanged and as before, measurements were taken for the target Wi-Fi source, keeping it the same for about a minute. These stages were repeated for each composite & non-composite materials tested.

5. DATA PROCESSING

Calculations were performed by using the data obtained from the application. The thickness of the building materials used varies from material to material. For that reason, the change in the signal strength per unit length must be considered. Therefore, the change per unit length was calculated as a percentage and the calculations were done as follows.

6. RESULTS AND DISCUSSION

Calculations were made using the strongest (Max), farthest (Min), and average values displayed on the application.

The initial values (ID) and final values (FD) obtained for each building material can be shown in a table as below.

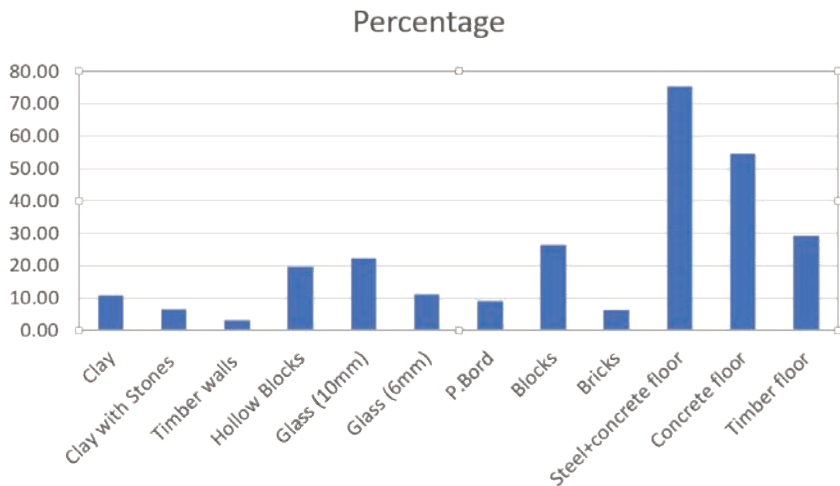
Table 1 observations

Material	Width	Material Discription	Data type	Min(dBm)	Max(dBm)
Clay	20	white plastering	ID	-49.00	-27.00
			FD	-56.92	-27.35
Clay with Stones	40	white plastering & double painted	ID	-96.00	-65.00
			FD	-96.27	-75.45
Timber walls	2	Loonumidella, painted	ID	-46.00	-30.00
			FD	-45.17	-33.25
Hollow Blocks	14	Plastering	ID	-52.00	-17.00
			FD	-60.00	-22.52
Glass (10mm)	12	2mm tempered	ID	-49.00	-23.00
			FD	-48.50	-39.70
Glass (6mm)	8	2mm tempered	ID	-46.00	-34.00
			FD	-55.40	-33.60
P.Bord	1.5	sound proof	ID	-59.00	-33.00
			FD	-77.54	-33.76
Blocks	18	Plastering	ID	-29.00	-26.00
			FD	-39.62	-29.95
Bricks	16.5	plastering & painted	ID	-35.00	-31.00
			FD	-38.38	-31.71
Steel+concrete floor	24	composite. Tiling	ID	-59.00	-33.00
			FD	-111.19	-50.24
Concrete floor	20	Redimix concrete	ID	-30.00	-25.00
			FD	-47.43	-37.62
Timber floor	5	Painting	ID	-68.00	-30.00
			FD	-91.52	-35.10

The difference between the average ID value and the average FD value can be obtained from these readings and the reduction in signal strength due to the building material being an obstacle is obtained as a strength change. That difference is shown in the table below.

Table 2 difference between ID & FD

Material	Data type	Avg(dBm)	Difference(ID-FD)
Clay	ID	-38.00	4.13
	FD	-42.13	
Clay with Stones	ID	-80.50	5.36
	FD	-85.86	
Timber walls	ID	-38.00	1.21
	FD	-39.21	
Hollow Blocks	ID	-34.50	6.76
	FD	-41.26	
Glass (10mm)	ID	-36.00	8.50
	FD	-44.50	
Glass (6mm)	ID	-40.00	4.50
	FD	-44.50	
P.Bord	ID	-51.00	4.65
	FD	-55.65	
Blocks	ID	-27.50	7.29
	FD	-34.79	
Bricks	ID	-33.00	2.05
	FD	-35.05	
Steel+concrete floor	ID	-46.00	34.71
	FD	-80.71	
Concrete floor	ID	-27.50	15.02
	FD	-42.52	
Timber floor	ID	-49.00	14.31
	FD	-63.31	



Considering the results of table 2, it is clear that building material has a significant effect on signal strength. But this varies depending on the thickness and composition the material. According to the results of differences of ID and FD, the highest disturbance to the signal strength is caused by concrete steel composite material and the least disturbance is caused by timber wall. But this cannot be taken as the final result as thickness of building material has been neglected here.

An accurate result can be obtained by looking at the percentage of signal strength loss per 1cm in Table 3. According to it, the greatest effect for the signal strength is caused by concrete steel composite material and the least effect is caused by timber wall. That is, the change in thickness of building material has also had an effect on this.

Although this result can be considered as the final result at a glance, it cannot be said that it is a more accurate result because it is difficult to obtain the same thickness building materials in practically.

7. CONCLUSION

Considering all these factors, timber has the least impact on signal strength. After that Bricks, Clay with Stones, plastic partition boards, clay, glass, hollow blocks, blocks etc respectively acts as a hindrance to the energy. Composite materials have the greatest impact on signal strength. Signal strength is greatly reduced when passing through concrete steel composite material.

Also, the signal strength varies depending on the thickness of the material. As the thickness of the material varies from material to material, strength also varies. Therefore, the change in energy per unit length was calculated.

Wi-Fi connection has become a necessity these days. This research shows that its strength varies depending on the material width and the material used. Therefore,

this research is useful to know what the most suitable material to use when planning to make a building such as educational, commercial etc.

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Environmental-based predictive fire monitoring and detecting system

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Abstract

Fire is a destructive outbreak of any situation prevailing in the environment. The forest fire (Wildfire) typically originated in the forest is due to a natural occurrence or human influence. The fire outbreak can extend to a massive area and could cause loss of livelihoods and valuable resources. Forest fire prediction is the key element of a forest fire handling prediction of forest fire is estimated to reduce the effect of forest fire in the future. The main objective of this study was to design and integrate the Internet of Things (IoT) into an Arduino-based detection and monitoring system, which will alert and end-user with an alert warning of fire detection. This project is mainly initiated on the fire detection and provoked warnings system based on the environmental condition of a fire outbreak. This system will recognize a problematic situation and factors that lead to a fire. To predict the occurrences of a forest fire, the proposed system processes using the weather parameters such as Temperature, humidity, flammable gases, smoke detection, and soil moisture content were used. Linear regression is the classification algorithm is used to predict the probability of a categorical dependent variable where the usage of various sample datasets was used to train the module correspondingly, if the climatic conditions and moderate effects are identified for a fire outbreak around the surrounding and if they want to discover out the possibility of a fire outbreak, it can be derived using the web application based on the accuracy of data obtained through the sensors reading such as when there is a high-temperature value, a high oxygen concentration and low humidity the probability of a forest fire is iv high in range vice versa if there is a high humidity a low temperature and a low oxygen rate the likelihood of a forest fire is to a lesser extent.

Keywords: Forest-Fire detection, Internet of Things (IoT), linear regression, Environmental-based predictive

1. Introduction

Sri Lanka maintains high biodiversity and ecosystem diversity; these forested areas are the main catchments of the main rivers and tributaries in Sri Lanka under the provisions of forest ordinances and wildfire conversation ordinances. Some of the forest areas are declared as conservations, preserve, or protected areas to conserve ecosystem services, biodiversity, and elephant habitats. These forest resources are managed by the Sri Lankan Forest department and the department of wildfire conservation.

In the Sri Lanka context, there is a lower priority for fire-related research and studies even though those damages make significant contributions to the forest resource

damages. Findings related to such studies will be helpful for the offices and people in forestry-related programs because they would improve the forest resources while managing the forest fire damage caused to the forest. This IoT Arduino based Forest fire detection system is fixed on a suitable place in a forest depending on the acres, which will collect the data using several sensors such as MQ2, MQ7, and MQ5 and soil-moisture and evaluate the collected data and if any exceeding situation prior to a normal condition this will provoke a warning generated through the triggers and the individuals and being alerted from a fire outbreak around the environment. Moreover, at times the situation is unpredictable to make a precise solution through a prediction a deployment of machine learning webpage using python has initiated anywhere an individual working on forest department will identify any climatic variations around the environment can extract some values of Temperature, wind, and humidity and check out the probability of a forest fire in the specific area this will be helpful to a forest department to conserve the property from being lost. In order to find the spatial and temporal variations of fire size, intensity, burn probability, weather, and ignitions, this kind of simulation model can be used as a preventive measure in order to save the ecosystem and livelihoods being lost whereas the policymakers can pay more attention to fire controls and mitigations since forest fire have become a crucial factor in deforestation and forest degradations.

The scope of this project is to create a fire outbreak IoT model which will detect any fire outbreak incident around the prevalent environment. This device is associated as a preventive measure control in protecting the eco-system and the livelihoods form being loss which can benefit forest department and any other cultivation sectors. The collection of data is based in the sensor's detection to a web application to predict the possibility of a fire outbreak in the environment.

The aim here is for creation of this IoT device that will assemble fire manifestation data like fire intensity index, smoke, Temperature, relative humidity, and stability of the environment and an alert is provoked to the people when the exceeding of certain factors which will be triggered of a fire incident occurrence in the environment and as objectives followings can be listed off. Collection of data and evaluate the gathered data on the fire occurrence and infected intensity through analytical visualizations. Generation of Warning is provoked and preventing the individuals from the critical level of being affected from the fire incident. This prototype will assist to gather data of fire causes contaminates and declares the safe and hazardous index of the environment. Identify the range of possibilities of a forest fire incident.

2. Methodology

The research philosophy is the process referred to as a set of principles concerning the nature of the existence being examined. Research philosophies are varied from research to research in terms of how the research is conducted and the goals achieved. The philosophy that is chosen in this research is pragmatism for the subsequent reasons. The nature of this research is based on a hypothesis "How does forest fire occurrence takes place and how the preventive measures can be

considered to initiate in order to protect and save the livelihoods and ecosystem". The fire outbreaks and consideration of preventive measures using the Internet of Things (IoT) have a conceptual foundation that greatly benefits humans and the environment. And the usage of this philosophy is because it is not constrained to explanation and understanding, as is the case in positivism and interpretivist. Pragmatism has the benefit that other learning forms such as normative, prescriptive, and prospective are vital in it. Using this philosophy will be convenient to explain, understand and suggest suitable preventive measures using the IoT. This philosophy will derive prediction strategy imposed using the IoT model where a diverse knowledge is incorporated with the research using pragmatists as constructive knowledge. This empirical study focuses on analyzing action and changes, which is inherent in pragmatic philosophy. This research studies how IoT enabled devices can be improved towards a fire outbreak. The data expected to carry out this research exists in various forms and across different sources. The pragmatism approach advocates multiple ways of data collection tools. This research relies on quantitative data collection where will be able to derive precise conclusions from the analysis. Because of some reasons mentioned above, and this philosophy will be efficient to build a solid philosophical foundation within this study.

There is a strong association between research and theory. The second layer of Saunders research onion is the research approach, Here Deductive and inductive are the two terms that are implemented. This layer is based on the aim and objectives of the research. In deductive approach reasoning, the researcher moves from general to more explicit where the deductive approach starts with a pre-existing theory and then the implication of that theory is tested with the data and moreover, The deductive method is used as a research approach in this project where the formulation of hypothesis is established upon a pre-existing theory such that "how a typical country like Sri Lanka can benefit and protect the ecology around the island and take preventive measures to reduce the fire outbreak incidents" this deductive approach is derived from the positivist approach where this permits the formulation of hypothesis and the statistical testing of expected results to an acceptable level of probability to predict a fire outbreak incidents. Here a dataset, which is used to test and train the model into a linear regression algorithm.

The research strategy is the process that describes how the progress is conducted. The selected research strategy is Experimental. Using an experimental research strategy in this research will derive a cause-effect relationship with a lot of credibility. The experiment research strategy has a particular nature where they are conducted in a systematic way and under controlled conditions. In contrast, this experimental method consists of two phases where the initiation of IoT model this model will detect all the sensor reading and Machine learning model incorporated with a dataset which will predict the probability of a fire outbreak around the forest where a systematic approach that uses controlled and manipulated testing to understand the causal processes. This empirical research strategy will derive the cause that precedes the effect of forest fire incidents. The research findings revealed the factors and causes of occurrences and suitable measures to prevent a fire incident. This experimental research strategy is one of the efficient ways to predict the probability of a fire outbreak, comparing the previous incidents, and arrive at conclusions. This control

of independent variables will differentiate the undesirable and irrelevant. This will be able to discover a cause- and-effect relationship by influencing independent variables. This research strategy will produce realistic results to identify the associated variables and their relationship. This is the fourth layer of the research onion; it is also known as research choice. This describes the choice between the qualitative and quantitative types or a mixture of both in research procedures and techniques as the research choice. The research choice of this thesis is based on the Mono method. In this IoT based forest fire prediction, the usage of quantitative data was established a thorough study was done based on the theories and assumptions that derived generalizable statistics regarding a fire outbreak and vice versa a quantitative content analysis strategy was initiated to find a problematic situation, effects, and causes of the fire outbreak and how the concepts should be initiated and accomplish the breaks discovered. The time horizon can be defined as a specific period that is covered by a study alongside the completion of the project. This research has a cross-sectional time-horizon. Where the research relies on the three months based on this time frame the development of IoT model and the Machine learning model deployed on the web based application was accomplished.

In this section, the research techniques and procedures will be discussed as Data collection and analysis,

1. What methods are utilized to collect data?
2. From which sources the data are collected
3. How to analyze the obtained data

IoT based predictive forest fire monitoring system is based on the secondary source data collection, which involves the data collection acquired through the statistics of forest fire incidents occurrence from past activity, the sources the data are collected from websites such as Kaggle, academia, google scholar, and disaster management and conservation authority where the data will reveal all the facts about the causes and incidents related to loss of property and lives and the collected data is analyzed through a machine learning model and predict the probability and notify the user in a fire incident.

3. Experimental Evaluation of the IoT model Results

The below table depicts the sensors and connection type and their success rates of sensors implementation

Sensors and modules	Connection Types	Success Status
DHT 11 Temperature and Humidity sensor	Digital output	100% functioning
Capacitive soil moisture sensor	Digital Output	100% Functioning
MQ9 Gas sensor – carbon monoxide and flammable gas detection sensor	Analog output	100% Functioning
MQ135 – Air quality index	-	100% Functioning
Visualizationof adafruit.io widgets	-	100% Functioning
Notification of triggers using IFTT	--	100% Functioning
Analyzation of data	-	100% Functioning

Table 1 Results of IoT model functioning

Visualizations of Adafruit.io platform widgets

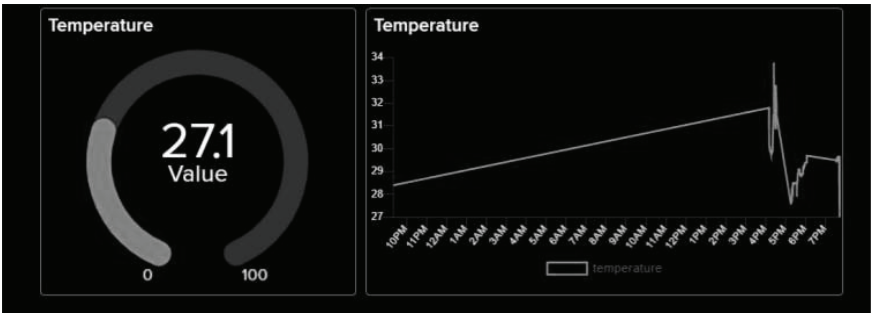


Figure 1 Extraction of sensors widgets

The above picture illustrates the sensor's connection types and success rate have been executed precisely as evidence of evaluation of the IoT model. Each widget is created according to the sensor type and their respective sensor extraction. The data feeds have been collected in the adafruit.io platform. Each sensor will have a unique

data extraction such as Temperature, humidity, flammable gases, soil moisture content, and the air quality index around the specific environment. All other sensors' data extraction is attached in the appendix section for additional results. Depending upon the sensor extraction values in the cloud if it is greater than the threshold value it will notify the end user with continuous monitoring and uploading value to adafruit.io platform.

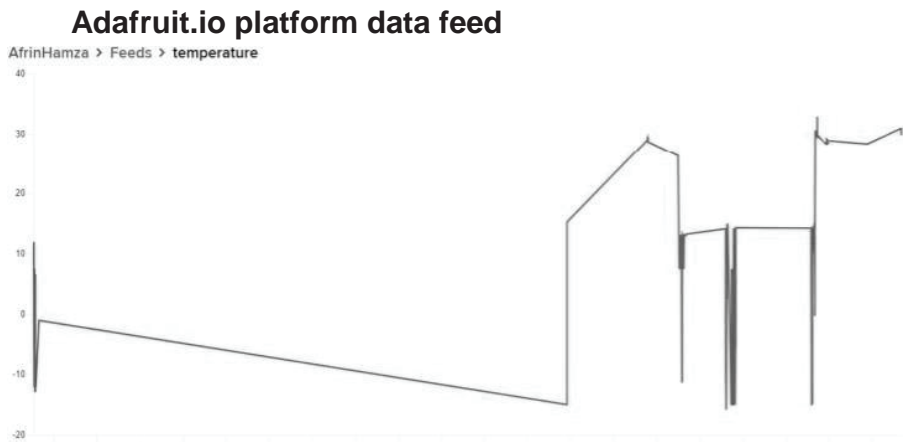


Figure 2 Temperature Feed

The images show the data feed of Temperature in adafruit.io platform\

Adafruit IO triggers

The triggers have been generated through IFTT. If a particular sensor DHT11 temperature and humidity sensor exceeds a threshold value, this will notify an end user via email and the generation of triggers is given below.

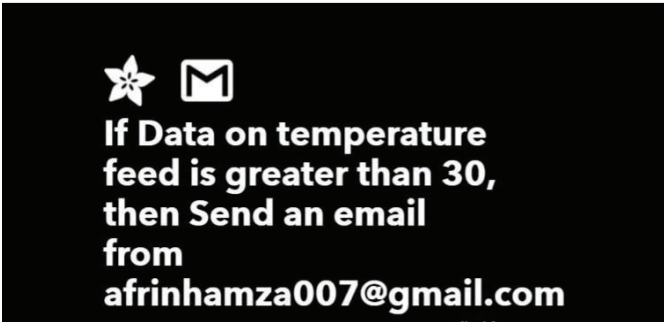


Figure 3 Generation of triggers using the IFFT

Analyzation

Data analysis using Power BI

The below picture illustrates the temperature and humidity analysis that has been analyzed using the power BI. The record of twelve days of sensors progress has been taken into consideration to predict the future Temperature and probability of a fire outbreak.

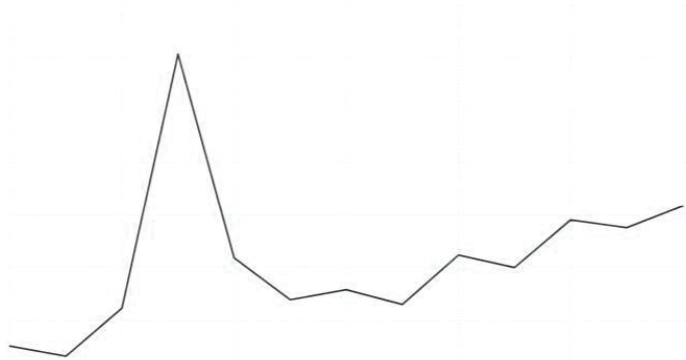


Figure 4 Power BI analysis of the temperature data in upcoming days

This is the visual illustration of temperature and humidity values ascertained for the corresponding days. There is an increase in the temperature and humidity values in the future which illustrates that the rise in climatic condition is predictable using the analysis of the data extraction from the sensors.

Evaluation of the Machine learning model

Applying the logistic regression algorithm on the forest fire dataset. This is a classification algorithm which is used to predict the outcome using a binary value such 1 Or 0 which will predict the probability the occurrence of an event by matching data to a logic function.

To test the Machine learning model, it should comprise a consistent dataset for better accuracy where the dataset is tested under some respective condition; with and without a fire outbreak and the system is tested in multiple areas in different districts within Sri Lanka, the areas that the system was fixed and the extraction of sensor data in another region is obtained such that the tested districts are Kandy, Matale, Nuwara Eliya, Badulla, Rathnapura, Matara, Kalutara, Kurunegala, Galle and Gampaha. The model detection values obtained for testing rely on the time

horizon of one week. The obtained data were tested with some conditions to seek the conditions that could be probable and not probable to a fire outbreak.

As a result, the data used is divided into two parts. The training dataset with 60% and the real time extraction values of sensors 30% which is used to test the model prediction accuracy. In common, the proposed models can enhance the prediction accuracy and solidity significantly and efficiently. The below-listed table below illustrates the results of testing specified to a fire outbreak in some forest areas. The area, district with data and time is extracted, and the sensor data such as humidity, Temperature, and oxygen values are extracted to test the fire occurrence probability. For a fire outbreak to take place, it should consist of a low humidity level, a high oxygen rate, and a high-temperature value

Time	Date	Area	District	Temperature Value	Oxygen Value	Humidity value	Fire occurrence
11.20 am	26 th December 2021	Galaha forest reserve	Kandy	24c	9	75	0
1.30 pm	27 th December 2021	Hunnasgiriya forest	Kandy	29c	12	63	0

2.30 pm	28 th December 2021	Udawattakele forest reserve	Kandy	27c	7	72	0
1.45 pm	29 th December 2021	Hantana forest and Gannoruwa forest	Kandy	27c	7	70	0
12.50 pm	29 th December 2021	Loolkandura	Kandy	28c	12	20	1

2.10 pm	26 th December 2021	Knuckles conservation forest	Matale	29c	12	65	0
1.55 pm	29 th December 2021	Pidurutalagala forest	Nuwara Eliya	18c	6	78	0
12.45 pm	29 th December 2021	Namunukal a Forest	Badulla	22c	2	98	0
1.20 pm	28 th December 2021	Rassagal a forest	Rathnapura	27c	3	27	1
12.30 pm	27 th December 2021	Sinharaja world heritage site	Matara	25c	8	95	0
2.20 pm	29 th December 2021	Kalugala forest reserve	Kalutara	23c	4	99	0
1.15 pm	26 th December 2021	Hadurukkand a forest	Kurunegal	32c	41	40	1
11.45 am	28 th December 2021	Kottawa forest reserve	Galle	31c	7	32	1
2.00 pm	30 th December 2021	Horagolla National Park	Gampaha	31c	8	63	0

Table 2 Result table of the sensor extraction values in different regions among Sri Lanka

According to the data collection, the sensor reading for environmental parameters are tested and monitored which is shown in the above table the results show that the system aims to detect numerous parameters to predict the possibility of a forest fire occurrence and moreover in some areas in Sri Lanka prevailing with this climatic condition is less in occurrence, whereas the regions where the presence of high

Temperature and low humidity with a high oxygen rate is probable to a fire outbreak.

4. Conclusion

Early precaution and rapid response to a fire outbreak are the main approaches to avoid unavoidable calamities and natural damages. Therefore, the most significant objectives in a fire detection system are fast and consistent identification and constraint of the fire. It is considerably less demanding to suppress a fire when the starting area is recognized, and consideration of this is also the starting phase. Moreover, the data about the fire outbreak in advance is advantageous for dealing with fire and its rising stages. Among the implementation of previous IoT model there have been some drawbacks associated with the implementation whereas a proposed system which is implemented using the drone and remote sensing technologies one should be skill full in handling drones which is a robust system and unreliable and likewise implementation of model through sensor network using a Zigbee which consist a smoke detection module, a wireless communication module, and intelligent identification and data visualization module which has a disadvantage associated where this system is highly expensive and complex to design and vice versa an SMS based fire alarm and detection system was implemented where this system works when fire or gas detection by the sensors are identified, the Arduino will trigger the GSM module and provoke a SMS, sound the alarm system and trigger the servo motor where this system had a drawback associated with the servo motor which works at an angle of 170degrees and hence cannot reduce fire outbreak as compared to using a pump motor moreover many previously existing and developed models using Raspberry pi and Node MCU where some system has unique features which is very high in price and certain system need potential people to handle the system, all the fire related detection system is based on developing to a particular hazardous areas whereas the fire detection system designed and implemented mainly in industries where the fire is test upon only in warehouse, electrical equipment usage area, involvement of chemical substances usage, and manufacturing products. The project is mainly commenced on the fire detection and provoke warnings system based on the environmental status of a fire incident, so implementation of this IoT model system is a cost-effective and reliable whereas different sensors are used, generally a smoke sensor and temperature and humidity sensor whereas the sensor extraction data is associated with Arduino UNO micro-controller. This system can be implemented in forest departments around forest area in Sri Lanka, which will be beneficial as preventive measure control. So, this is research that is based on developing predictive forest fire detection. This monitoring system is implemented using the Arduino UNO so when the conditions of the value of the sensor exceed the threshold value, which will notify the user via email. When there is a fire outbreak, the buzzer will get activated. Information will be conveyed to the respective authorities, so by initiating this IoT model, it would be beneficial to the user to recognize the fire outbreak and take some preventive measures before devastation occurs and move over the web application will be helpful to identify the probability rate of a fire outbreak if there is any environmental conditions imbalance the user can check the probability of a fire outbreak at the current ecological condition.

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Cybersecurity regulation to mitigate possible risks from cybercrimes for children under 18 in Sri Lanka

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1. INTRODUCTION

Nowadays, almost everything is connected to cyberspace due to various reasons, and it has become popular. Because of that, bad actors have exploited them for illegal and criminal activities that have made cyberspace vulnerable. Illegal or criminal activity in cyberspace is known as cybercrime, and some major reasons to happen this are political motives, organized crime, revenge, reduced social engagement, and stress. Hence, the cybercrime rate has increased exponentially.

One emerging possible fact that increases future cyber risks is the involvement of children. Some official statistics throughout the world demonstrate this growth over decades. When considering global incidents, research done by Joint Research Centre (JRC) has highlighted that 49% percent of children in the sample space had encountered cyberbullying, and 44% of them had reported it during the COVID-19 lockdown in 2020-Spring (Lobe, et al., 2021). Research done by the Ministry of women and child affairs of Sri Lanka highlighted some statistics on how children have been exposed to cybercrimes as victims. (*Ministry of Women and Child Affairs of Sri Lanka, et al., 2019*)

Some reasons happening this for children are non-awareness, increased exposure to digital devices, loneliness, political influences, digital hate speech, lack of incident reporting, and loopholes in the existing law. For example, during the past COVID pandemic, children missed their regular attendance for school education since they had to stay safe at home, and then moved to online education, which exposed them to cyber severely. As a result, the bad actors have exploited cyberspace to lure children into their traps and victimize them for cybercrimes. Some major cyber threats which have affected children are cyberbullying, online pornography, and cyber harassment, and they could lead these children to face risks such as social disorders, physical and mental illnesses, and radicalization.

Therefore, proper law is required to mitigate these risks to increase protection for children. There are numerous global and local Acts to support protecting children from cybercrimes. The Sri Lankan constitution contains the Penal Code and some specific Acts related to computer crimes (Computer Crime Act, No. 24 of 2007) and child protection (National Child Protection Authority Act, No. 50 of 1998). Globally, the organizations such as Internet Watch Fund (provides services through Child Exploitation and Online Protection Center), Federal Trade Commission (provides Children's Online Privacy Protection Act), and United Nations Children's Fund (provides "Protecting children online" program) provide supportive legal frameworks

and standards for child protection from cybercrimes. However, the existing constitution in Sri Lanka is currently lacking a special Act to protect children specifically against cybercrimes on the local ground.

This research has focused on proposing a set of legal clauses to compile a legal draft under the Sri Lankan constitution to mitigate possible cyber-risks for children under 18 in Sri Lanka under a limited scope. This scope has considered the target group of children under eighteen in Sri Lanka, and considered threats are online pornography, cyber human trafficking, and cyber harassment. The final legal proposal has been drafted with the legal terms according to the Sri Lankan constitution and proposed as a supportive document to consider for hardening the existing local law to mitigate these risks for children and provide a supportive legal structure for them (to identify the risk before any incident happens), parents, and guardians (to protect their children), the government (to provide legal support for children), and other relevant organizations and communities (to support the society and provide legal advice, awareness, mental and physical health support, etc.).

2. METHODOLOGY

- Defining the importance of having a particular cyber-act to mitigate cyber risks for children under 18 in Sri Lanka.
 - The current global and local situation has generally been identified by referencing publicly available reliable resources.
- Identifying existing global and local standards, acts, and regulations related to child security and cybersecurity.
 - The existing global and local standards, frameworks, legal Acts, and regulations specifically related to children's cybersecurity have been identified by referencing publicly available data in reliable resources.
- Identifying possible threats that could happen to children.
 - The impact of defined threats on children has been identified.
- Identifying how these threats have legally been mitigated using identified acts and regulations.
 - The mechanisms under the local constitution that have been used to mitigate these defined cyber threats and the gaps in identified legal structures specifically related to these cybercrimes and children, and new suggestions to support filling these gaps have been identified, evaluated, and used to propose new legal clauses.
- Discussing the identified new clauses with the lawyer and finalize the draft.
 - An official discussion has been done with the lawyer to verify the legality of newly formed clauses to comply with the Sri Lankan constitution, and finalized, reviewed, and verified to ensure their compliance with the Sri Lankan Constitution.

3. FINDINGS

The studies in this research have been able to identify the followings.

Considerable facts for updating the Penal Code:

- Include a clear definition for 'a child' to be used across the legal framework in Sri Lanka.
- Include a definition for 'a cybercrime' in general.
- Include definitions of all possible cybercrimes that could be harmful to people/processes in Sri Lanka.
- Include a definition for 'a communication network' in general.
- Include penalties related to all cybercrimes in all possible communication networks.
- Include penalties for all possible cybercrimes through all possible digital devices, not only related to computers.
- Include penalties for all possible cybercrimes, not only related to sexual abuse and harassment.

The identified relevant clauses in this research are as follows.

- Adopting the Budapest Convention to deal with cybercrime cases.
By assuming the Budapest Convention has been adopted by the Sri Lankan Constitution to deal with cases related to cybercrimes, the following clause can be made.
The Clause:
(1) All the cases related to cybercrimes get apply through the framework provided by the Budapest Convention.
(a) A 'cybercrime' is any act or a process that use of digital devices and communication networks to commit or support any type of crime.
- Providing a clear single definition for 'a child' to be used across the Sri Lankan Constitution.
By assuming that this proposal has been reviewed, discussed, and enacted in the Sri Lankan Constitution, the definition of the child along with the Act can be included in the relevant clause as follows.
The Clause:
(1) An Act to provide practices for the implementation of a cybersecurity strategy related to children in Sri Lanka, to provide a legal cybersecurity framework related to children, to provide online safety for children, to protect children from all possible cybercrimes, and to provide for matters connected therewith or incidental thereto.
(a) A 'child' or 'children' is/are a person or people who is under the age of eighteen.
(b) The age of a defined 'child' can be exempted according to the other relevant Acts and regulations where it is applicable.
- Defining the cybercrimes and devices and networks.
By assuming that this proposal has been reviewed, discussed, and enacted in the Sri Lankan Constitution, the definition for Cybercrimes under the scope defined in this research and the definition for devices and networks that involves with cybercrimes can be included in the relevant clause as follows.
The Clause:

- (1) A 'cybercrime' contains the general definition as defined in this Act. A specific definition for each possible types of cybercrimes are covered in this Act.
 - (a) Cyberbullying is a cybercrime that bullying a person by threatening or intimidating through online using any possible way or supporting such an act in any possible way.
 - (b) Online pornography is a cybercrime that distribute or demonstrate pornographic content through communication networks, attract people for them, or support any pornographic content and activity in any possible way.
 - (c) Cyber harassment is a cybercrime that execute cyberbullying, harassing people, or any similar activity that could harass people through online or supporting such an act in any possible way.
 - (d) A digital device is a device that can be used to communicate through communication networks, and it is not limited only to 'computers'.
 - (e) A communication network is a network that can be used to communicate between peers in local area networks or wide area networks, and it is not limited only to 'the Internet'. The possible subnetworks are also included under the defined networks in this definition.

4. CONCLUSION

Cybercrimes are ubiquitous, and children are victims in cyberspace. The analyzed statistics in this research have highlighted them and a few reasons that lead children to get victimized. A properly defined legal structure can legally support mitigating this risk, or else it could impact future society. This research has identified necessary terms to be defined in related legal Acts and proposed a set of new legal clauses for filling the identified gaps in the existing local constitution, and suggested some other remediation for mitigating these mentioned cyber risks for children, such as providing awareness, updating school curriculum, anonymous incident reporting, and counseling for victimized parties. Also, the clauses proposed in this research have been reviewed and verified by a lawyer to certify their legal readiness for consideration in creating relevant legal drafts/Acts. Moreover, further implementations can include specific definitions of every other possible cybercrime, which can support Sri Lanka to reduce the rate of cybercrimes to ensure the safety and future of children.

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EFFECTIVENESS OF INTRODUCING AN INFORMATION MANAGEMENT SYSTEM FOR “GAMPOLA ZONAL EDUCATION OFFICE IN SRI LANKA DURING THE COVID-19 PANDEMIC”.

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ABSTRACT

Covid -19 virus had spread all over the world as a global pandemic. This pandemic situation effects to change the entire world process. Gampola Zonal education office were unable to communicate and exchange data and information among the schools under their jurisdiction due that pandemic situation in Sri Lanka. Because they did not have a proper online method to collect data from schools and provide modules, question papers and other information that the zonal education office should supply. Hence that problem was implemented a formal web application system to maintain a proper relationship between schools and zonal office for exchange information online as a solution. Through this information management system, it was able to exchange modules, Papers effectively and was able to collect all data in one location among directors, principals and teachers through online. Data was collected through the interview in that research according to the qualitative research method. Interview was held with the zonal director and IT director of the Gampola Zonal Education office and at the end of the interview gave creative brief to collect data furthermore. This system was mainly targeted zonal education office directors, principals, and teachers. This project was aimed to give an effectiveness way to exchange information and collect all data into one location between the Zonal education department and the schools that fall under it through online.

Keywords: Covid – 19, Global pandemic, jurisdiction, Zonal education office, Information management system.

1. Introduction

During the pandemic situation, Gampola Zonal education office had been lacking a proper online method for collecting data from schools and providing modules, question papers, and other information that the Zonal Education Office should provide. Because of this reason, it was proposed to create a better system for maintaining proper relationships between schools and exchanging information online. This is a formal web-based system capable of exchanging information and effectively collecting all data in one location between the Gampola zonal Education department and the schools that fall under it. This system primarily serves two users: principals of schools and directors of the Gampola zonal

education department. Teachers can exchange lessons and papers with other teachers who have created their own as an additional user. However, the system focuses mainly on the online exchange of modules, model papers, zonal papers, and department papers between directors and principals. As a result, directors can insert that information into the system, and principals can download it through this web-based system. It used to develop development technologies and tools such as visual code, XAMPP, HeidiSQL, Php, css, html, and so on, as well as project management tools such as WBS, Gantt chart, Trello, risk assessment, and etc, to successfully manage the project until the end.

2. Methodology

Identified the current problem that the Gampola zonal department was facing during the pandemic situation under the philosophy layer. After identified the problem sought out for the technologies, which can help to sort this problem.

Data collection

- Secondary data

In the requirement gathering stage gathered data according to two techniques. First gathered primary data. Here used interview to collect data from the client side and at the end of the interview gave a creative brief and able to gathered furthermore data and information regarding the current issue that they were facing.

- Primary data

As second technique was collected secondary data through a litterateur review. It was able to understand the tools and approaches they used in their previous projects thanks to the study of previous work. It was possible to organize and come up with more new and creative features and concepts for this study project after conducting a thorough review of similar previous projects.

Designing and implementation

In the designing stage prototype, methodology was used to check whether is there any changes to do before move with the project. In that method done a prototype according to the requirement, which gathered from the client to get a visual idea to how system work. Then created use case diagram and ER diagram to get better structural idea about the system After that, implementation part was done by according to two steps such as Database design and interface design.

3. Result

The system was implemented for the zonal education department with the all functionalities they have required as requirements.

This information management system involved with three types of user. As a requirement, they had mention separate login facility to three user types. Here had implemented separate three login interfaces to log into the system as teacher, director and principle.

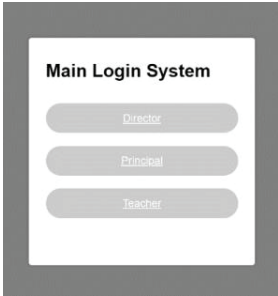


Figure 1 (separate login facility)

In this system separately had added sections to Add modules, model papers, zonal papers, department papers and model papers using add function to directors.

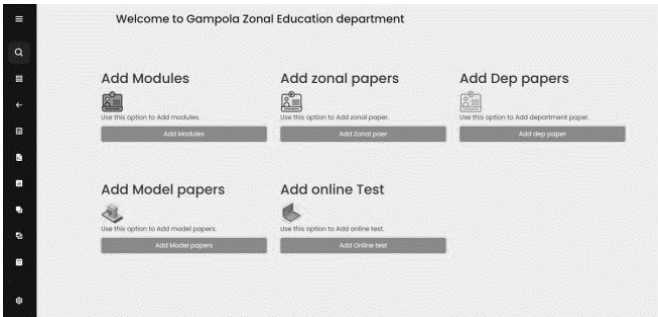


Figure 2 (Director Interface)

Using the delete and Edit function directors was able to delete and update each modules, model papers, zonal papers, department papers and model papers from the database.

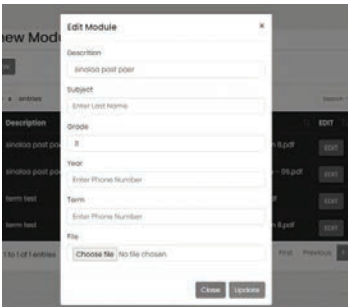


Figure 3 (Director: edit module form)

Here had implemented separate section to add news. In that, section directors can add news and delete news. Only principals can see this news. According to the requirement, principals can download modules, model papers, zonal papers, department papers and model papers through their interface from the database after director add that information to the database through director interface.

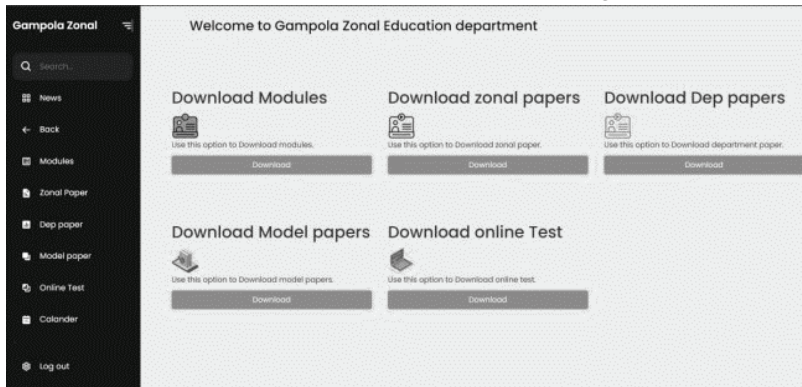


Figure 4 (Principal interface)

In other hand teachers was able to add and download lesson notes and papers through their interface. They only can download papers, which was added by teachers into the system. A separate section was built as an open section can log into the system as a teacher and download papers, which already added to the system by teachers. Here if any user want to add their own lessons and papers that function can perform through this. This system is a user friendly, simple and has implemented all the facilities should have exited in the system to exchange zonal department information effectively through the directors and principles.

4. Conclusion

Because of the pandemic situation Gampola zonal education department was unable to exchange information between directors and principals effectively and on time. Hence, that come up with an information management system which able to exchange data on time effectively and which able to collect data from one place on time. It include download, edit, delete, view and search functions according to the requirements that get from the zonal education department. The process that takes place through this system is smart instead of the existing process.

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Efficiency of Implementing Smart Poultry Farm for Reducing Transportation Time and Cost

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Abstract

Now a days in the world if we take any field, all are changing into virtual platform because of the technological field's improvement. Technology has seen many developments in every type of fields like library, banks, shops and super markets. In farm side also people trying change the activities into virtual platform. This research carries out the involvement of virtual platform in a poultry farm. If we consider about the daily activities of a poultry farm, one of the main and important activity is feeding the hens. They want to feed the hens two times per day. Therefore, what they are doing is, poultry farm owners are keeping one employee to feed the hens. So, definitely owners of the poultry farm must give a salary to them. Is the feeding process is must for a poultry farm? Definitely yes. Because if the owner stopped the feeding process, then the weight of the hen will be decreased. In other hand without the food hens also can't live. Therefore, feeding is an important and a must needed process in a poultry farm. Keeping only one employee also not possible for biggest farms. Because if that employee can't come to work because of some issues like curfew and personal issues, then the owner wants to have another employee to work. For that employee also farmer wants to give the salary.

In order to do this research to know about the activities done in a poultry farm and the issues they are facing during the working times, an interview taken from 3 poultry farmers who are living in Maskeliya, Sri Lanka. According to the response given by those poultry farmers, the main issue they are facing is, now a days according to the situation of Sri Lanka all the things are expensive. Therefore, prices of the feeds also increased. Anyhow they want to buy it. Prices of fuel also increasing. So, when the farmers travel to issue or supply the chicken, they must spend more money compare to older days. The vehicles used by the farm should be maintained properly. So, time to time maintainers or the drivers need to make sure that they have done the service for vehicles properly. Considering about the these problems if we think to give any solution using IoT it is little bit difficult and sometimes it won't possible other than feeding process. Because putting the vehicles to do the service can be done in the garage. Prices of fuel can be decided by only the government. Therefore, can't take a solution using IoT for these two problems. But it is possible to make the feeding process easier by giving IoT solution.

So, the purpose of this research is as a result introducing an IoT device to change the poultry farm process into virtual platform and make the feeding process easier. This will help the poultry farmers to feed the hens easily. Using this IoT device what the poultry farmers can do is, they can store the food which needed for 3 days or 1 week. That is up to them. Then under that this device will be fixed. There will be a path to get the food out from the device to the dish which is kept in a cage. That

path will be closed. When the caretaker, poultry farmer or owner of the farm needed to feed the hens, they can put a message to the sim which is connected in the device. After the device got the message the path which is closed will be opened and using the path food will be come down to the dish which is kept in the cage. To make a confirmation that whether the device is started to work or not, a confirmation message also has been set to the device. So, using that message user can make sure that the device has started to work or not. After the feeding process finished, the path which has opened will be closed automatically. Another message will come to the user's mobile number to make sure whether the feeding process successfully finished or not.

The farmer no need to use a smart phone to operate this device thinking that this is a smart IoT device. Using any type of mobile user can operate this remote feeder. Day by day technology is getting improved. Therefore now 5G also being used. No need to get afraid that can the farmer use this in all over the area in Sri Lanka. Because in some areas people can get 3G coverage. So, will it be possible to operate this feeder from anywhere? Definitely yes. To make this work successfully, people who are using this device need minimum 2G coverage. That is possible when consider about Sri Lanka.

Mostly this remote feeder can be used in areas which are comes under central province. Because people who are living in central province according to the responses of the poultry farmers 80% of population taking this as their livelihood and hobby also. According to the financial issues they are facing most of the people moving to other provinces to earn more and take care of their family. So, the housewives also facing difficulties to maintain the farm. So, this remote feeder will be very useful to them and a needed thing also.

So, there are many benefits can be taken by using this remote feeder. Farmers can operate this device whenever they want to feed the hens from anywhere. Poultry farmers can save their time more and more. It means the time which is going to be taken to go near to the cage and putting the food two times per day. If any person kept to maintain this feeding process will ask minimum three hundred rupees per day. For one month it will take nine thousand which is a small amount when it comes to a business. But when thinking about one year, for one maintainer they wanted spend one lakh eight thousand which is a huge amount. So, by implementing this solution more and more money can be saved. Because no need to keep one person to do the feeding process.

In order to make this device work, power is needed. Sometimes power cut issues also their most of the time because of the country's situation. So, using solar panel is one recommended solution at that time. So, over all anyhow it will be a useful solution to the poultry farmers and others who are having farm. This device not only can be used in poultry farm but also the people who are having other birds as their pet can use this and implement.

Key words: virtual platform, remote working, poultry farm, feeding

Digitalization of Gauging Employees

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1. Introduction

The topic of digital transformation is currently the center of attention of employees and a key strategic priority for employers. Considered a high level, digital transformation stands for radical technological changes, which are happening in society and in different industries due to the use of digital technologies. Considered at the organizational level, digital transformation describes a holistic form of business transformation. This transformation requires significant changes at different levels of a company. The changes at these levels are induced by the application of various information, computing, communication, and connectivity technologies, such as mobile, social media, analytics, the internet of things, the cloud, and platforms. Many companies take the "more is better" attitude when it comes to evaluating talent and gauging work performance across a wide range of characteristics, talents, competencies, and other factors. When it comes to employee performance measures, though, less is more. Consider scaling down from too many weak measurements to these four tried-and-true talent performance criteria to correctly estimate the level of performance of employees. Reviewing employee performance on an individual level will help you establish an accurate idea of how your talent compares to the rest of the organization, from examining job quality to creating individual goals. Any organization can benefit from employee performance management solutions. The capacity to assess and improve staff performance is a vital asset that will aid your business's success. want to be sure the system you choose is the best fit for your organization because effective staff management and growth are so important. Real-time monitoring and control were possible because to this method.

2. Methodology

The project based on secondary research. Depending on the data sample, such as quantifiable or non-numerical data, empirical research can be conducted utilizing qualitative or quantitative observation methods. Unlike theoretical research, which is based on preconceived beliefs about the research variables, empirical research uses a scientific approach to determine the experimental probability of the variables under study. Qualitative research is written down. It's used to comprehend ideas, thoughts, and experiences. This form of research allows you to learn more about topics that aren't well-understood. Interviews with open-ended inquiries, observations reported in words, and literature reviews that investigate concepts and theories are all common qualitative methods. Experiments, observations recorded as numbers, and surveys with closed-ended questions are all common quantitative methods used. Data collection is the process of acquiring and evaluating information on variables of interest in a systematic manner that allows researchers to answer research questions, test hypotheses, and assess outcomes. According my gauging system project most of the objective based on real time data (Primary data). And also, Used some secondary data. So that is help develop my project in an efficient way. There are six objectives in my project. Used primary data for Such as tracking employee's movement, use hidden webcams and microphones, detect mobile device tracking, monitor remote desktop control and I have used primary and secondary data for monitoring the internet usage, and submit day by day reports online. Waterfall project management is a method of project management in which a project is finished in stages and then progressed step by step toward final consumer release. develop a big plan ahead of time and then follow it step by step, hoping that nothing would go wrong. When all of the activities are shown on a Gantt chart, the result resembles the slopes of a waterfall, hence the name. Requirements and design take up 20–40% of the time, coding takes up 30–40%, while testing and operations take up the rest. On waterfall projects, activities must take place in a specific order, and one set of activities cannot begin until the previous one has finished. This is why, with waterfall projects, planning is crucial: if you don't plan

properly, a phase will be late, pushing every other subsequent phase behind schedule, putting the entire project behind schedule.

3. Results and Discussion

Gauging system based on digital transformation. This gauging system can be implemented using proper software monitoring components. The software monitoring covers a wide range of computer resources that have used. To analyze the use of monitoring and productivity tools in digital transformation which contains Task Management, Time and Schedule Management, Performance Management, Attendance Management and Rewarding Management. Task management includes tracking task progress from start to completion, setting deadlines, and delegating duties to team members. Time management allows you to keep track of the time you and your employees spend working on different projects and tasks. Performance management is a corporate management tool that helps managers monitor and evaluate employees' work. A biometric time and attendance system is the automated method of recognizing an employee based on a physiological or behavioral characteristic. Payroll is an important document that is used by organizations and companies to perform day to day staff management activities. Employee data management is the practice of collecting, organizing, and retaining employee data. The most important thing to remember is that employee performance reviews are a major victory for both your organization and employees. The goal should be to determine how to assist each individual at your company in becoming more productive and reaching their full potential. Goals of Digital transformation are reducing costs, time optimization. faster time to market, increasing revenue, increasing collaboration, increasing employee productivity, improving agility, improve customer experience, increase governance and compliance and gain competitive advantage. Digital transformation is the combination of multiple projects, changes initiatives, and business processes that occur across the organization to enhance the overall digital capability. In a digital transformation process customers and employees are at the center of all strategies. Digital transformation helps to track and measure the success of your digital transformation strategies, ensuring you're moving in the right direction and that

you're maximizing growth opportunities. Federal workplace privacy and employee monitoring regulations stem primarily from the Electronic Communications Privacy Act of 1986. The ECPA allows business owners to monitor all employee verbal and written communication as long as the company can present a legitimate business reason for doing so. It also allows for additional monitoring if the employee gives consent. However, the ECPA consent provision can be tricky, as it might be inferred to allow monitoring of employees' personal communications as well as business ones.

4. Conclusion and Recommendation

Digital transformation is one of the key challenges facing contemporary businesses. The need to leverage digital technology to develop and implement new business models forces firms to reevaluate existing capabilities, structures, and culture in order to identify what technologies are relevant and how they will be enacted in organizational processes and business offerings. With these four objectives, emphasize that digital transformation influences firms across industries and entails both cross-industrial and industry-specific challenges; is a complex phenomenon that affects an organization holistically at its different levels; and while being linked to different digital technologies, includes some key technologies for a particular industry. My empirical results indicate that although digital transformation is primarily associated with performance benefits for firms, such as an increased market capitalization, employee trust, process speed and control as well as customer intention to use the services, it can also be linked to negative impacts, such as reduced market capitalization, missing employee trust and decreased relationship readiness of processes. Therefore, firms that are starting to transform digitally, should try to carefully investigate the possible outcomes of their digital transformation initiatives with this thesis, aim at supporting companies on their digital transformation path to gauge the employees. The workplace of the future will be a very interesting place. With the advent of artificial intelligence and machine learning, the workplace of the future will employ intelligent employee monitoring that will be capable of performing the following; Behavioral analysis: Employee monitoring solutions of the future will have the ability to track changes in employees'

behavior in multiple ways. This will greatly assist in assessing behavioral anomalies in real time. In situations where disgruntled employees are likely to pose a threat such as a security-related one, future solutions will help prevent these, Advanced management: Future monitoring solutions will include devices such as accelerometers to monitor when employees move and special trackers that collect data on how frequently employees talk or listen. This will be very useful in determining which groups are receiving more attention from management and which ones are getting neglected. Remember that any employee performance measurement is merely a snapshot of how the employee is doing at a particular point in time. Comprehensive performance reviews should be based on an average of snapshot measurements compiled over time. Some organizations see performance appraisals as a continuous process, rather than an annual event. Regular feedback can keep the ship from veering too far off course by identifying problems early and developing solutions that can evolve more organically. Employee happiness can improve your company's performance and retention of top employees. It also promotes an environment in which employees can progress from passive to active participation. Simultaneously, the means for obtaining employee feedback changing. It takes time to figure out what your employees desire from workplace and what motivates them to perform at best.

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COMPARING AND ANALYSING THE DATA PRIVACY POLICIES OF INSURANCE COMPANIES IN SRI LANKA AND SUGGESTING THE BEST DATA PRIVACY POLICY TO THE INSURANCE COMPANIES AND THE CUSTOMERS

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Abstract

Personal data is very much important for an organization to run. Protecting personal data is a very difficult part that every organization faces all around the world. The data should be protected with proper security methods to keep the data from attackers who misuse it. To show the users and customers how the data is collected, used, and protected, the organizations use a privacy policy that details and explains all the details related to the personal data collected by the organization. In Sri Lanka protecting personal data is difficult since the data protection bill has not yet been approved by the government. In this research project, the privacy policies of the Sri Lankan Insurance Companies have been collected to analyze and compare to identify the weaknesses. Then a proper GDPR (General Data Protection Regulation) compliant privacy policy has been suggested to the insurance companies through a website.

Keywords: Privacy Policy, Data Protection Bill, GDPR (General Data Protection Regulation)

1. Introduction

Personal Data privacy and security concerns are the main problems people face these days. Commonly, the problem can be found in the method of data is collected by online communications such as social media, online transactions, queries from search engines, etc.(Buck and Bodenheimer 2021). The rise of collecting personal data and publicly publishing it has become the main privacy issue in people's personal data. The problems have increased because the data has been publicly used for medical research purposes, market analysis, and economical processes(Afifi *et al.* 2018).

In Sri Lanka protecting the data is the biggest concern since the government has not yet published a Data Privacy Bill (Puvimanasinghe, 2021). In this research project, the data privacy policies of the Sri Lankan insurance companies have been compared and analyzed to find the weaknesses. For the analysis and comparison, Allianz insurance company's privacy has been examined. Finally, a proper GDPR (General Data Protection Regulation) compliant privacy policy has been created to

suggest the insurance companies through a website. The insurance companies are able to access the website, check and go through the policy and follow it. Also, all the insurance company's existing privacy policy details have been added to the website where customers can see currently how the data is protected and maintained by the insurance companies.

1.1. Background

The data protection bill of Sri Lanka provides data privacy laws. The aim of the protection bill covers all the sectors including private and public. The data protection bill is similar to the terms of EUGDPR (European Union's General Data Protection Regulation). Also, many obligations of controllers and rights of data subjects are based on GDPR (Greenleaf, 2019). The data protection bill which was launched in 2019 to bring governmental protection against the personal data of the people of Sri Lanka and has been approved by the cabinet and soon after the parliament approves the bill, it will become law (Dailymirror, 2021). The data protection bill contains similar details and set of rules of EUGDPR, therefore this research focuses on providing solutions and suggestions related to the GDPR. The main target of this research project is to suggest a proper GDPR compliant Privacy Policy to the Insurance Companies of Sri Lanka.

2. Methodology

2.1. Qualitative Method

Selected Insurance Companies' websites were visited to collect the privacy policies. Companies did not have the privacy policies on the website were contacted with phone calls and request E-mails.

2.2. Secondary Data

Privacy Policies for this research project were already available on the website of the insurance companies and already followed by the insurance companies. The privacy policies are created and added to the websites by the companies themselves.

2.3. Data Collection and Methods

To suggest the best Privacy Policy to the insurance companies, the current privacy policies of the insurance companies were collected. The below table shows the selected Insurance Companies of Sri Lanka for this research project.

Table 1 name lists of the selected Sri Lankan insurance companies

No.	Name
01	AIA Insurance Lanka Ltd
02	AIG Insurance Limited
03	Amana Takaful PLC
04	Arpico Insurance PLC

05	Ceylinco General Insurance Limited
06	Ceylinco Life Insurance Limited
07	Continental Insurance Lanka Ltd
08	Cooperative Insurance Company Ltd
09	Cooplife Insurance Limited
10	Fairfirst Insurance Limited
11	HNB Assurance PLC
12	HNB General Insurance Ltd
13	Janashakthi Insurance PLC
14	Life Insurance Corporation (Lanka) Ltd
15	LOLC General Insurance Limited
16	LOLC Life Assurance Limited
17	MBSL Insurance Company Limited
18	National Insurance Trust Fund
19	Orient Insurance Limited
20	People's Insurance PLC
21	Sanasa General Insurance Company Limited
22	Sanasa Life Insurance Company Limited
23	Softlogic Life Insurance PLC
24	Sri Lanka Insurance Corporation Ltd
25	Union Assurance PLC

2.4. Analysis

Collected Privacy Policies were analyzed to identify the weaknesses and to suggest a proper privacy policy that is aligned with GDPR (General Data Protection Regulation) passed by the EU (European Union). To identify the weaknesses of the Sri Lankan insurance companies' privacy policy, Allianz insurance company's privacy policy was examined and analyzed.

Privacy Policy should have the details related to the personal data of the users and other information in a clear way that a normal person could read and understand. Followings are the basics that a privacy policy should have:

- Details about what type of data is collected.
- Details about where the data is collected.
- Details about why the data is collected.
- Details about how the data is collected (cookies and other tracking technologies).
- Details about who the data is shared with or sold to.
- Details about the rights of the users have over the data.
- Contact details about the site or the organization.

2.5. Comparison

Privacy Policies were compared with Allianz insurance company's privacy policy to show the users and customers which insurance company has and follows a proper detailed privacy policy and to show the weaknesses of the existing privacy policies. Here also the basics of a Privacy Policy are used for the comparison.

Comparison between Allianz and AIA Insurance Company

Table 2 comparison of allianz and aia insurance companies

Contents	Allianz Insurance Company	AIA Insurance Company
Details about what type of data is collected.	Perfectly explained	Perfectly explained
Details about where the data is collected.	Perfectly explained	Perfectly explained
Details about why the data is collected.	Perfectly explained	Perfectly explained
Details about how the data is collected (cookies and other tracking technologies).	Perfectly explained	Perfectly explained
Details about who the data is shared with or sold to.	Perfectly explained	Perfectly explained
Details about the rights of the users have over the data.	Perfectly explained	Perfectly explained
Contact details about the site or the organization.	Perfectly explained	Perfectly explained

3. Design and Implementation

3.1. Privacy Policy

GDPR (General Data Protection Regulation) compliant privacy policy was created using Termly.io. in order to suggest to the insurance companies. It covers all the relevant basics of the privacy policy and additional details. The privacy policy can be viewed and followed by the insurance companies and be modified according to the way that companies want.

3.2. Website

A website was created using Wordpress.com to suggest the policy to the insurance companies. The website has two pages, one page is to show the suggested Privacy Policy and the other page is to show the details of existing Privacy Policy of Sri Lankan insurance companies.

4. Results

The below table shows the lists of insurance companies names that were selected for this research project and the list of the privacy policies that were collected from the insurance companies.

Table 3 results of collected privacy policies from insurance companies

No.	Name	Results
01	AIA Insurance Lanka Ltd	Policy Collected
02	AIG Insurance Limited	--
03	Amana Takaful PLC	Policy Collected
04	Arpico Insurance PLC	Policy Collected
05	Ceylinco General Insurance Limited	--
06	Ceylinco Life Insurance Limited	--
07	Continental Insurance Lanka Ltd	--
08	Cooperative Insurance Company Ltd	--
09	Cooplife Insurance Limited	--
10	Fairfirst Insurance Limited	Policy Collected
11	HNB Assurance PLC	--
12	HNB General Insurance Ltd	--
13	Janashakthi Insurance PLC	--
14	Life Insurance Corporation (Lanka) Ltd	--
15	LOLC General Insurance Limited	Policy Collected
16	LOLC Life Assurance Limited	Policy Collected
17	MBSL Insurance Company Limited	--
18	National Insurance Trust Fund	--
19	Orient Insurance Limited	--
20	People's Insurance PLC	Policy Collected
21	Sanasa General Insurance Company Limited	--
22	Sanasa Life Insurance Company Limited	Policy Collected
23	Softlogic Life Insurance PLC	--
24	Sri Lanka Insurance Corporation Ltd	--
25	Union Assurance PLC	Policy Collected

Below pie chart shows the amounts of insurance companies that have privacy policies on the website and amounts of insurance companies that do not have privacy policies on the website.

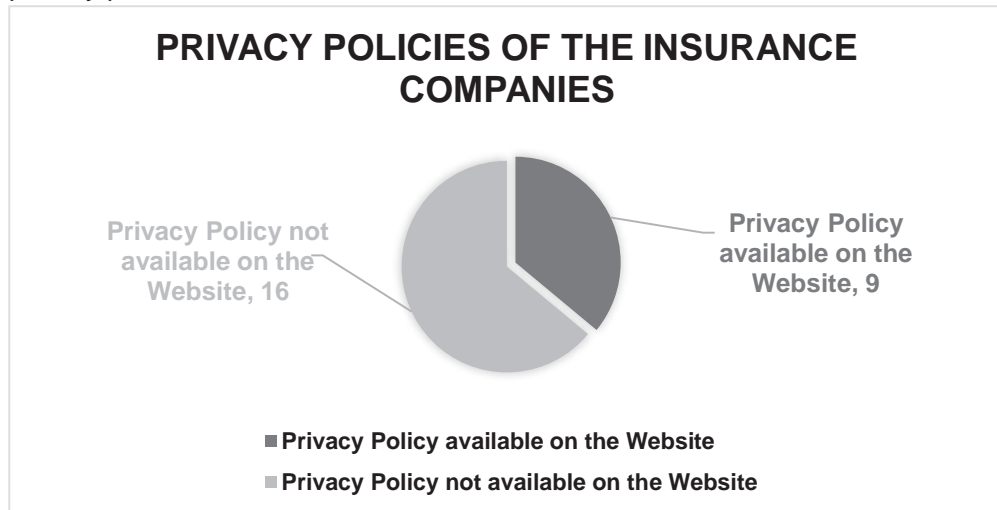


Figure 1 pie chart results of privacy policy availability on the website

- 16 out of 25 insurance companies which is the majority of the insurance companies in Sri Lanka do not have privacy policies on the website.
- 9 out of 25 insurance companies which is a small amount of the insurance companies in Sri Lanka have privacy policies on the website.

Below pie chart shows the amounts of insurance companies that have and do not have proper privacy policies.

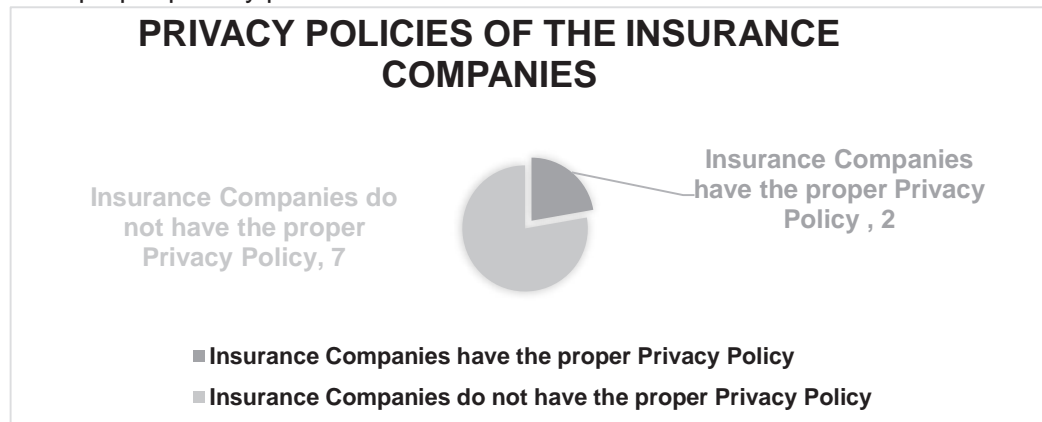


Figure 2 pie chart results of insurance companies use proper privacy policies or not

- 2 out of 9 insurance companies which is a small number of insurance companies have the detailed proper privacy policy and follow it.
- 7 out of 9 insurance companies which is a major amount of insurance companies do not have the detailed proper privacy policy and follow it.

5. Conclusion

Personal data of the people should be protected with high security. Organizations should follow a proper Privacy Policy to show the users how the data is protected and used. This research mainly focused on the privacy policies of the 25 Sri Lankan Insurance Companies. 9 companies' privacy policies were able to find on the website and among them only 2 companies were identified as using a proper privacy policy. To overcome the issue, a GDPR (General Data Protection Regulation) compliant privacy policy has been created and suggested through a website where insurance companies can check and follow the policy.

6. Recommendations

- It is recommended to have an encryption method built for the personal data of the users. Companies should encrypt the personal data of the users so if the data is leaked, there will not be an issue with the data because it is encrypted.
- It is recommended to create a method that can make the users check and read the privacy policies of the insurance companies when the users access the website and add personal details.
- It is recommended to have all the personal data collected from the users stored in cloud platforms to protect the data.

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Stopping Abductions through the Microchips

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1. Introduction

The world is plenary of variants of malefactor actions. Abducting is one of the most prevalent malefactor action that affects people's life deplorably. The aim of this research is stop abductions utilizing a microchip about the size of a grain of rice. This will be a turning point of the reducing social crime.

Purpose and motivation

Abducting

Millions of people are abducted in one day in the world. The increasing number of abducting incidents in various countries has a great impact on human lives. There are several type of abducting in this world. Those are,

Taking a person with the object of extorting large amounts of ransom money or other concessions for his safe return.

Abducting young women and selling them for concubine or prostitution is also considered kidnapping.

Abducting for extortion has lately become a technique used by political revolutionaries or terrorists seeking concessions from governments. (Britannica, May 16, 2022)

Kidnapping per country

Kidnapping rates vary by nation, and are not totally consistent with rates of other violent crimes worldwide. Kidnapping is one of the crimes that contribute to a nation's ranking among the world's most dangerous or violent countries, alongside criteria such as murder rate, frequency of rape, and whether or not a country is actively at war. Kidnapping may take several forms and can occur for a variety of reasons. It is also worth mentioning that the definition of abduction, as well as the frequency with which it is reported and documented, varies per nation.



Source: <https://worldpopulationreview.com/country-rankings/kidnappings-per-country>

(Worldpopulationreview, 2022)

Kidnapping in Sri Lanka

Since the late 1980s, the number of enforced disappearances in Sri Lanka has been estimated to be between 60,000 and 100,000, according to the human rights organization Amnesty International. In 2018, the rate of abduction in Sri Lanka was 1.2 incidents per 100,000 people. Though the abduction rate in Sri Lanka has varied significantly in recent years, it has tended to drop from 2009 to 2018, concluding at 1.2 occurrences per 100,000 inhabitants in 2018. Information accumulated from the police department in Sri Lanka.

Problem

Abducting is a criminal act involving the unlawful abduction and carrying away of a person by force or trickery, or the unlawful capture and imprisonment of a person against his will. The purpose of this study is to stop abducting and find people who are being abducted in a short period of time.

2. Methodology

When a person goes missing, it is very consequential to identify the whereabouts of the missing person. The moment a person is born into this world, a harmless electronic microchip is inserted into the body through an injection and the place where the microchip is injected into the body varies from person to person. So, it can't be removed by any other random person. The private number of the electronic microchip will be entered into the birth certificate. The location of the electronic microchip can be identified utilizing the PIN entered on the birth certificate. Using special computer software, that PIN gives police access to locate the electronic microchip. In this way, the police will be able to know the location of the person through the electronic microchip inserted into the person. When a person is born, this electronic microchip is inserted into the body, so this chip can be called Birth Electronic Microchip. The microchip injection process will take place under complete medical supervision.

3. Results and Discussion

It is very facile to trace the missing person utilizing this method. The moment a person is found missing, all one has to do is take the missing person's birth certificate and go to the nearest police station. There, using the secret number on the birth certificate, the police can locate the missing person within a few minutes through their computer system.

Through this method, the lives of an immensely colossal number of people can be saved.

Currently, human microchips are operated using RFID systems, but this is somewhat as the RFID system can only track locations up to 100m. But if GPS technology can include in this microchip system, it will track huge areas. Even so, a GPS system needs an antenna, an integrated system to perform math and data communication, and a communication protocol output that feeds to the user or end system. For all those things, it will require a huge space. But this is just a microchip. However, Technology improves day by day. So, thinking about tracking in huge areas, the best option for location tracking in huge areas is GPS technology. According to that, this GPS will be the best location tracking system for these tracking microchips. Nevertheless, GPS technology should be more innovative in order to use in these human microchip systems.

4. Conclusion

Already this microchip injecting system uses for pets to identify their location. In that process, if someone found a lost pet, that person takes that pet to the nearest vet, animal hospital or shelter, if that pet has been microchip injected, they will read the pet's microchip ID number using a microchip scanner. Utilizing this ID number, they can look up in the microchip database, to identify the parent of the pet. Microchips are not big enough to contain hardware for GPS or another localization technology at this time. So, it should be more innovative to use for people. The purpose of this research is to improve this microchip injection system to the level of location tracking, develop it undetectable using a pet microchip scanner, and make it work for humans, reducing abductions and engendering an environment where all people can live freely.

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Analyzing the Current Network design of an organization and suggesting a Secure Network Design

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Abstract

The 21st century is an information technology era; every human attaches to technology; there is no way forward without technology, even if it is common to organizations. All organizations want to develop and expand their business, so achieving that organization also benefits from technology. Today, all organizations use their network to full fill the organization's activity, but on the other hand, malicious people use technology to harm organizations. So today, it is critical to protect the internal organization network from malicious persons, and it's challenging because network vulnerability occurs due to insecure design, misconfiguration, and human errors. But if an organization can design a secure network hierarchy and minimize misconfiguration issues, the organization can mitigate security risks as much as possible. So, this project analyzes the existing network of ABC Company by auditing the current network and referring to existing documents like PPDIOO, IP planning, VLAN planning, etc. During the analyzing process, the designer can identify the current designing issues, quality of service issues, and security misconfiguration (It identifies critical security settings that are not configured, and the security setting configured with vulnerability, like Trunking without a no negotiation command.)

After identifying the ABC network's vulnerabilities, the designer used the PPDIOO life cycle to develop a proper infrastructure design and configure Quality of service for classified network traffic. Finally, to minimize the specific misconfiguration issues, configure essential security parameters like DHCP snooping, Port Security, Access control list, Firewall configuration, DMZ configuration, secure remote connectivity, etc.

Keywords:A Denial-of-Service (DoS), VLAN, DMZ, Firewall, Quality of Service, VOIP, Packet tracer, Port security, Secure remote connectivity

1. Introduction

In 1980, scientists attached to the DARPA (Vint Cerf and Bob Kahn) project developed a protocol known as TCP/IP. The TCP/IP architecture provides a solution for internetwork communications. So, TCP/IP architecture opened the golden era for information technology and networking. In the 21st century, the computer network is essential for every company to perform their activity more efficiently. The primary purpose of network architecture is to establish proper organizational management, communication, and connectivity. To achieve that, CISCO introduces a network development life cycle known as PPDIOO. Network designers always

follow the PPDIOO life cycle and design networks, but unfortunately, at least 225 security violations are reported daily. These violations mainly affect the organizations' business activity and reputation; most security breaches happen due to inaccurate network designs and security misconfigurations.

Network attacks can be divided into two categories: active attacks and passive attacks. Active attacks are more potent than passive attacks. Network attacks can either be active or passive, but both attacks damage the organization's networks, and attackers learn new technology daily

So, the above facts prove that network security is compulsory when designing or updating a network because any attack directly affects the organization's reputation. This project analyzes the existing network of the ABC Company, a construction company in Sri Lanka, and identifies the infrastructure issues, quality of service issues, and security vulnerabilities, and provides solutions for mitigating those risks, minimizing existing misconfiguration issues, updating existing security mechanisms and redesign of the ABC network, and securing the network from malicious activities.

2. Methodology

This project is about an organization's Analyzing Current Network design and suggests a Secure Network Design. To design a secure network for ABC company, it is essential to examine the current network and information about security theatre, protocols, tools, techniques, etc. So, research is crucial for gathering that information and making decisions based on collected data. So, this research used primary and secondary data collection methods to collect the data.

Under the primary data collection method, the researcher used Observation to examine the current network. Here, the developer mainly identifies the configuration mechanism, cable arrangement, security mechanisms, topology, protocol, Quality of service, VLAN, VTP, Ether channel, etc. This Observation refers standard of the network rather than the quantity. So, this Observation can be categorized as a qualitative mechanism. In addition, the developer must identify a number of layer two devices, IP phones, servers, and Layer three devices used in the network. So, Observation deals with quantity. So, this approach can be categorized as a quantitative approach.

In designing a secure network, it's essential to identify the common threat, misconfiguration issues, tolls, development methods, etc. This information can be gathered through a Literature review. So, the researcher used a Literature review as the secondary data collection method.

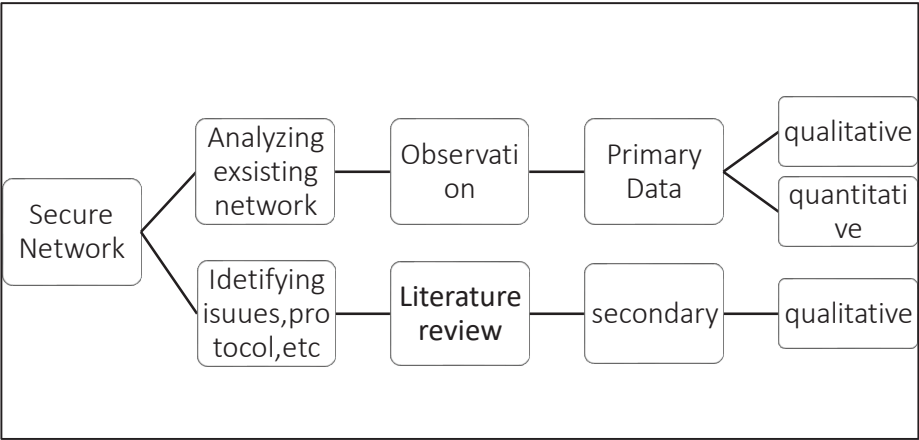


Figure 1:Methodology

3. Designing and Implementation

CISCO introduces the PPDIOO life cycle. Using the PPDIO life cycle designer can develop a quality network to fulfil the organization's requirements. PPDIO life cycle contains six phases: Prepare, Plan, Design, Implement, Operate, and Optimize. The designer used the PPDIOO life cycle to update the existing network.

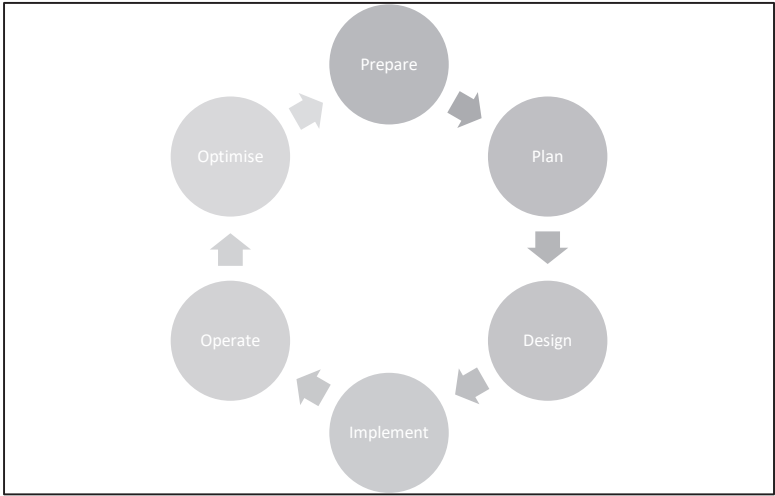


Figure 2: PPDIOO Life cycle

The implementation Process is divided into three main categories: Infrastructure Design, Quality of service, and Security Implementation.

Under Infrastructure Design designer Implement, VLAN Design, Ether Channel Configuration, Trunk Port configuration, VLAN trucking Protocol, VLAN Interface of Switch, Inter VLAN routing, and Server Configuration.

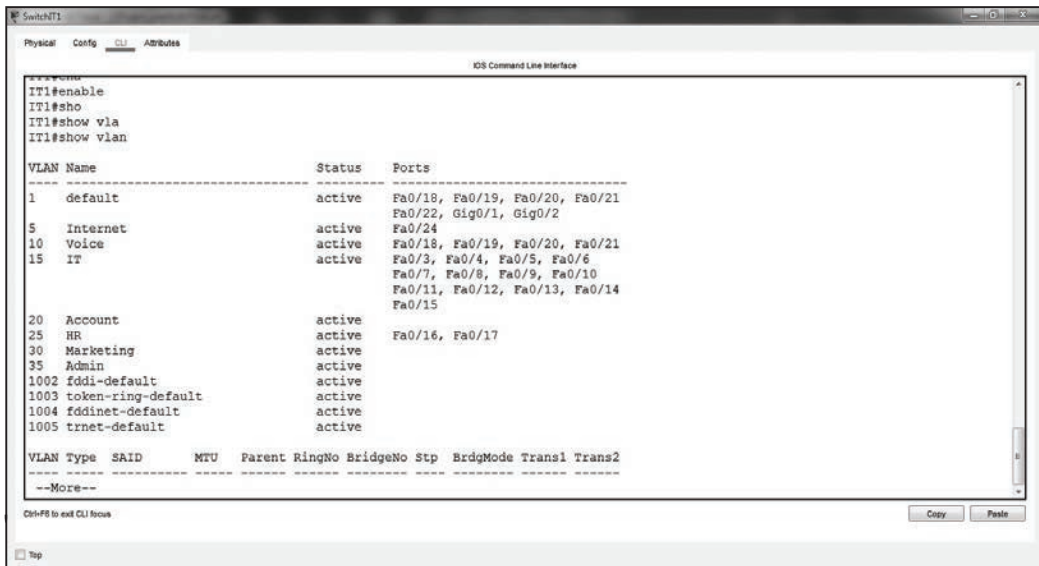


Figure 3: VLAN Configuration

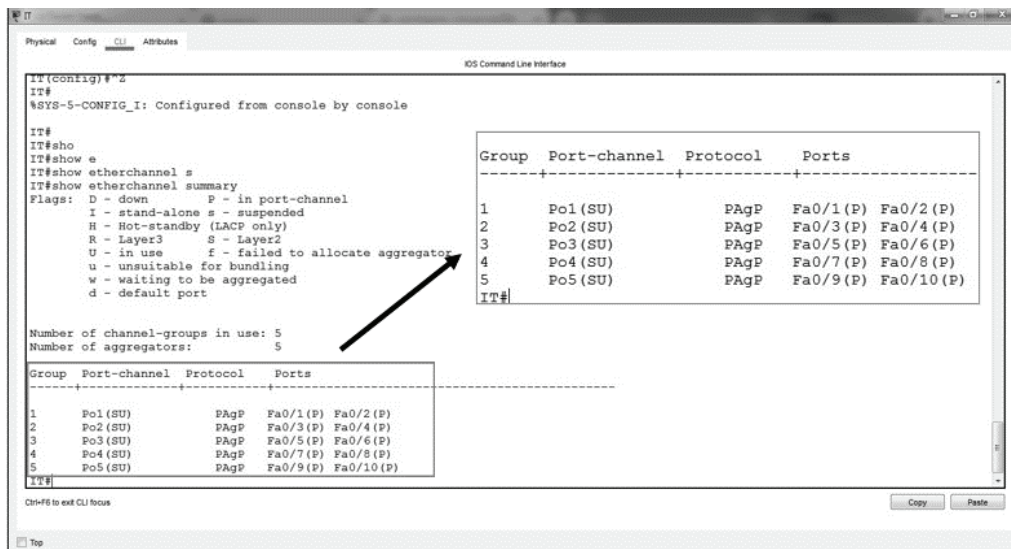


Figure 4: Ether channel Configuration

Under Quality of service configuration designer Assign a Port to Voice VLAN, Configure IP telephony service, and finally configure Quality of Service.

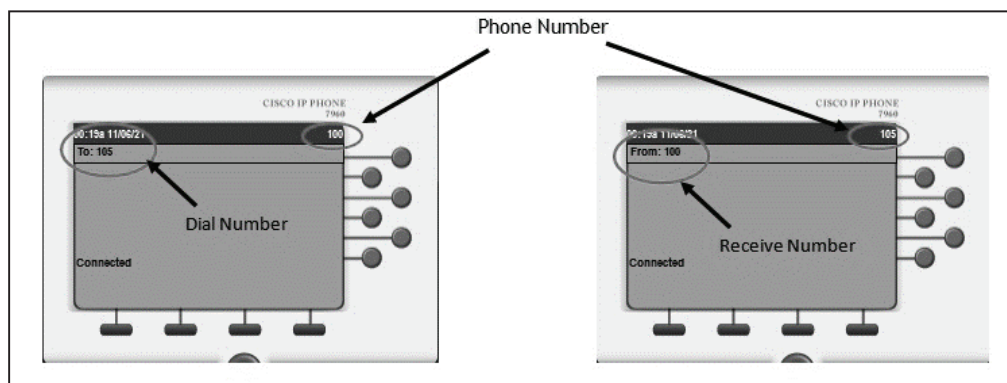


Figure 5: Phone Connectivity

```

ABC>enable
ABC#configure terminal
ABC#password
ABC#show
ABC#show p
ABC#show pl
ABC#show po
ABC#show policy-map
Policy Map apply
  Class voice
    set precedence 5
  Class http
    set precedence 3
  Class udp
    set precedence 2
ABC#show
ABC#show cl
ABC#show cla
ABC#show class-map
Class Map match-any class-default (id 0)
  Match any
Class Map match-all voice (id 1)
  Match ip dscp ef (46)
Class Map match-all http (id 2)
  Match ip dscp af31 (26)
Class Map match-all udp (id 3)
  Match ip dscp af11 (10)
ABC#
  
```

Figure 6 shows the QoS configuration in the IOS Command Line Interface. The configuration includes a Policy Map named 'apply' with three classes: 'voice' (precedence 5), 'http' (precedence 3), and 'udp' (precedence 2). It also shows the configuration of three Class Maps: 'match-any class-default (id 0)', 'match-all voice (id 1)', and 'match-all http (id 2)', each with specific IP DSCP values.

Figure 6: QoS Configuration

Under security implementation designer Secures network devices, Enables secure remote connectivity, Configure DHCP Snooping, Port Security, Access-Control list, and Network Address Translation, Finally designer implements a firewall, under that designer configures Gateway of Last resort, Address Translation, Modular Policy Framework, DMZ, in addition to that designer manage the ASA firewall which is used to protect the ABC network.

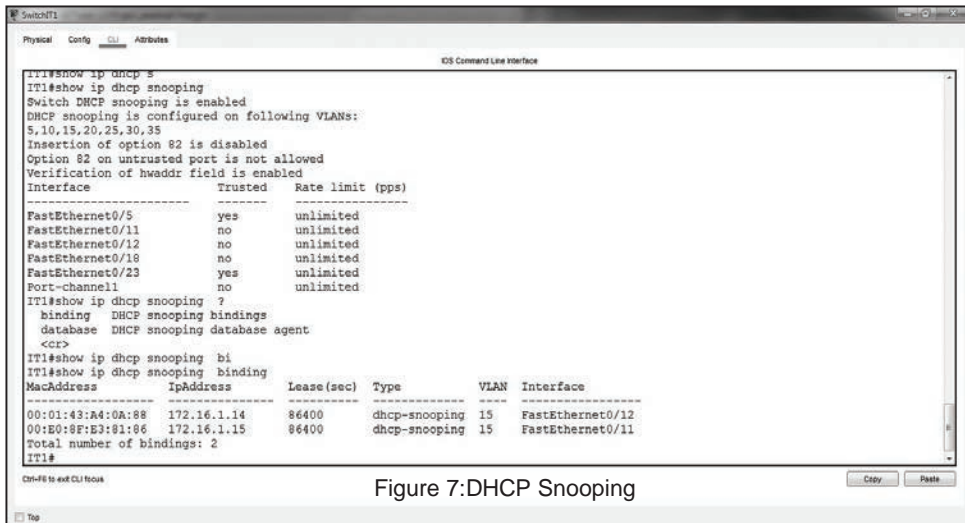


Figure 7:DHCP Snooping

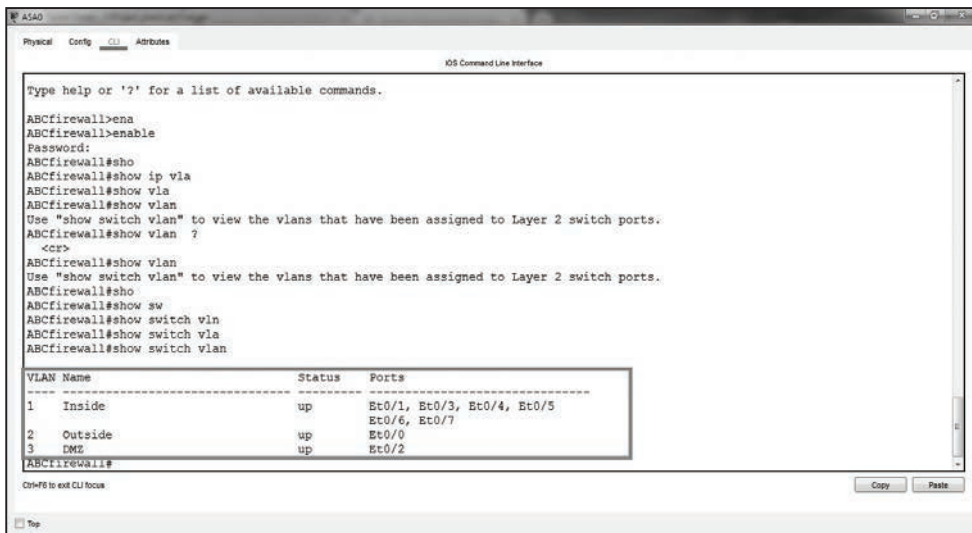


Figure 8: security level of ASA firewall

4. Test Results

After the update, the ABC network configuration is checked using CMD and other verification tools. The testing part is divided into three-part, Infrastructure testing, Quality of Service testing, and Security testing.

Testing Section	Testing Unit	First Attempt	Final Result	Details
	VLAN	Success	Success	

Infrastructure	Ether channel	Success	Success	
	Trunk Link	Success	Success	
	VTP	Success	Success	
	Router on a Stick	Success	Success	
	DHCP	Success	Success	
	NTP	Success	Success	
	Syslog	Success	Success	
Quality of Service	IP Telephony Configuration	Not Success	Success	During the first attempt did not configure information about the TFTP server in the DHCP configuration. So, IP telephony didn't receive an IP address.
	Phone Connectivity	Success	Success	
	QoS Configuration	Success	Success	

Network Security	Device Protection	Success	Success	
	AAA	Success	Success	
	DHCP Snooping	Success	Success	
	Port Security	Success	Success	
	Access-Control List	Not Success	Success	The first attempt did not configure the Access-list rule correctly.
	NAT (ABC Router)	Success	Success	
	Security level	Success	Success	
	NAT (ASA firewall)	Success	Success	
	MPF	Success	Success	
	Access-Control List (ASA Firewall)	Success	Success	
	DMZ	Success	Success	

Table 1: Test result

5. Conclusion

This project firstly investigates the currently available infrastructure technology of the ABC network, the Quality-of-service technique used in the network and the existing vulnerability of the network.

During the implementation, the designer implemented VLAN, Ether channel, Secure Trunking and the servers required to protect the network. In Quality-of-service implementation, the designer configured the policy map and the class map to prioritize traffic based on the request. Security configuration, the designer, protects the devices and enables secure remote connectivity using an AAA server. In addition to that designer used techniques to avoid DDOS attacks, mac address flooding attacks, ARP poisoning attacks, VLAN Hopping attacks, etc.; under firewall configuration, configured DMZ and allowed external users to access the website host in the DMZ and blocked the external users from accessing the ABC network's internal network.

After updating the ABC network, a testing process is conducted to verify the configuration and the performance. The testing is done using various CMD tools and multiple CISCO verification commands.

Throughout this project, implement proper solutions to mitigate existing issues of the ABC network. During the testing part, the designer proved new technology worked adequately. So updated network architecture of the ABC network can minimize most of the attacks in the digital world.

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Effectiveness of a smart IOT Water filling system to reduce water and electricity wastage

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Abstract

Water is one of the basic needs of any living being. Earth is covered with 70% of water, yet only 3% is suitable for consumption and domestic use. Due to many reasons like global warming, increase in population, pollution and unnecessary wastage, the usable percentage of water is greatly affected and eventually leads to water scarcity. This research intends to discuss about how an IoT (Internet of Things) based water filling system will be useful for Sri Lankans instead of a regular water filling system. Using an IoT based water filling system can help to reduce water and electricity wastage, contribute to country's economy, save time, effort and expense. A quantitative research methodology was used, therefore a primary short survey was conducted with 50 participants regarding "Effectiveness of a smart IOT (Internet of Things) Water filling system to reduce water and electricity wastage" in Sri Lanka. The participants were from various career backgrounds, where majority of them had very slight idea of IoT concepts or none at all. Most of them have no concrete idea how IoT can be beneficial for each individual and its importance for country's economy and technology sector. The survey shows that majority of the participants use a regular water filling system and obtain water from water board line. People are aware that using a regular water filling system at home causes water and electricity wastage, yet people continue to use this system because new technological solutions were never brought up and majority of them had only a slight idea of IoT. More than 95% of participants obtain water through water board using regular water filling system. Survey further showed that using the regular system people had faced the common problems such as difficulty in switching ON and OFF the water motor and overflowing of water as a result of forgetting to switching OFF the motor. As an IoT based water filling system has multiple benefits, all the participants agree that using IoT based system will be very useful domestically for each individual and for the country. In South Eastern countries like India and Bangladesh, smart water filling system for domestic use has been designed only as a prototype. Smart water tank monitoring system has been implemented in New Zealand and Australia. This system helps to monitor water level inside the tank, monitor water usage history, and adjust level of water to be filled inside the tank using a LED display or the mobile application. Though technology sector is far behind in Sri Lanka, implementing IoT concepts at domestic level can be a great start. This system is an easy concept to understand, easy to handle and cost effective. IoT based water filling system consists of few components, but contributes to the user in

a large scale on the long run. The IoT based water filling system is more effective than regular water filling system in many ways, as it eliminates all the problems caused in a regular water filling system and provide additional benefits for user and environment.

Keywords - Home Application, Smart Water filling system, Internet of Things, Technology

1. Introduction

1.1 billion people have lack of access to water and 2.7 billion face water scarcity for atleast one month of the year. (Worldwildlife, n.d.) In today's modern world, with the increase of population, inefficient water management systems, global warming, and pollution has greatly impacted water resources and may eventually lead to water scarcity.

In Sri Lankan homes a regular water filling system is used to obtain water from either a well or water board line. The regular water filling system has many drawbacks such as unable to know the water level inside the tank, thus not know when to ON and OFF the motor, overflowing of water when motor is not switched OFF when the tank is fully filled, excess pressure in pipes causing it to blast and unable to know the temperature of water inside the tank. These problems leads to water and electricity wastage, increase of expenditures, interruption of work and waste of time and effort. Every domestic home in Sri Lanka is likely to face atleast two of the above mentioned problems when using the regular water filling system.

Technology is beginning to have its influence from the minute object like smart dust to an entire city. Automation technology has become popular as it makes people's life much more easier and convenient. IoT (Internet of Things) have been implemented in various sectors such as agriculture, health, weather station, smart homes and even smart city. This research intends to discuss the effective of using an IoT based water filling system instead of a regular water filling system at domestic level, in order to eliminate all the problems caused by the manual system as well as by providing additional features.

2. Methodology

The components needed for the mentioned IoT based water filling system are Arduino Uno Microcontroller, Ethernet shield(W5100), ultrasonic sensor (HC SR04), water flow sensor (YF-S201), waterproof temperature sensor (DS18B20), water pump, LEDs, buzzer, relay module, NodeMCU ESP8266, resistors (220 and 4.2k ohm) and jumper wires (male-male and male-female).

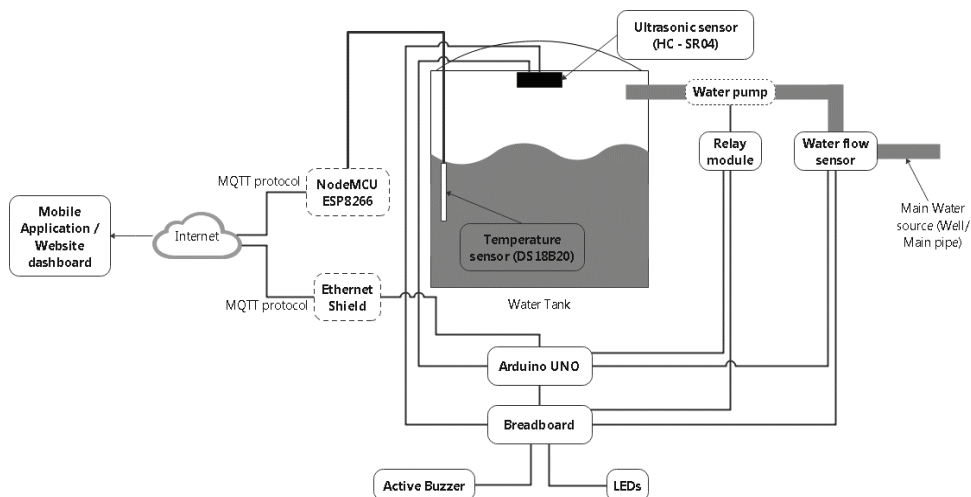


Figure 1/ Smart IoT water filling system design model

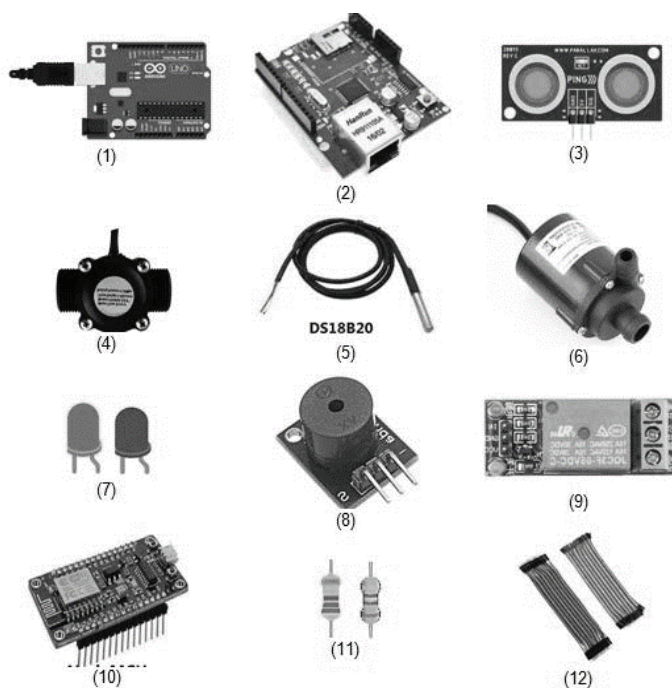


Figure 2/ Arduino Uno Microcontroller¹, Ethernet shield(W5100)², ultrasonic sensor (HC SR04)³, water flow sensor (YF-S201)⁴, waterproof temperature sensor (DS18B20)⁵, water pump⁶, LEDs⁷, buzzer⁸, relay module⁹, NodeMCU ESP8266¹⁰, resistors (220 and 4.2k ohm)¹¹ and jumper wires (male-male and male-female)¹².

The above figure 1 shows the design model of the smart IoT water filling system. When the code is uploaded to the microcontroller, ultrasonic sensor will detect the distance inside the water tank, using which we could analyze the water level inside the tank. If low water level is detected, automatically the water pump is triggered to turn ON, a red LED is turned ON to indicate the user and alert SMS or email is sent to the user. The alert message will include water level and motor status. Meanwhile water flow sensor will be reading the water flow rate inside the pipes, which can be used to analyze and determine the water pressure inside the pipe. Also, the temperature sensor will read the water temperature inside the tank. Once the tank is filled to the required level, motor will automatically turn OFF, the green LED will light to indicate the user and alert SMS or email is sent to the user. Also, the mobile application and web dashboard will have buttons to remotely operate the system. Buzzer will alert the user when the water flow sensor detects high water flow rate, which indicates that water is flowing with high pressure, which could damage the pipes and cause leakages.

3. Experimental

This study employed a quantitative research methodology. 50 people from different career backgrounds participated in a quick primary survey. Email and social media were used to spread the survey questions. In order to gather information about users' present experiences with the traditional water filling system and their opinions of an IoT-based water filling system, a brief survey with 14 questions was created. Survey:- [Link](#)

4. Results and Discussion

According to the survey conducted, it is clearly evident that all the participants are still using a regular water filling system. Majority of the participants obtain water from water board and 22% of participants obtain water from well. The common problem mentioned by the participants is overflowing of water when forgot to turn OFF the motor switch, this leads to water wastage as well as electricity wastage as motor keeps on running. Secondly most common problems faced by using the regular water filling system is difficulty is turn the motor switch ON and OFF. Other problems faced were interruption of work and not being able to know the water level inside the tank in order to use efficiently. With all these problems users still continue to use the regular water filling system and agree that they are aware that it causes water wastage.

1. How do you obtain water for home?

50 responses

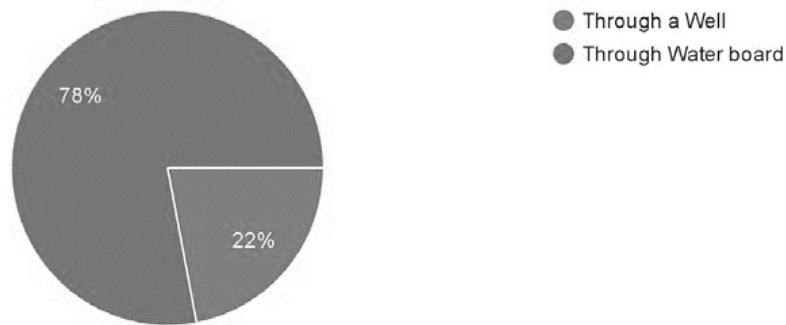


Figure 3/ Summary of survey

The figure 2 shows that many of them obtain water from water board, this result reflects that wells are being over pumped which causes lowering of the water table, thus most of them have started obtaining water from water board. When obtaining water from well, if there is excess pumping, especially when the user forgets to turn OFF the motor on time, it can cause many problems like spreading of contamination or even subsidence. (Well manager, 2017) (Groundwater, 2022)

4. What are the problems you have faced by using the regular water filling system?

50 responses

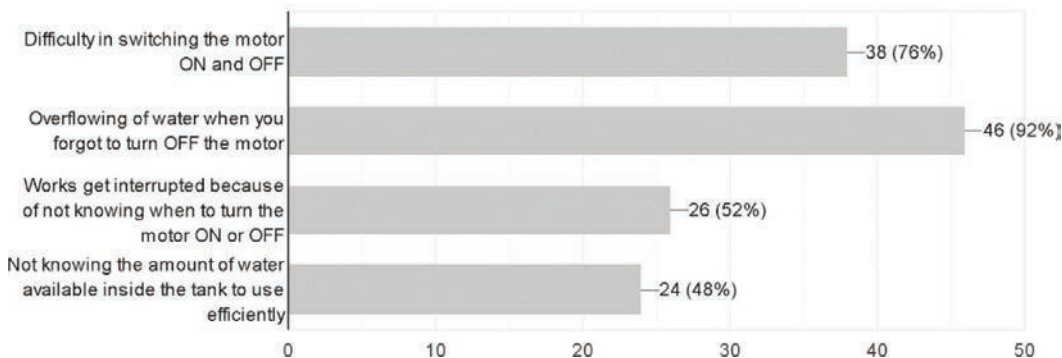


Figure 4/ Summary of survey

3. Are you aware that there is water and electricity wastage when using regular water filling system?

50 responses

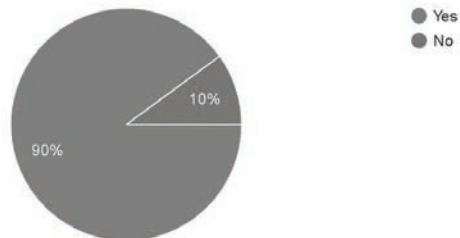


Figure 5/ Summary of survey

5. Do you think using regular water filling system contributes to water and electricity wastage?

50 responses

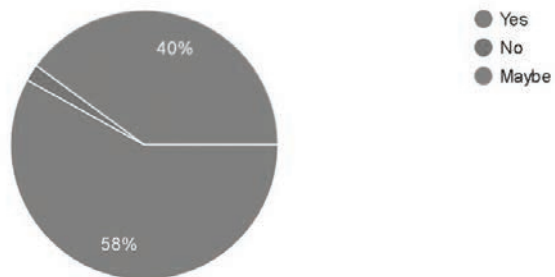


Figure 6/ Summary of survey

The figure 6 below shows that out of all the participants, 52% have an idea about IoT, while 38% have slight idea and 10% have no idea at all. It shows that implementing an IoT system will be easy as the current generation knows about IoT as well as are more advance and adapt quickly to new changes.

6. Are you aware about Internet of Things (IoT) technology?

50 responses

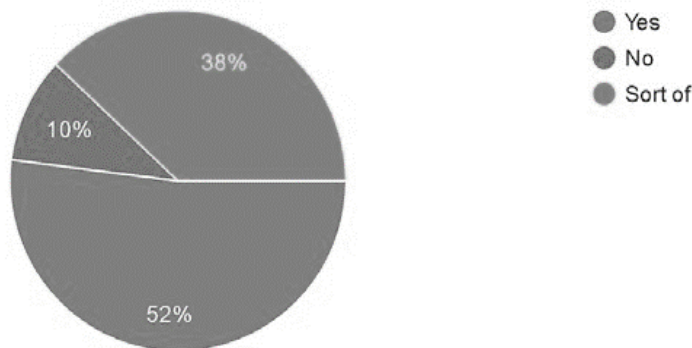


Figure 7/ Summary of survey

Since majority of the participants are aware of this technology, the IoT system will be cherished as it has many benefits as well as eliminates the problems in the regular system.

7. A smart IoT water filling system automates the functionality of the motor by auto detecting the water level inside the tank. Also allows the user to operate the system simply using their mobile. Do you think using a IoT based water filling system can help to overcome the problems faced with regular water filling system?

50 responses



Figure 8/ Summary of survey

The above figure 7 shows that 100% of participants agree that an smart IoT water filling system can help overcome problems in the manual system.

8. Do you think shifting to a new technology will be problematic or helpful?

50 responses

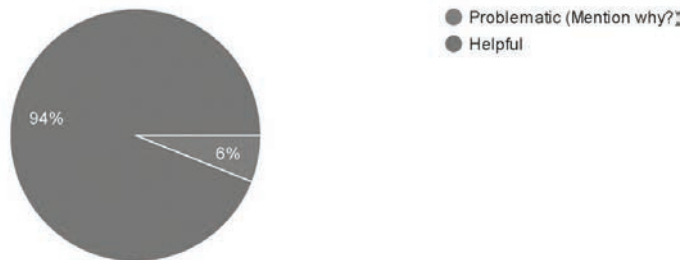


Figure 9/ Summary of survey

The figure shows that 94% of participants agree that shifting to a new technology can be helpful, as mentioned before, most of the participants are aware of IoT technology. Shifting can be helpful for each and every individual, country's technological sector and economy as well as it will promote greener future.

On the contrary 6% of the participants consider it to be problematic if shifting from the current water filling system to smart IoT based water filling system as Sri Lanka is so behind in technology and implementing an IoT system can be costly and difficult to adapt to it.

As majority agrees it can be helpful, implementing at a domestic level and be a great kick-start for the technology sector of Sri Lanka.

9. Some of the benefits of the IoT based water filling system are,

1. Water fills into the tank automatically by detecting the water level inside the tank (High and low levels).

2. Detects the water temperature inside the tank

3. Alerts user when water pressure inside the tank is high.

4. Alerts user when motor is turned ON (Low water level) and OFF (High water level).

5. Able to manipulate the system using a mobile application.

Considering these advantages do you think this IoT based water filling system can be helpful to efficiently reduce water and electricity wastage?

50 responses

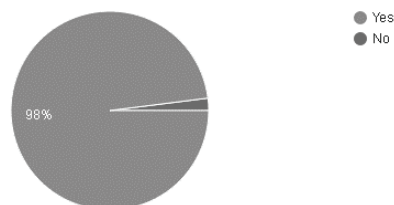


Figure 10/ Summary of survey

Considering the advantages of the smart IoT water filling system 98% of the participants agree that it will reduce water and electricity wastage.

12. Implementation cost of the system can be high but on the long run lots of money can be saved. Not only money, this system also saves water and electricity. Do you think this system will be helpful for Sri Lankan people?

50 responses

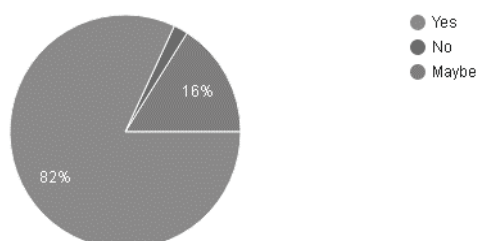


Figure 11/ Summary of survey

According to the figure 10, 82% of the participant agree that IoT based will be helpful for Sri Lankans. As a developing country, implementing a system at domestic level with the purpose of saving water and electricity will be helpful for the economy of the country.

If every individual can contribute to save water and electricity by implementing the smart IoT water filling system at domestic level, production of electricity using fuel can be reduced as well as excess water can be used for production of hydro electricity. This will contribute for greener future and be helpful for the economy. (Aljazeera, 2022)

In South Eastern countries like India and Bangladesh, automatic water filling system has been developed only as a prototype, but has not been implemented at domestic homes. (Prima et al., 2017) A similar system has been implemented in New Zealand and Australia as smart water tank monitoring system. This system helps to monitor water level inside the tank, monitor water usage history, and adjust level of water to be filled inside the tank using a LED display or the mobile application. (smartwateronline, n.d.)

5. Recommendations

The proposed smart water filling mainly focuses on reducing water and electricity wastage. In future the system will be upgraded where the user can check the quality of the water. This will be helpful if the user is obtaining water from well. In the current system a water flow sensor is used to know the water flow rate, which helps to determine the water pressure inside the pipe. Depending on the water

flow rate, if it reaches higher rate, a buzzer is triggered, in future a valve will be used between the water source and water flow sensor, thus when the buzzer alarms, the valve will automatically close the pipe and prevent leakages and blasting of pipes.

6. Conclusions

The survey has showed how positive and effective a smart IoT water filling system would be for Sri Lankans and that would be greatly cherished if implemented instead of the manual water filling system. Using the smart IoT water filling system will definitely save water as well as helps users to reduce the cost electricity bills. Considering the economic crisis in Sri Lanka using the smart IoT system can help for the country's economy greatly, because excess usage of electricity is reduced thus production of electricity can be reduced as well.

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MANAGING EMPLOYEE THROUGH REMOTE USING DIGITAL TRANSFORMATION STRATEGY

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Abstract

In the present era, complete workforce analytics and employee productivity coaching prospects have shown more potential thanks to digital transformation strategy for gauging system. This article describes a study that aimed to discover several types of employee "visibility," as well as how employee visibility technology could aid in assessing employee productivity and performance. Employee productivity is increased because to the use of such technology, which offers in-depth insight into the difficulties that remote workers encounter when dealing with business processes. Today, a variety of employee measuring instruments are accessible, each with a unique set of characteristics. Time tracking is one of the most essential components of employee monitoring software, despite being a more challenging application. This kind of monitoring software is growing in popularity as a result of current technology improvement, and for good cause! Businesses benefit from increased productivity, better time and project management, and overall improved performance. The general design of the system for measuring digital transformation is presented in this study. This digital transformation statistic can be used, among other things, to evaluate personnel by monitoring their progress and receiving alerts about their online behavior. They support personnel oversight. The system will alert the manager of the company if an employee doesn't show up for work or doesn't do other tasks.

Many people are working from home as a result of the coronavirus outbreak. Fortunately, firms can achieve this thanks to a wide range of contemporary software alternatives. For a number of good and practical reasons, businesses utilize software to track their remote workers. Gauging the Digital Transformation gives fresh perspectives on the state of the digital transition by comparing current digital

policy concerns with indicators from a variety of fields, including trade, economic and social outcomes, education, and innovation, as provided in *Going Digital Shaping Policies, Improving Lives*. In doing so, it identifies holes in the existing measurement framework, evaluates the progress made in bridging these gaps, and establishes a roadmap for future gauging. The objective is to increase the body of evidence in order to provide the groundwork for stronger policies to promote growth and well-being in the globalized world. The influence of digitization has caused enormous transformations in all industries worldwide in recent years.

I designed this system as a web-based application that can only be used by the CEO and admin of the business. I intend to use my investigation to verify the data supplied. If you don't have defined policies on how the system monitors employees and gathers data, your staff can be against the system. Implementing guidelines for responsible usage of the internet, client emails, and desktop and web applications is also beneficial. Keep an eye on staff during certain times and Don't use monitoring systems. along with altering consumer behavior, these shifts have compelled businesses to speed up digitization and actively begin the digital transformation process. In order to construct the dimensions and criteria to assess enterprise digital transformation plan for measuring, a literature analysis and focus group interview were employed in this study. The remortgage working industry was utilized as an example to measure the total digital transformation performance by data envelopment analysis to highlight the criteria for digital transformation provided in this study. The findings showed that an executor's low technical efficiency wasn't just a product of the industry's declining returns to scale, but also of a drop in pure technical efficiency. executors should effectively manage their internal operations, pay attention to their resource and scale allocations, and change their output in accordance with market conditions in order to avoid declines in their pure technical efficiency. Digital tools are used by most organizations, but frequently not to their whole potential. Over the next ten years, a number of significant changes that are frequently referred to as the next production revolution are anticipated. The creation of digital infrastructure and applications like high-speed internet, Big Data, cloud computing, 3D printing, and the Internet of Things are some of the technological forces behind this revolution. These technologies are becoming more and more

accessible to smaller businesses. However, in order for the dissemination of technology to result in increased productivity, businesses must incorporate the technology into their operational procedures and make supplementary investments in human capital and business strategies. Recent academic and professional interest in investigating digital transformation gauging and enterprise systems has largely concentrated on the technology or the external forces affecting the organizations, neglecting internal aspects, particularly workers.

In my project I collect data in this way there are questionnaires in questionnaires by far one of the most popular ways of primary data collecting, owing to its ease of use, customization, and power, as well as the fact that it provides for secure data collection from a large user base with minimal effort. Because the data is organized by default, this type of data collection greatly enhances data accuracy. If properly constructed, such a data collecting method can be used to obtain answers to closed-ended questions quickly and provide a lot of information and leads. interview Another method of data collecting that is utilized to gain important information is the interview. It can be accomplished in person, through a phone conversation or web chat. In interviews, open-ended inquiries are increasingly common

This research explores employee digital literacy as an organizational opportunity to capture contextual aspects that affect where and how digital technologies are employed. This study covers the digital transformation strategy for gauging, its benefits and drawbacks, its various forms and methods, key tools that support it, and its primary application areas. Our findings and associated contributions can be summed up in three ways On the basis of a thorough and structured analysis, we first construct digital transformation maps that inductively organize and characterize the corpus of available knowledge. These theme maps identify technology and actors as the two main pillars of the digital transformation. Within these dimensions, we identify nine key themes that help understand the particulars of digital transformation processes and highlight the most important and distinctive causes and repercussions of this specific type of change. As a result, it is now possible to pinpoint the crucial contextual factors for which research would have the biggest influence on understanding the challenges brought on by the digital transition. Second, we broaden this topic by identifying possible research areas on digital

transformation that integrate all three points of view. We find that the critical middle management perspective on digital transformation, which is influenced by corporate entrepreneurship, has up until now been generally disregarded in studies.

The main advantage of using a digital transformation plan to measure system productivity is that it may help you assess the effectiveness of your team. Knowing how well each employee performs allows managers to decide who can take on additional duties or who is best suited to lead a collaborative project. The important components, key elements, and main parts of the digital transformation strategy for gauging plan will all be explained in this study. Digital transformation is the process of integrating and exploiting digital technologies to improve organizational culture, business processes, and consumer experiences. You may address shifting business requirements, cut expenses, increase efficiency, and resolve challenging issues thanks to this. The extent and pace of digital transformation strategy for gauging have changed clearly as a result of the epidemic. Employers found it difficult to manage their distant workforces. However, after employee monitoring software became available, businesses were able to manage and keep an eye on their remote workers. Employee monitoring is no longer a temporary fix to manage distant workforces since the epidemic is over. Employee monitoring is crucial for firms because many in their sector are implementing hybrid work models. traditional employment procedures are quickly changing. Those that can adapt to change will thrive, while the others will inevitably fall behind. It speeds up the resolution of complex problems, reduces expenses, increases productivity, and adapts to changing business requirements.

Key words: Chief Executive Officer, Administer, Additive manufacturing, compound, General plan

A study on the current cryptography solutions used in the Sri Lankan Insurance Companies in protecting personal data and provide recommendations on the cipher suits to be used along with current weaknesses

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Abstract

Insurance companies enable business leaders to accept risks and open new avenues of business and secure the existing lines of business by compensating risks with tolerance levels set by insuring the businesses. At the same time, insurance companies provide insurance coverage to individuals enabling them security against hazards. This way, insurance companies gain a load of information on individuals as well as organizations automatically. This large amount of information gathered in a single place or an entity is a very lucrative target to the eyes of the attackers or the malicious intended parties since the information is treated as the new world's oil. By placing adequate cryptographic controls on data at rest and data in motion, Insurance companies will be able to assure the Confidentiality and Integrity of this information.

This paper shows what cryptography mechanism used among srilankan insurance company and provided recommendation the company to be adapted in the future. also discussed the current setup of information protection using the external available controls as well as internal penetration. However, this paper is also written n the considerations of information secrecy and privacy requirements as well as the ethical backgrounds of institutions that come under the scope of application.

Key Words

Encryption, Cipher Suits, ISO27001: ISMS, NIST800 53, AES, DES

1. Introduction

Today, information is treated as the oil of the 21st century. In the same way, as Oil does have control over the world with its availability, in this digital era, the owners of large collections of information can control the world, influencing decisions and actions made related to that information. As the world is slowly moving towards digitalization where most countries, enterprises, and governments are adopting digital methods of collecting their customer information, and citizens' details over digital means, the demand for properly securing that information increases.

Insurance companies, in particular, do collect a large amount of data due to the nature of their business and that includes sensitive personal data such as medical records and health conditions of individuals with their identifiable details as well as

secrets of companies and their endeavors as the insurance industry enables individuals to take risks. The size and value of this data set is a good motivation for a hacker or a group of malicious intended individuals or any other parties interested to launch an attack against an ill-protected data infrastructure.

In Sri Lanka, at the time of this research, there are no legal frameworks supporting information security implementations within organizations or any regulatory requirements from the insurance regulatory body of Sri Lanka that requires to protect of sensitive information or personal information which are collected by the insurance companies operating within Sri Lanka. The horizon is having a glimpse of policy changes as Sri Lanka is expected to have a cyber security bill soon to be published. Therefore, it would be the right time to conduct these sorts of studies to identify the gaps between international standards and local practices with proper recommendations being provided.

2. Methodology

The paper is mainly focusing on the analysis of the cryptographic controls that are used to protect the information within insurance companies across Sri Lanka. The data set is aimed to be gathered using two main methods via a survey from different insurance company by providing cryptographic security related question. In the second method through each insurance company's public website, Digital certificate has been used to analyses the cryptography in placed

3. Experiment and Results

Encryption is not a new technique. It did evolve with time and had been challenged by attackers attempting to reveal the secret information protected with cryptography. As per the study done by Dr. Prerna Mahajan and Abhishek Sachdeva from IITM, India (Mahajan and Sachdeva 2013), it has been identified that the AES algorithm is taking the least amount of time, in terms of time to complete the encryption cycle and RSA is the most time consuming cryptographic method. Also, they have identified the AES algorithm is much better than the DES and RSA encryption methods. This result can be agreed with the study of the current cryptographic solution analysis since we have dissected how the algorithm works and how the

computational power requirements would increase as the mathematical conditions are in use within cryptographic ciphers in securing the data it would protect. With this statement, the following analysis can be presented to bring the results into visual form.

Factors	Cesar Cipher	AES	DES	RSA	Diffie-Hellman
Development	100BC	2000	1977	1978	1976
Primary use	Encrypt messages	Encrypt data	Encrypt data	Encrypt transmission	Encrypt transmission
Method	Monoalphabetic	Symmetric	Symmetric	Asymmetric	Asymmetric
Possible attacks	Cryptanalysis, frequency analysis	Brute force attacks	Brute force cryptanalyses	Brute force Oracle Attack	Man in the Middle Attack
Attacks reported?	Yes (No public records available but evolution suggests there had been attacks)	No	Yes	No	Yes
Speed of operation	Very Fast	Fast	Moderate	Slow	Fast
Rounds of encryption	1	10/12/14	16	1	1
Security	Not enough	Secure	Not enough	Moderately Secure	Least secure

Table 1: Data Analysis of the ciphers discussed

From the insurance companies in Sri Lanka, the following external data was collected on cryptographic usage by assessing their main websites.

Table 2: Data analysis of the external interface

	Not Encrypted	ECC	RSA
Count of Insurance Companies	6	3	13

From the above table, it can be seen that of the 22 insurance companies operating in Sri Lanka, **16** companies are using any form of encryption to secure their websites, enabling protection of information exchange between the site and the customers or potential customers who visit their site. Six of the companies have not thought of such an approach yet. Out of the 16 companies who encrypted their data in motion, 3 companies can be identified as users of reverse proxy servers or web application servers to protect the sites against possible DDoS attacks, as they are using ECC-based cryptographic certificates which are from Cloudflare company. these three companies cannot be identified if they are genuinely using cryptographic controls or not since of this configuration.

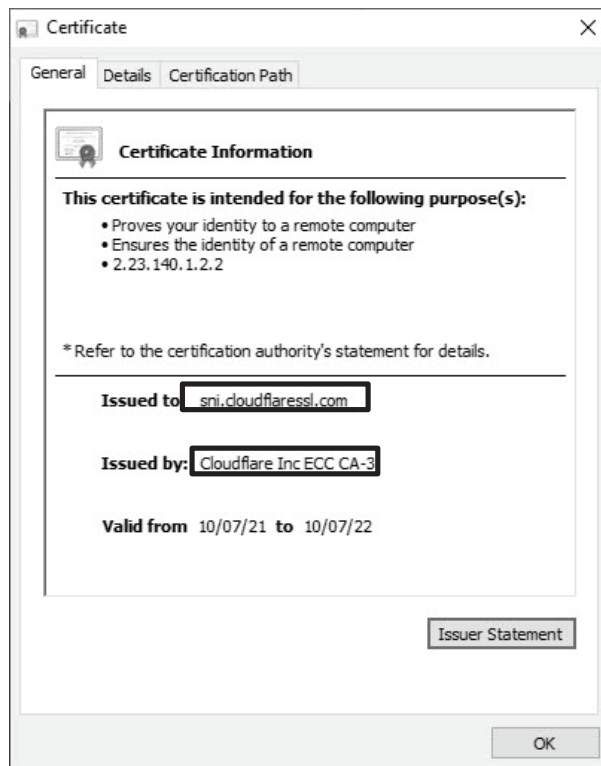


Figure 21: Showcasing the Cloudflare certificate

With this identification, it can be safely assumed that 13 companies are using RSA algorithm-based cryptographic protection for their external websites.

4 Conclusion

The majority of the Insurance companies in Sri Lanka have selected good cryptographic controls despite the fact there is no legal or governance body regulation (Insurance Board of Sri Lanka) requirement on having information security controls or a policy describing how the information security landscapes

should be set for the Insurance organizations within Sri Lanka. Few companies are having less understanding of the importance of information security thus having no protections enabled for their environments so far. This could be due to the reason of the absence of a legal system in Sri Lanka or could well be a reason management's understanding of the new trends are not adequate.

Under such conditions, it would be highly unlikely that a company in Sri Lanka would be required to pay an extensive sum of money as a penalty or a possible other cease of benefits for not having proper governance.

5 Recommendations

It is highly recommended that all insurance companies adopt the following controls to protect the data that is stored within the companies (data in rest)

1. Encrypt the data with the AES algorithm, recommended using AES 192 for short-term encryption requirements. Short-term can be defined as data that is required to be secured for a period of up to five years from the day it is classified as confidential.
2. Encrypt data that require long-term protection, where data is required to hold for over five years, up to twenty years, with AES 256 encryption. These data could be the data required for litigation processes, business secrets having validity for a longer period, etc.
3. Businesses are also advised to be vigilant on the advancements of information security, especially in the field of cryptography since the ciphers recommended today would become invalidated if in case a successful breach is reported or any proof of concept is publicly revealed.

The insurance companies of Sri Lanka are recommended to encrypt the following data in motion controls

1. External web interfaces, unless otherwise, they are containing static information that would not require a secure tunnel between parties to exchange information.
2. Internal web interfaces, unless they are static contents within.

Recommended encryption methods for the external interface would be RSA-based encryption since RSA tokens require the private key to be held in one place, where it can be within the organization. This enables anyone from the internet to encrypt their messages sent to the organization to be encrypted and the receiver or the organization to have the power of decrypting the information. Information exchanges that happen constantly between parties are advised to shift to VPN tunnels that are even further secured.

Organizations are strongly advised to employ a good security method for protecting the encryption keys with a good key management program consisting of regularity in changing the keys within a given timeframe and disposing of older keys securely. The keys are also required to be changed when an employee who is authorized to

handle the security keys resigns or is assigned to another work scope within the organization to ensure further security. The key controls recommended being conducted through specially designed software components.

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Employee Monitoring and Productivity Tools

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1. Introduction

Employee monitoring systems have proven more promise for complete workforce analytics and employee productivity coaching prospects in the modern world. This paper outlines a study that intended to identify many types of employee 'visibility,' as well as how employee visibility technologies might help monitor staff productivity and performance. Such technology provides in-depth information into the problems that remote workers have while interacting with company systems. Employee monitoring software helps to boost employee productivity. There are numerous employee monitoring tools available today, each with its own set of features. Although it is a more difficult application, time tracking is one of the most fundamental parts of employee monitoring software. With the advancement of current technology, this type of monitoring software is becoming more popular, and for good reason! It helps businesses increase productivity, manage time and projects more effectively, and improve overall performance.

2. Methodology

This research is conducted through the secondary research method. There are many existing monitoring tools for employee monitoring. Those employee monitoring tools are analyzed and found the weaknesses of those monitoring tools and suggest some techniques for monitoring. According to research techniques, applied the two testing strategies for the Employee Monitoring System which are qualitative and quantitative research method. Data collected via a qualitative analytical approach, which included the face to face conversation, group discussion, literature review and interview however data obtained using the quantitative analysis approach, which is involved an online survey and also Mixed methods combine the above two research methods, integrating both qualitative and quantitative approaches which involved observation. Primary data is any original information that you collect for the purposes of answering research question. Data collected through primary data by face to face conversation, group discussion, observation, interview, surveys and questionnaire. Project implemented through the agile model to create the project Employee monitoring system. This concept eliminates the flaw in the waterfall model. Once the work begins, teams cycle through a process of planning, executing, and evaluating. Some steps are doing one after the other and some steps are done parallel, that means did some steps while doing another task. In software testing methodology, Employee Monitoring System tested through Integration testing, System testing, and Acceptance testing are the levels applicable to the black box testing. Integration testing is a methodical testing process used to build software

architectures in which the system is tested after each item has been integrated and also tested via Unit testing is the level of white box testing. Unit Testing is done to check whether the individual modules of the source code are working properly. A set of requirements must be met by the system, therefore testing is done to validate. Test Artifacts are the deliverables that are given to the stakeholders of a software project. Employee Monitoring system which follows agile methodology undergoes the different phases before delivering to the customer. Artifact like Product backlog, Sprint backlog and Product increment created. There is also other artifact maintained like burned down chart. Some of the deliverables are provided before the testing phase commences and some are provided during the testing phase and the rest after the testing phase is completed.

3. Results and Discussion

The aim of this project is Automatically monitor and how to support the visibility of the effectiveness of remote workers' tools and methodologies and also benefits and challenges that remote workers face when interacting with enterprise system. This research presents the overall design of the Employee Monitoring Tool system. This employee monitoring tool system can be used to monitor employees by detecting internet activity tracking which means employers can gain insight into employee engagement by tracking how much time an employee spends on unproductive websites, email monitoring to monitor the quality of employee communications, employee progress to monitor employee performance and attendance, and receiving employee activity alerts, among other things. These aid in personnel monitoring. If an employee fails to work or complete other tasks, the system will notify the organization's manager. Above present the results that address this specific hypothesis question first. The hypothesis question is "Employee Monitoring Current Satisfaction?". In this case, perhaps a line graph illustrating data from a survey. Response percentage can be included in this graph. Standard deviations, probabilities, and correlation matrices are displayed on a line graph. Focus on experimental results and other findings that are especially relevant to questions and create objectives and include them to support the ideas and hypotheses. As the representation of hypothesis question data output, the Results section presents the core information. According a survey 70% of working employers doesn't feel it is completely all right. So working on this application and want to deploy it in large scale, to decrease this rate and bring a great difference in society and make employee and employers feel it is ok for monitor the work performance, from houses.

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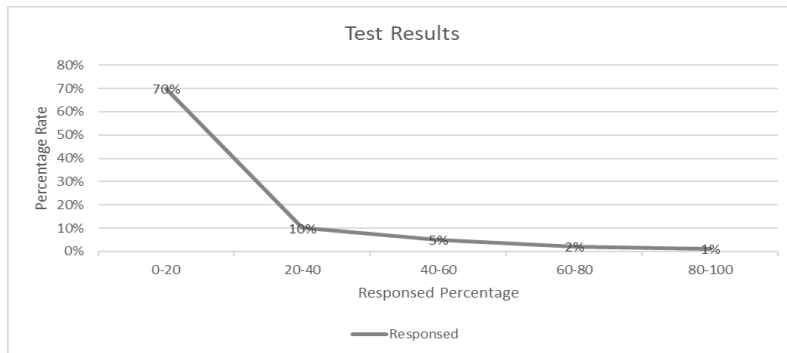


Figure 1 Hypothesis Question

technique of observation used to identify the current systems and their methods of employee monitoring. These methods of employee monitoring were studied, and their shortcomings in the monitoring process were discovered. Successful and employee-friendly methods for workers who work remotely were discovered. Timekeeping and productivity monitoring are essential for any company's success. won't be able to manage your firm effectively if you don't understand why employees can't finish their work or submit their projects. Making sure remote workers put in the same amount of effort as they would if they were at an office where their managers could observe them is one of the most popular justifications for keeping an eye on them. Employers have a stake in seeing that workers maintain their level of productivity and accomplish their goals. However, using these technologies it had some drawbacks that you should be aware of before doing so. Many federal and state regulations controlling when employees have the right to privacy and when they must be informed that they are being watched may apply to your business if you monitor your employee. Whether or not you had company insurance, you should be cautious about this. Always seek legal advice before starting any kind of monitoring. Businesses are increasingly embracing digital technologies to monitor employee work, performance, and ongoing projects.

4. Conclusion and Recommendation

Finally, come to the conclusion that the employee monitoring is a trending way to remote working. Remote working can enable the work much easier and reduces the organization workplace costs and another expenditure. Employee monitoring has good and bad effects on employees but employees need to get practiced for monitoring system. Applications are designed for employee monitoring. There are some other methods also for employee monitoring system. Application monitoring is an easy and simple way of monitoring because the all aspects of employee monitoring included in a one application. Application will automatically upload and update the information about the particular employee. The external factors and legal factors that affect the employee monitoring and employee monitoring tools are discussed in this project. The application of this employee monitoring will be helpful to monitor employee activity while work from home. There are many advantages in

employee monitoring and employee monitoring tools. Employee monitoring enables the relationship between the employers and employees by monitoring them, effective work of employees, easy to find out the abilities of employees, easy to detect their problems in tasks and sort out them easily, easy to learn about employee behavior, and easy to recognize the strengths of the employee through monitoring them are some advantages of employee monitoring. The technology growth is a non-stoppable in this world. Instead of traditional apps with large and heavy packages, there are bite-sized apps. These apps use things like micro services that communicate via APIs. Employee monitoring software will continue to be useful in the future, but with some technological upgrades. When someone schedules a vacation, the system will recommend areas to visit based on their budget. If you file for sick leave, the system will recommend some of the best hospitals in your area. In other words, if you take a leave every month for a specific amount of time every day, the system will start questioning you about it the following month. Do you want to apply for a leave of absence. The workplace of the future will be an interesting one. The workplace of the future will use intelligent employee monitoring, thanks to artificial intelligence and machine learning. Smartphones and microcontrollers are used to control the majority of employee monitoring systems. Using wireless communication techniques, a smartphone application is utilized to control and monitor staff functions. An Employee Performance Monitoring system offers a multitude of help to the organizations, including performance management, productivity, and creates a better workplace environment. However, there are several factors to be taken into consideration while implementing Employee Performance Monitoring system in the organization. Concerning the benefits, it provides big-data which help to evaluate and provide better insights about the employee performance which helps the employees to work enthusiastically. However, the success of an Employee Performance Monitoring system is highly contextual and largely depends upon the perception of individuals subjected to the Employee Monitoring system.

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Effectiveness of an IoT-powered Website, to Monitor Stock Controls at Fuel Stations for the Transparency of Information, as a Remedy to Eliminate Long Queues, in Sri Lanka

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Abstract

The drop of the economy in Sri Lanka by the later part of the year 2021, led to a rapid escalation in the dollar rate resulting in a shortage of dollars within the country. Sri Lanka being a country that relies on foreign exchange to meet its expenditure, had to encounter a shortage of foreign currency to import essential requirements. Consequently, the fuel crisis was created bringing the country to a standstill situation having a huge blow to the population and industries, both directly and indirectly, resulting in long queues of people in front of fuel stations, as fuel is a major source of energy used in Sri Lanka. There were widespread abnormalities in that political and financial influence, added with street thugs interfering with the fuel distribution. In some instances, there were reports of people dying in the fuel queues, and quarrels erupted among the consumers resulting in additional police coverage required within the limit of fuel stations. Some corrupt individual connivance of fuel station staff engaged in black market business to sell fuel at exorbitant prices depriving genuine customers. It has prompted the authorities to find a solution using new technology.

Accordingly, this research was conducted to gather the opinions of all parties concerned, using a survey regarding the use of the website; which contains instantly updated data on the fuel volume that is currently available in each fuel station. The project was supported by an IoT device using a water flow sensor, fixed to the fuel dispenser which records the quantity of fuel dispensed, where the data is updated to a cloud database that performs the calculation of stock in-hand and is displayed to the consumers through the website together with a count of the vehicles that can be refueled. This resulted in the transparency of the information to the consumers regarding the stock control and to refrain the owners from hiding their stocks to indulge in the black market business. As per the survey results conducted under the quantitative methodology, it was concluded that the majority of the consumers among the 50 individuals living across the central province of Sri Lanka are pleased with the website because it will eliminate the waste of time and embarrassment of standing in queues for a long period of time indefinitely, until the arrival of fuel and the turn of the vehicle to be refueled, yet some

unscrupulous fuel station owners of some selected stations in Kandy and intermediaries appeared displeased as this will hinder their illegal earnings and underhand businesses in fuel distribution. As the available data of fuel is instantly updated together with the number of vehicles that can be refueled, the public gains the opportunity to decide whether to remain in line or go to another fuel station. This will reduce unnecessary gatherings at the fuel stations and also stop the fuel station owners and employees from indulging in malpractices and enhance fair fuel distribution to customers. This database is also of use to the main fuel distribution points to decide the volume of fuel to be distributed to fuel stations by calculating their stocks available.

Keywords: Fuel queues, IoT-powered website, Manage stock controls, Eliminating long queues, Transparency of fuel transactions.

01. Introduction

Sri Lanka; a country that depends on foreign exchange to cover the budget deficit, as a result of poor planning, ran into high inflation and bankruptcy. Due to non-availability of sufficient foreign exchange, dollar exchange rates escalated unexpectedly which caused problems in importing essential items. The economic meltdown further aggravated the hardships encountered by the public in their daily life.

Fuel; the main source of energy is unavailable locally has to be imported for which foreign exchange is required. As Sri Lanka could not pay to import the required stocks of fuel, some industries stalled resulting in a drop of export volume, transport encountered difficulties in day to day movements of the public. The vehicle owners had to waste time in fuel queues to meet their fuel requirements. Clashes erupted with genuine customers and those intruding the fuel queues. Further the medical staff and those in essential services were unable to purchase their requirements which hindered the smooth running of essential services. Additional police personnel had to be deployed at fuel stations to maintain law and order, because people influential with fuel station workers obtained fuel and sold outside at exorbitant prices to gain illegal earnings. There were instances where people fought each other while some could not bear the strain, died in the fuel queues. At times it went to an extent in selling adulterated fuel to make more money but created problems to the vehicle owners to repair the vehicles. Some customers had to stay more than 2 days in the fuel queue and when they reach the fuel dispenser it was announced that the fuel is over. The vehicles lined up for fuel added to the traffic congestion in the cities and the behavior of some people in the queue caused disturbance to the people living in the area.

Fuel distributions turned up to be extremely unsatisfactory. There were widespread abnormalities, in that political, financial, favoritism and official influence with street thugurism controlled fuel distribution while some fuel station owners too ended up

storing fuel, to sell at black market prices as well as to make profit from stock once the price of fuel is hiked by the authority (a common issue faced prior to fuel crisis).

Under the above circumstances it became important to find a solution to streamline the fuel distribution for the benefit of the genuine customers and to ease the congestion at the fuel stations. Under this research an IoT artifact is designed, which could record the quantity of fuel dispensed and update to a cloud database that will automatically calculate the stock available at the fuel station and display the data for the public to view through the website.

02. Methodology

The stock balance being the core of the research, highlights the requirement of producing an artifact that is capable of handling the data relevant to the fuel distribution. Considering the need of recording the fuel volume being dispensed, the device was designed to be built using a water flow sensor. This sensor is then connected to the Arduino which is programmed using the Arduino software to perform its function of measuring the volume. The dispensing of fuel is supported by a push button connected to the Arduino, where the operator of the dispenser presses the button which permits the fuel to flow through the water flow sensor. The data related to the volume is immediately updated to the cloud via the Ethernet shield using the MQTT protocol to maintain communication between the device and the cloud.

The data in the cloud is then stored in the cloud service; Adefruit.io which enables access of the data over the internet. This data is then subjected to analysis using the Power BI tool and updated to cloud every 10 seconds. The updated data undergoes some calculations that produces the currently available volume of fuel at the station, together with a count of the vehicles privileged of being refueled and is displayed to the public on the website. *Figure 01* depicts a block diagram of the fuel control system.

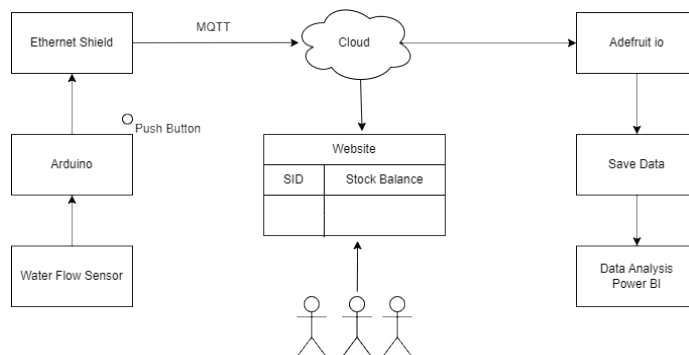


Figure 01: Block diagram of the fuel control system

Implementing this system to several fuel stations across a geographical area would benefit the general public to refer to the website in order to check the fuel stock available in each station, closer to their location. This would eliminate the long

queues and make the operation much more convenient.

To fulfill the objective of the research the primary research method was taken into consideration, together with quantitative data collection through a survey in order to gather the opinions of both the customers and fuel station owners, regarding the successful implementation of the fuel control system.

03. Experiment

With the intention of acquiring the opinions regarding the effectiveness of the implementation of a website to monitor the stock controls at fuel stations, two specific surveys were created. One of the surveys were conducted with 50 people among the general public living across the Central province of Sri Lanka, while the other survey was completed by 7 owners of fuel stations selected around Kandy.

As per the survey set for the public audience 82% of them shared positive opinions regarding the system and mentioned that it would be a very convenient method that would help them get their vehicles refueled rather than wasting time in long queues unnecessarily. The rest of the 18% of them; majority above 50 years of age had issues in handling the system. The survey carried out with the fuel station owners produced contrasting results where 71% of them were not satisfied with the program.

Table 1: Survey results of the fuel consumers

Survey (Fuel Consumers)	
Positive opinions	Negative Opinions
82%	18%

Survey (Fuel Consumers)

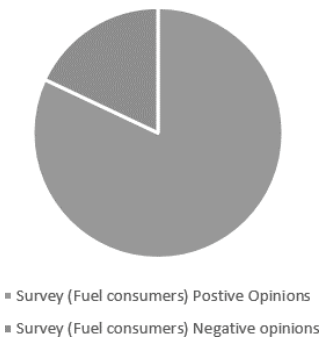


Figure 02: Survey results of fuel consumers Table 2: Survey results of fuel station owners

Survey (Fuel Station Owners)

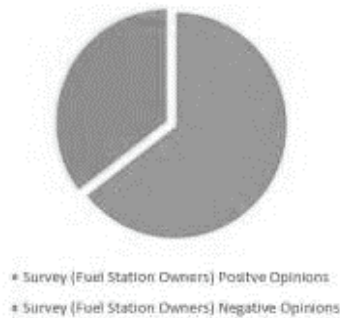


Figure 03: Survey results of fuel station owners

04. Conclusion

According to the results obtained by the surveys it can clearly be concluded that the majority of the public is looking forward for the implementation of such a system which would conveniently facilitate fuel distribution to their satisfaction. The rest who has issues is anticipated to gradually adapt to it once when the system is satisfactorily implemented. The survey showed that the fuel station owners dislike implementing such a procedure. The reason behind this could be that it will hinder the opportunity of making some extra profit due to the transparency of information available to the public.

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Study on Mental Health issue who is working Remotely IT Industry

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Abstract

During the COVID-19 pandemic of 2020, many workers were unexpectedly forced to remote working. This change became a great challenge between career and personal life of many employees. This paper aims to give the reader to understand the mental effectiveness of employee who is working remotely in IT sector. A survey was done in order to gain information about the mental health and the respondents were from the IT companies in the Kandy district. **85.9%** of the employees gave positive feedback about their mental health while engaged in remote working. Most of the employees who worked remotely are likely to work in person as well. The overall view seems to be that working from home has impacted employee's mental health positively.

Keywords:

Remote working, Employees, IT Industry, Mental Health

1. Introduction

Due to COVID pandemic, the physical health, mental health, and productivity of remote employees can all be improved by having a better understanding of work-life balance. Those who working remotely had a negative impact on the mental health, increased stress, and decreased motivation of many employees in general also reported lower work productivity. This paper provides simple explanations about the mental health of the employees in the IT industry while engaged in remote working.

The main aim of this research is to find out whether the employees are really motivated or not while engaged in remote working.

2. Methodology

This paper uses both primary and secondary research methods for finding facts. Studies about the mental health of the employees used in this research was gathered from similar articles published on the internet and also information were gathered by creating a questionnaire via google forms for the employees in the IT industry. The respondents for this study were collected employees who is working in Kandy District.

In order to understand about the employee's mental health, the responses collected by providing set of questionnaires. The questionnaires were provided using google forms. Analysis of the results were done using Microsoft Excel.

3. Results and Discussion

As per the analyzed results the below graph conclude. According to the chart 74.7% of the employees are between the age of 18 – 29 and 22.2% of the employees are between the age of 30 – 39. And only a 3% of them are in between the of age of 40 – 49. Also, 78.8% of the employees are male and 22.2% of them are female. It shows that there are more male employees working in the industry than female employees.

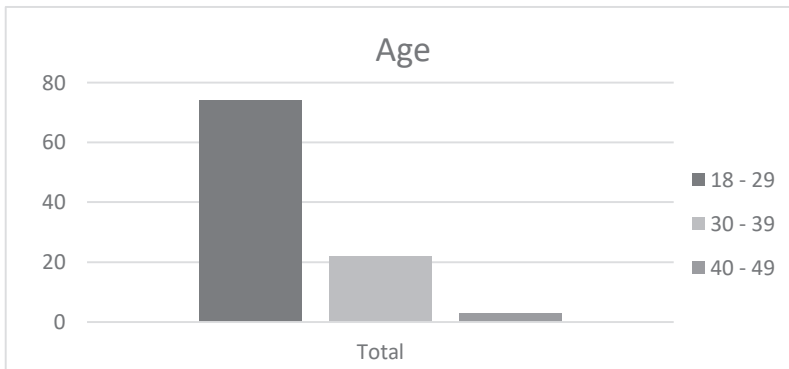


Figure 1 age limit of the employees

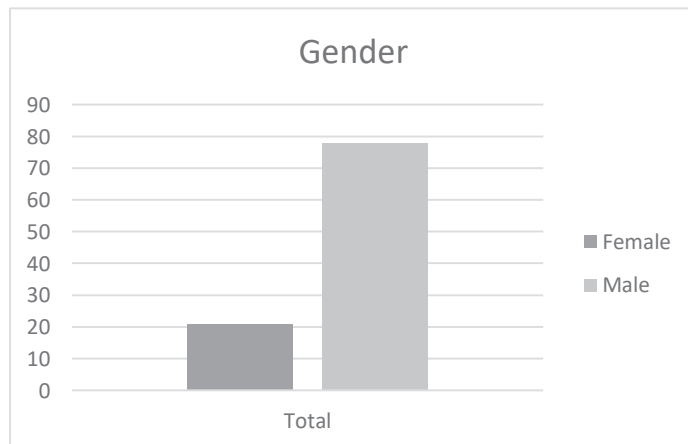


Figure 2 gender of the employees

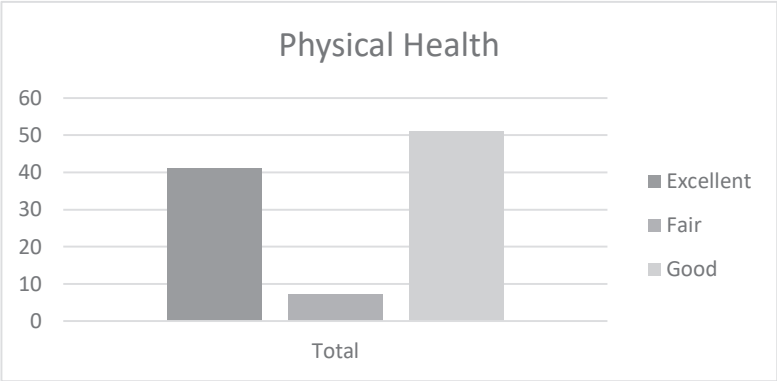


Figure 3 employees physical health

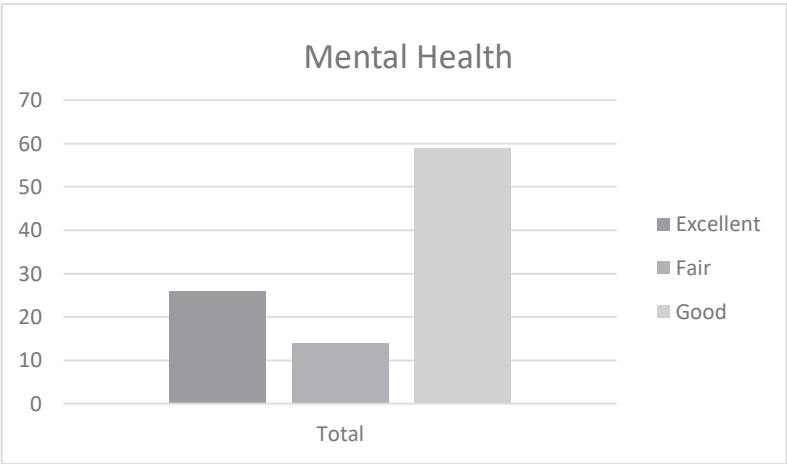
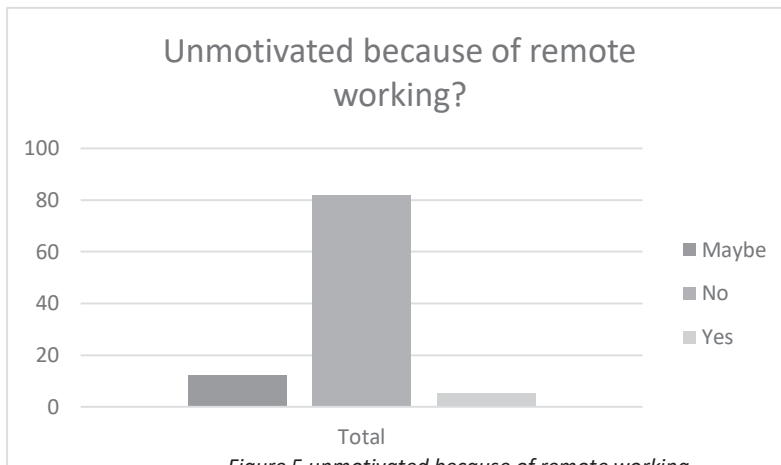


Figure 4 employees mental health

The above given charts are the ratings of the physical and mental health of the employees. 51.5% of the employees have rated 'Good' saying that they are good with their physical health and 41.4% of the employees have rated 'Excellent' saying that their physical health is perfectly alright. Only 7.1% of the employees have rated 'Fair'. So, we can say that most of the employees have a good physical health while engaging in remote working.

In the mental health chart, 59.6% of the employees have rated 'Good' and 26.3% have rated 'Excellent' saying that they have a good mental health while engaging in remote working. And 14.1% have voted 'fair'. So, according to these responses we can say that most of the employees have a good mental health while engaged in remote working.



In the above chart 82.8% the employees say that they are not unmotivated because of remote working. And 12.1% of the employees say that they might or might not be unmotivated because of remote working. Only 5.1% of the employees have said that they are

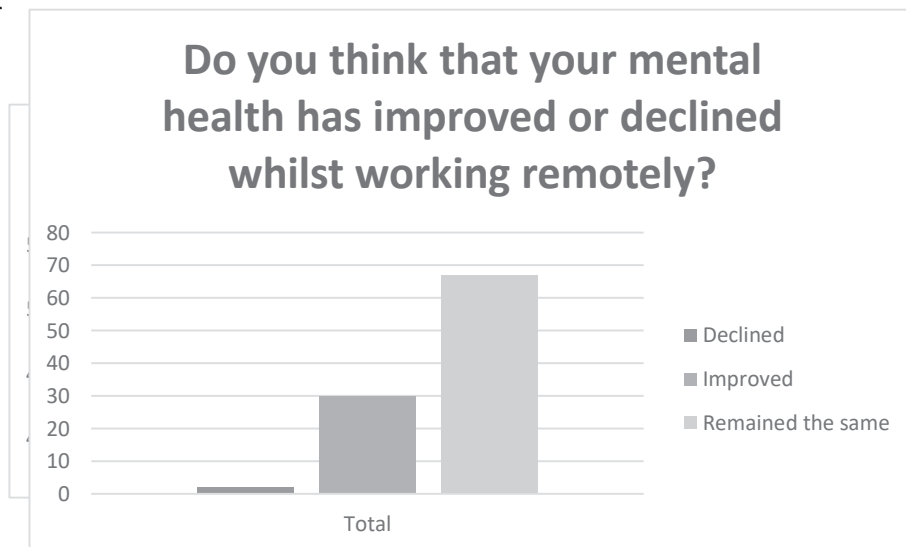


Figure 6 mental health has improved or declined whilst remotely

unmotivated because of remote working. And by looking at the above chart we can say that most of the employees are not unmotivated because of remote working. As you can see the above chart 53.5% of the employees prefer working in person and 46.5% of the employees prefer working remotely. So, we can say that most of the employees are willing to work in person as well as remotely.

In the above chart 67.7% of the employees have said that their mental health hasn't improved or declined because of remote working. And 30.3% of the

employees have said that their mental health has improved because of remote working. And only 2% have said that their mental health has declined because of remote working. So, we can say that mental health has improved and remained the same among the employees whilst working remotely.

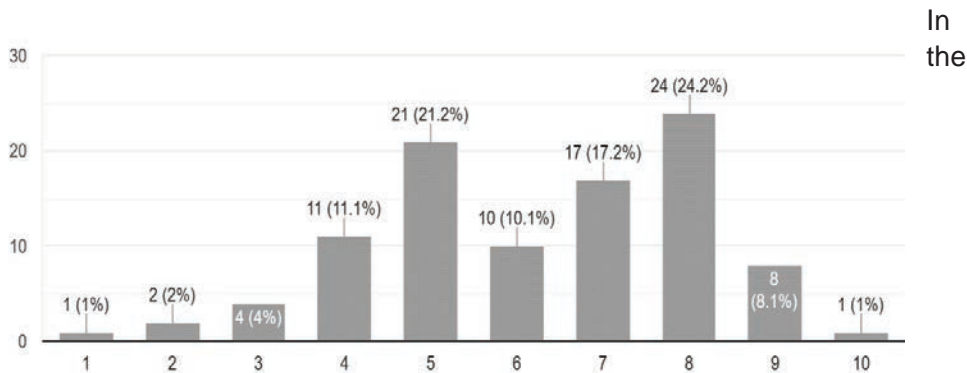


Figure 8 rating the experience as a remote worker

above given graph, you can see the ratings given by the remote working employees in the IT industry.

4. Conclusion

From this study we have found that 90% of the employees have enjoyed and had a positive experience whilst working remotely. And 90% of the employee’s mental health has generally improved as a result of working from home. While 10% of the employees certainly suffer with the loneliness and disconnect that come with working from home. According to a study in UK, 64.6% of the employees prefer working remotely and 17.2% of the employees prefer working in office. And only 16.1% of the employees were willing to work remotely as well as in person (Burton-Hughes, 2020). With these similar studies conducted around the world, we can say that most of the employees had a positive experience whilst working remotely.

The overall view seems to be that working from home has increased employee’s mental health, and some employees kept it about remained the same. And a very few employees did notice a decline in their mental health, but overall, the responses tended to be positive. A better work-life balance is one of the biggest benefits of remote work for employees. In order to maintain a balance between their personal and professional life, they can take control of their own flexible work schedules. A study found that the remote workers could be influenced by lack of organizational support (Domene, 2021). Not only in Sri Lanka, but also employees from various countries prefer working remotely because of their own flexible work schedules.

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ADOPTION OF WORK FROM HOME AND ITS IMPACT ON EMPLOYEE'S MINDSET

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ABSTRACT

Innovations in telecommunications technology increase the possibilities of working from the home. Connections of work-at-home arrangements for the individual's quality of working life. Recent progresses in information technology and changes in social and economic relationships have led individual workers and organizations to explore various types of distributed work arrangements. One of the biggest advantages of the internet is that people can be productive from anywhere they have access to it which includes places that may have once been inaccessible, or even inhospitable: beaches while on vacation, hotels while away on business, or even the car. When we looking at the internet from a purely business standpoint, the internet is great. Employees can be as productive as they want, whenever they want. They can always be connected to the office. The major disadvantage of doing the work from home is that employees become less active and become lazy. Laziness is a very bad part of doing work from home. Employees start to skip things and mix up your schedule. Laziness may also lead to many diseases. In addition to its benefits, working from home can come with several drawbacks including increased isolation, home office costs and risk of overworking. The purpose of this study is to find the importance of internet in work from home and employees mind set about this work from home. This study was done using quantitative methodology for data collection which collected from Fifty different employees by giving questioners. The finding of study shows that internet is most important for the work from home process. Even though there are some disadvantages in the work from home (WFM) it is un-avoidable in the current situation. People think work from home will be the future as they have more advantages than disadvantages which having impact on sustainability.

Keywords: WFH; Office; People Opinion; Future WFH

1. INTRODUCTION

The possibility of working remotely has increased because to communications technology improvements. Analysis of the contrasts between working from home and in an office, as well as conjecture about the possible effects on an individual of moving employment from the employer's premises to the employee's house, are all significant factors that affect the quality of work life. 32% of Sri Lankan professionals

today find it difficult to fulfill family duties due to urgent job demands. The capacity to successfully juggle work and family obligations is crucial since it has a big impact on employees' wellbeing. Given the prevalence of today's high-stress work situations, questions are being raised regarding how employees may combat the negative consequences of excessive workloads and strike a healthy balance between work and life. These issues have compelled businesses to review their hiring practices and look for alternative working arrangements, like telecommuting. A policy that permits employees to work from home for a portion of the workweek while remaining connected to the office via communication technologies is known as telecommuting, sometimes known as telework or working from home. A growing number of businesses have adopted telecommuting policies in response to the COVID-19 epidemic in the hopes that staff members may better manage their work-home balance and protect their wellbeing.

2. LITERATURE REVIEW

2.1. Daily consequences of working from home

We focus on work interfering with family as an outcome related to the work-home interface, as previous studies have shown that working from home affects work to-home conflict more so than home-to-work conflict (Allen et al., 2015; Delanoeije et al., 2019). On a demanding workday, employees' personal resources are more likely to be drained, leaving them with fewer resources in the family domain (Ten Brummelhuis & Bakker, 2012). Time-based and strain-based work-family conflicts refer to situations in which work consumes time and energy, respectively, that cannot be spent at home (Greenhaus & Beutell, 1985). Interestingly, individuals' work-family conflict experiences are likely to vary daily as a result of day-to-day fluctuations in job Demands (Ilies, Schwind, Wagner, et al., 2007; Pluut et al., 2018). Employees' daily work environment may be an important antecedent

2.2. Cross-day effects of work-family conflict

We further suggest that the resource drain connected to work-family conflict may carry over to the following workday using the resource loss spiral principle of conservation of resources (COR) theory (Hobfoll, 1989; Hobfoll et al., 2018). To deepen our understanding of what transpires when work and family dispute, in particular, we integrate COR theory with the resource (drain) perspective in work-family spillover theory (Edwards & Rothbard, 2000). According to the COR theory, once resources are lost, people become more susceptible to resource loss in the future and may experience a resource loss spiral. Researchers have looked at both the long-term effects of resource loss and the role that resources play over shorter time frames, like days or weeks (Airila et al., 2014; Demeroutiet al., 2015; Donald et al., 2016). We suggest that employees' feelings about their forthcoming workday are influenced by work-family conflict, which is defined as a situation in which resources are exhausted. We focus on how work-family conflict experiences throughout the evening affect work-related well-being the following morning. By

focusing on work engagement, emotional exhaustion, and positive and negative affect towards the organization, we follow a recent line of research that integrates positive and negative perspectives on well-being in the workplace (Van den Tooren & Rutte, 2016) in our analysis of work-related well-being.

2.3. Work Balance and Family Time

Conflict between work and family arises when expectations from the office sap one's resources, such as time and energy, which then affects performance at home (Edwards & Rothbard, 2000; Ten Brummelhuis & Bakker, 2012). Employees who work from home occasionally may feel that performing their job duties is less taxing. In fact, a substantial body of research has demonstrated a negative relationship between telecommuting and work-related role stress, weariness, and other outcomes (Allen et al., 2015; Delanoeije & Verbruggen, 2020; Gajendran & Harrison, 2007). (Sardeshmukh et al., 2012). According to the work-family spillover theory, working from home would mean that there is a lower chance of having a negative spillover from work to family because employees have more resources at their disposal to actively participate in the family role. Working from home should lessen work-family conflict from a resource (drain) standpoint, notwithstanding the possibility that it will obfuscate the lines between work and family (Pluut & Wonders, 2020). In fact, most studies on the connection between telework and work-family conflict demonstrate a negative correlation between the two constructs (for meta-analyses, see Allen et al., 2013, and Gajendran & Harrison, 2007).

3. Methodology

Data Collection was initiated following a preliminary survey carried out of the industry. The survey included a questionnaire survey distributed among officers, Engineers, office admins, managers and lecturers a carried out of the employees who is working in the corporate office. Structure questionnaire were given among them to measure the benefit of workers as per the factors.

4. Results and Discussion

In the present era of Covid 19 pandemic, where remote working is becoming the new normal and physical interactions have gone on a toll. There is a need to understand the impact on the relationships and interpersonal networks within organizations. We all know that conversations & socialization are productive tools. As a collective society, employees are more productive when they engage in conversations and socialize. The current research shows that female employees are finding it difficult to integrate work and personal life. However, virtual workplace is the new normal but virtual communication has its own disadvantages that it makes people more negative, more distracted, less willing to cooperate with others, less likely to share useful information, less trusting, and less willing to listen to new ideas. The role of a team leader is more imperative. The future perspective is that, this pandemic has given us the opportunity to reset the way of working. But as we know

humans want that face to face interactions and so this is not the end of working in a collaborative way in physical workspaces completely. This scenario made us understand that we can be productive in both physical as well as virtual workspace. In the post pandemic world, those managers and leaders who are able to manage the working in both the way, will become better and more adaptable for the future.

5. Conclusions

In this study, we investigated if WFH-related job demands and job resources are related to remote work productivity and work engagement as well as on stress. We found that the empirical results we analyzed and discussed, except for the relationships between distracting working environment and the outcomes of productivity and stress, and the relationships between both autonomy and self-leadership and stress, mostly confirmed our assumptions. We believe that this study contributes to the literature concerning remote work and the well-being of remote workers that, during the COVID-19 pandemic, which is marked with relevant emotional and health implications. Furthermore, the implications of this study are of further importance as they provide information concerning the needs of workers who have had to adapt to enforce full-time WFH due to the pandemic, most of whom have no prior WFH experience. Managers, HR officers, and workers engaged in remote activities should consider family-work conflict, social isolation, and distracting work environments as potential obstacles and job autonomy and self-leadership as potential enablers of WFH engagement. In times of pandemic, such as the COVID-19, where containing the spread of the disease is crucial, WFH is a key opportunity and can give a competitive advantage to sustain and improve performance of organizations.

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Health Care (IoT) Internet of Things Monitoring System. Monitor the Patient's Health Level

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Abstract

This system is the direct monitoring of a patient's physical health, to check patient's body temperature, heartbeat level, and blood glucose level. The data of this device can be tracked directly through the IoT cloud platform. Through this system, it is possible to monitor the patient's health levels and inform to the chief and assistant doctors to perform treatments quickly to the patients. For this research, data were collected through a survey from health sector and public. This research intends to discuss whether this system is good or not for the medical department in Sri Lanka. The data collected through the survey showed that this system would be useful for the health sector in Sri Lanka. People expect that there would not be side effects, because no chemical products are induced into the patients, instead the manual testing devices are replaced with an IoT system. Also, people's opinions are high that Sri Lanka's economy and medical sector will improve. Though the initial setup would be high, eventually it can be beneficial for hospitals as multiple works are done simultaneously. Most importantly using this system saves time and effort for the health officials. Finally, this system is useful to the Sri Lanka Medical department according to the people's results. If this system is used in Sri Lanka Hospitals, the hospital can get the most benefits. and this system will reduce the death rate in hospitals in the future.

Keywords - Health Care IoT Monitoring System, IoT System, Internet of Things, Technology, Printed Circuit Board.

1. Introduction

This system has digital humidity and temperature sensor, Pulse Sensor, and Glucose Sensor. This device's components are assembled in the Printed Circuit Board. Once a patient is admitted to the hospital, the main device with the sensors is attached to the patient's body, then the patient's heart rate, blood sugar level, and body temperature are monitored directly through the IoT cloud platforms by a chief doctor assigned to the smart unit. If the patient's health condition is adverse, the chief doctor will press the proper button in the cloud platform. Then the receiver device will receive the messages from the main device. The receiver devices will be

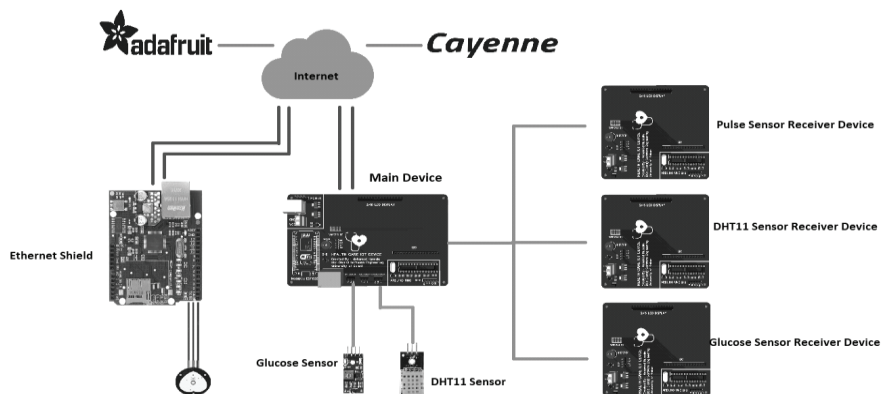
there in the related doctor's hands and after receiving the patient's health condition message, they will make a proper treatment for the patient.

Sudden heart attacks, high blood sugar levels, etc. are the leading causes of death, and nurses who monitor patients in the hospital can potentially cause fatalities if they are unable to fully comprehend the patient's symptoms at all times. Each test must be done separately, therefore, they may spend too much time testing the heart rate, body temperature, and blood glucose level of a patient once admitted to the hospital. Blood sugar testing is difficult to analyze. But with this Health care IoT monitoring system can quickly test and analyze the blood glucose level, heart rate level, and body temperature level. So, the main purpose is to improve the health of the patients with this device.

This system has many objectives such as monitoring the patient's body temperature, heart rate level, blood glucose level, quickly inform patient's body vitals to the doctors, fast treatment, fast analysis of the patient's health level, and the main purpose is to improve the health of the patients with this device. Nowadays, most people are admitted to the hospital for treatment and performing tests on all these patients quickly and efficiently is difficult and definitely tasks time, but this device will quickly monitor the patient's health level and analyze it automatically and inform to the doctors. The aim of this device is to make medical testing and operations in hospitals faster in the future.

2. Methodology

The needed parts and components for this system are Atmega328p pu IC, digital humidity and temperature sensor, pulse sensor, glucose sensor, resistors, Printed Circuit Boards, display, LEDs, I2C, NRF24L01 Transceiver, and buzzer.



The above figure will show how this system is connected and all sensors how connected. components and all sensors are fixed in the printed circuit board. the router should be connected to the nodeMCU and the Arduino.

This system was completely created on the printed circuit board. circuit components like resistors, LEDs, IC, buzzers, and pin headers were soldered in the PCB board. then the Arduino and the NodeMCU code were uploaded into the Atmega328p pu IC and NodeMCU board.

All sensors are connected to the main device and the main device should be fixed to the patient's body the main device will detect the patient's health level and send it to the Internet of things cloud platform. the chief doctor will be watching the monitor so the patient's health level is adverse, the chief doctor will press the proper emergency button. then the information signal will go to the receiver device and the monitoring and buzzer will beep.

3. Experimental

For this IoT system, the survey was conducted among 50 participants from various career backgrounds. The survey form was forwarded through Social media like Email and other platforms. the survey was created with 10 questions that were intended to obtain data about users' current experience with the current healthcare medical testing methods and their opinion about an IoT Health Care IoT Monitoring System.

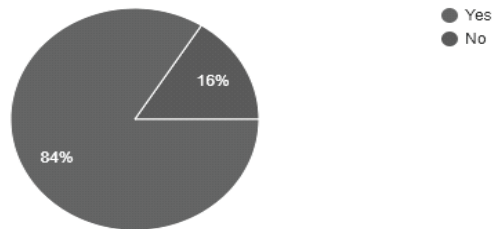
4. Results and Discussion

Based on the data from the survey. it is known that more people will get benefits using this Health Care IoT System and more benefits will be there for the medical field. So this IoT Health Care System will be very useful for medical centers and people by installing it in all medical centers and hospitals in Sri Lanka.

In the hospital, manual testing devices are used for testing blood glucose level, heartbeat level, and body temperature. and these tests are done separately which takes time. Are you aware of this?

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50 responses

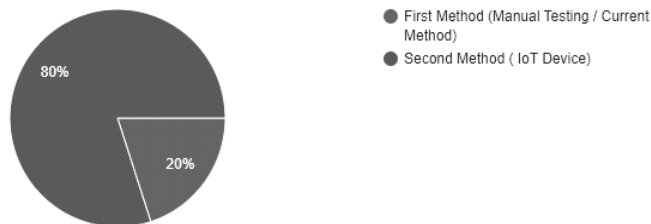


Currently, manual testing devices are used in the hospital and medical centers and it takes much time for the testing and getting the report. Survey result shows that people are aware that making a health appointment will cost their entire day even for basic testing.

The above-proposed IoT system performs these tests simultaneously. Considering the manual method and IoT methods, which method do you think can be done faster?

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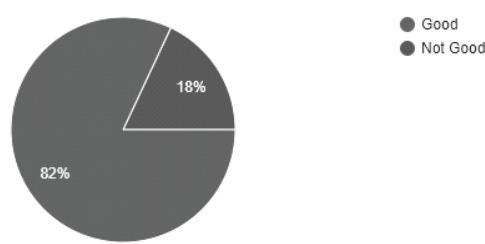


There are many votes that experiments can be done very quickly with this Health Care IoT Monitoring System.

What do you think about this device, it is good or not for use in the hospital?

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50 responses

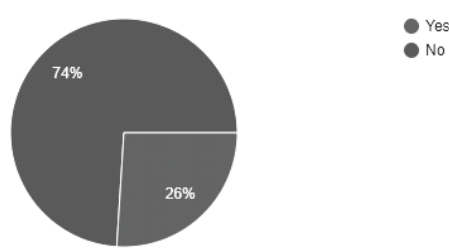


This data shows if this device is used in the hospital and medical centers, most people will get the benefits, therefore most people prefer to install this healthcare IoT monitoring system in all hospitals.

Do you think using this device can cause health effects?

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50 responses

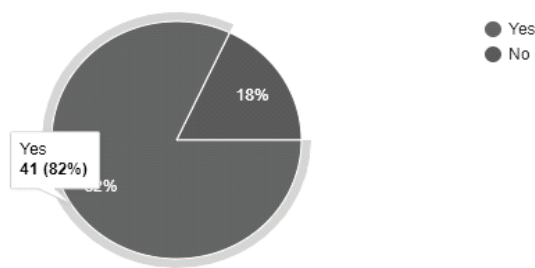


In this research, 74% percent of the respondents answered that there would be no effect on the body by using this health care IoT monitoring system in the hospitals.

Do you think, This IoT device contributes to the Sri Lankan economy and health sectors?

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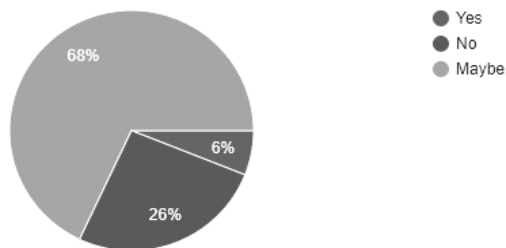


By installing this healthcare IoT monitoring system in hospitals in Sri Lanka, people's opinions are high that Sri Lanka's economy and medical sector will improve.

Do you think the initial setup cost of this IoT device would be expensive?

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50 responses



For this question, most of the people answered that **"maybe"**. because the installation expensive is high but after the installation, the medical expenses will reduce for the people.

5. Recommendation

This device will detect the heart rate, body temperature, and blood glucose level so this device will be very useful for hospitals and medical centers. the employees and nurses can quickly understand this device and installation. Therefore, mankind will get benefit from using this device in the hospital.

In the future, it is expected to add more sensors for this device like an ECG sensor, Blood Pressure sensor. Currently, this device can only monitor the health level of one patient. But in the future, this device will be developed to monitor all patient's health levels at the same time.

This system will accurately detect the patient's health condition. Sometimes if the patient's health condition is adverse, the system will inform the doctors instantly, if this system is fully automated. So the doctors will be tired of facing this situation. Therefore, this system is designed half automated because the chief doctors know about the patient's health level when watching the monitoring the data. so the chief doctors can be aware of patient's health and when required, the chief doctor will press the emergency button at the proper time.

This system will work very accurately but first, this system needs to be approved by the people for installation in the hospitals. then can test this device's all sensors by

physical testing like testing the artificial blood with the glucose sensor to test the both accurately are the same or not. first of all the artificial blood should be tested by the original glucose testing then merge both results and create the program and algorithm for the device.

6. Conclusions

A Health Care IoT Monitoring System would be beneficial and effective for all hospitals in Sri Lanka, according to the poll, and it would be much valued if it were adopted in place of the manual health testing instruments. This healthcare IoT system will be highly helpful for Sri Lanka, according to opinions of those in the medical industry and the general public, and this technology will also greatly aid Sri Lanka's economic growth. By installing this device in hospitals in Sri Lanka, people's health can be tested faster, and get reports can be obtained quickly.

Smart Women's Health Monitoring & Safety System

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Abstract

Women in Sri Lanka faces many security issues and health concerns at the present. With the vast development of the technology, though many sectors are developed in Sri Lanka, still it is a challenge to the Sri Lankan women to secure themselves while being active in the society, at home or in any public area. Though the health sector in Sri Lanka is gradually adopting technology, still many of the women in Sri Lanka do face many health concerns and issues because of the lack of health monitoring approaches. Especially the young ladies and the pregnant women are more affected in this matter where as their physical health is only monitored in certain fixed time. The IoT technology has now well developed and has adopted in many countries all over the world. But still Sri Lanka is struggling to completely adopt IoT based technologies and devices because of the lack of knowledge about the technology among the Sri Lankan citizens. Because of this reason Sri Lanka is facing so many issues in security and health sectors of women in Sri Lanka. To overcome this situation, easily without struggling much to make people adopt and learn IoT technology, this paper proposes an IoT based Women Safety and health monitoring system. Which is easy to adopt and use, and which will be aided to increase women safety and monitor health condition of the proposed device users. The proposed device is built using the Arduino technology. It also contains a GPS module which helps to track the live location of the device user at any emergency situation. Which is helpful to monitor both safety and health conditions. Also this proposed device contains the temperature sensor, pulse and the pressure sensor which will collect live data of the device user to monitor their health condition. Also by using the pulse sensor and the pressure sensor this device acts as a safety equipment which will help the guardian of the device user to identify any emergency situations which cannot be directly communicated to them by the device user. The emergency button which is connected to this proposed device will trigger the guardian of the device user at any safety or health emergency when the button is pressed by them. The proposed device has been implemented as a prototype and has been tested among 15 selected women who has health concerns and who has not. By analyzing their feedbacks on the tested prototype this proposed system has been evaluated and then the benefits and the drawbacks of using this device has been identified in order to aid the safety concerns and health concerns of women in Sri Lanka to ensure the women in Sri Lanka are safe and monitored.

1. Introduction

Safety of women is a very significant problem nowadays, with important consequences for women's lifestyles. Even in this day and age, while technology is quickly developing and scientific temperament is encouraged, women continue to experience insecurities. Daily, our news feed contains stories about women who have been sexually or physically harassed, and there are many more incidences

that go unreported or do not make the media. The business world is changing, and women now make up a larger proportion of the workforce than ever before. We need to ensure their safety in order to encourage equality and participation. (Sethi, 2018) Women's violence, in all of its forms, is pervasive in communities and countries across the world, cutting across class, race, age, religion, and national boundaries. The United Nations Declaration defines gender-based violence as "any act of gender-based violence that causes or is likely to cause physical, sexual, or psychological harm or suffering to women, including threats of such acts, threat of force, or arbitrary injustices of individual freedom, whether happening in publicly or privately daily existence." (jansen, 2019)

Not only do Sri Lankan women have safety concerns, but they also experience a variety of health challenges. Because of technological developments and environmental circumstances, people nowadays choose to consume fast food due to job pressure, which is harmful and leads to obesity. As a result, women suffer as a result of stress, which mostly affects pregnant women. Due to improper and unhealthy diet choices and fast food, a significant number of young pregnant women are currently experiencing high blood pressure and high blood sugar difficulties. (V, n.d.)

This article explores how an IoT-based system that can be implemented and utilized as both a health monitoring system and a security-based safety system which can be used to tackle both issues: conquering and protecting ourselves from gender violence and monitoring the health state of every individual. This suggested device includes a GPS module that records the user's current location, as well as an emergency button that alerts the guardian as soon as the button is touched, as well as a buzzer to alert individuals around, which is a primary content concern for the safety purpose. Furthermore, the pulse sensor module, which detects the pulse rate, will aid in the detection of a panic scenario by detecting the heart rate of the person wearing the device, which may be utilized for both security and health monitoring. The temperature sensor and the pressure sensor both aid in the monitoring of the device's user's health. In all, this IoT-based device may be utilized in two scenarios: monitoring the health state of a woman who is suffering from a disease, and tracking the person in the case of emergency. This device, on the other hand, may be utilized with the emergency button for both medical and safety emergencies.

2. Methodology

A qualitative secondary research is done on previously built systems on women safety and health monitoring systems, and the tools, techniques and device functions are analyzed. Based on the research and findings the suitable and unique functions, objectives for the proposed system is identified. According to the identified objectives of the proposed system, the title, devices to be used, platforms and tools are defined. Then the proposed design model is created considering the objectives to be achieved along with the cost analysis. Based on project management process,

the planning for the proposed system is completed through identifying objectives and the created design model. The implementation of the system happens in the designing and implementation phase as a prototype.

The Arduino platform is used for the implementation process. The proposed system is designed and implemented using Arduino Uno, Ethernet Shield, GPS module, heart rate sensor, temperature sensor, pressure sensor, Emergency button and buzzer. Then according to the objectives, the data is collected from the implemented design. The data collection is done by using the system built, via the Arduino Uno platform. The connected three sensors and the GPS module will be collecting the data and visualize it in a dashboard where as the trigger will be given to the guardian when the emergency button is pressed. and also if the heart rate, pressure and temperature value is increased than the standard value. In addition, the buzzer will be enabled when the emergency button is pressed.

The Arduino Uno main controller, connected to the Ethernet shield, will transmit data via Ethernet to the access point. Using the MQTT protocol connected to the Internet, the data will be transmitted to the Adafruit.IO cloud platform. From the cloud platform, Adafruit.IO the triggers will be sent to the relevant guardian. The collected data will be analysed and shown in the Adafruit.IO dashboard, Separately as each sensor's collected data value in a visual format. Triggers from the emergency button and the sensors are sent as messages and an email with the live location detected by the GPS module.

Then, the built prototype will be given to be tested within 15 selected women, who are currently being experiencing health issues and not. With that, A survey will be conducted among the selected women who tests the built prototype, in order to collect primary quantitative and qualitative data. Which will be used to analyse and identify whether how far the proposed system is functioning and, how far does the proposed system solves the health and safety issues of women in Sri Lanka.

3. Design

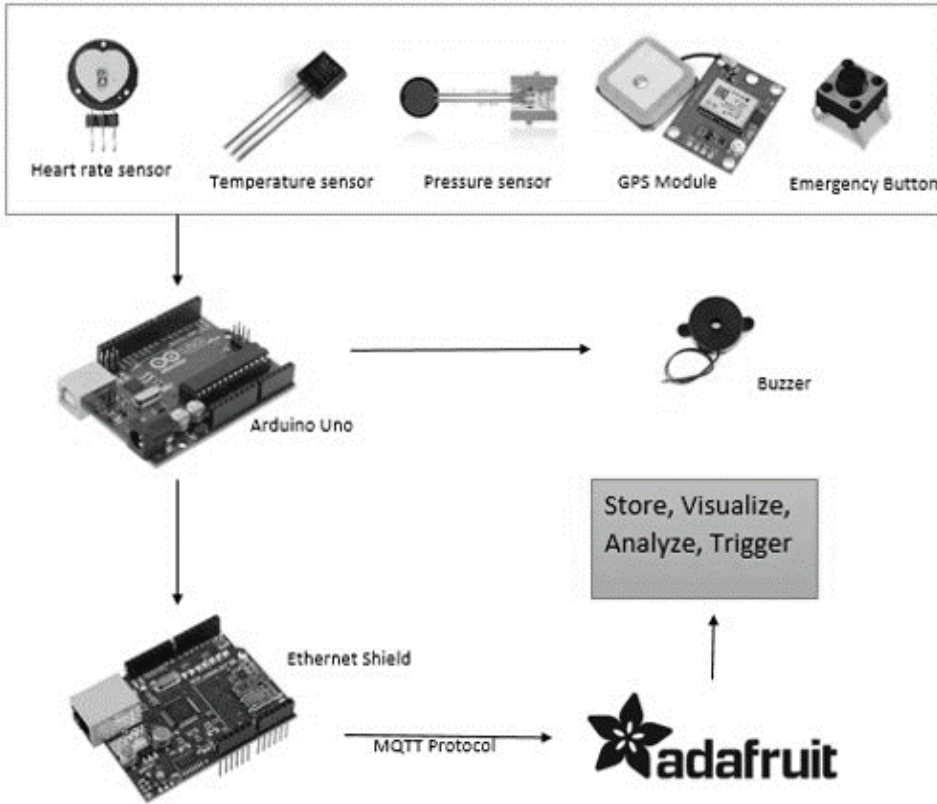


Figure 1 Design of the suggested IoT based System

4. Testing

The testing of the prototype has been done by using 15 real time device users, who are actually having health concerns and who are not. The device first has been explained with all the device functionalities and how the prototype has to be used by them. Then the feedback has been collected as a survey among the tested device users according to the following attributes:

- Performance – defines the overall performance of the prototype device, the success rate of each sensor module and their performance level rated among 0-10.
- Usability – defines how far the device is easy to use and handle even without having a deep knowledge about the technology used to design the device.
- Functionality – defines how far the device is fulfilling the requirements of the user which is already defined as objectives in order to design the device.
- Security – defines how far is the designed device is secured for the user considering both legal and ethical concerns.

- Comfortability – defines how far the device user is comfortable and satisfied in using the designed prototype/ device

5. Results

Considering the feedbacks given through the survey which was conducted as a testing for the implemented IoT prototype in order to find the overall success of the proposed system, the below results and findings can be used to analyse and identify on how far the proposed system is successful to be produced to the society. Out of 15 device users 8 of them have considered/used it as a safety system, 3 people have used it as a health monitoring system while 4 people have used it as both safety and health monitoring system. So according to the information it is clear that this proposed system is mostly used for security/ safety purpose. When considering the response for the overall functionality of the system it is clear that 60% of the device users have ranked the device functionality as 7/10 whereas 27% of the device users have ranked 8/10 which is considered as overall, the proposed prototype device functions well. Also 40% of the device users have ranked 5/10 for the overall usability of the prototype system. Whereas 33% of the device users have ranked 6/10 and 27% of device users have ranked 7/10 for the overall usability of the prototype system. This clearly gives an idea that the usability of the proposed prototype system should be improved for better customer/ user satisfaction.

Also, 67% of the device users have ranked 6/10 while 33% of the device users have ranked 5/10 for the comfortability in using the system. Which gives the clear idea that even 67% of the device users have ranked 6/10 still the comfortability of the device should be increased. The performance and the functionality of each sensor has been evaluated and ranked in a scale from 0 to 10 by the testing device users as well. Finally, Each objective in the project has been evaluated as a criteria by the testing device users, in order to clarify whether the targeted objectives are achieved through the proposed IoT model. Here, 26% of the device users, have ranked 7/10 as an average concluding that this proposed device collects the information of the temperature, pressure and heart rate of the device user per thirty minutes. Also, 26% of the device users, have ranked 7/10 as an average concluding that this proposed device does trigger the guardian of the device user when the emergency button is pressed, along with the live location tracked by the GPS module.

And also, the criteria Does the auto alarm trigger when the emergency button is pressed has been ranked 7/10 as an average by 26% of the average testing device users. 22% of the device users, have ranked 6/10 as an average concluding that this proposed device triggers the guardian of the device user with the live location and the sensor values, if the heart rate and the pressure rate is increased and the device user does not press the emergency button in case.

As a conclusion, by evaluating the above test results generated using the feedbacks and evaluations provided by the testing users, it is clear that the proposed device do support in monitoring health and safety concerns of women in Sri Lanka. Though there are some minor and major concerns that should be improved in the proposed system such as the usability, comfortability of the device can be further improved to make a better functioning IoT module to aid solving health and safety concerns of women in Sri Lanka.

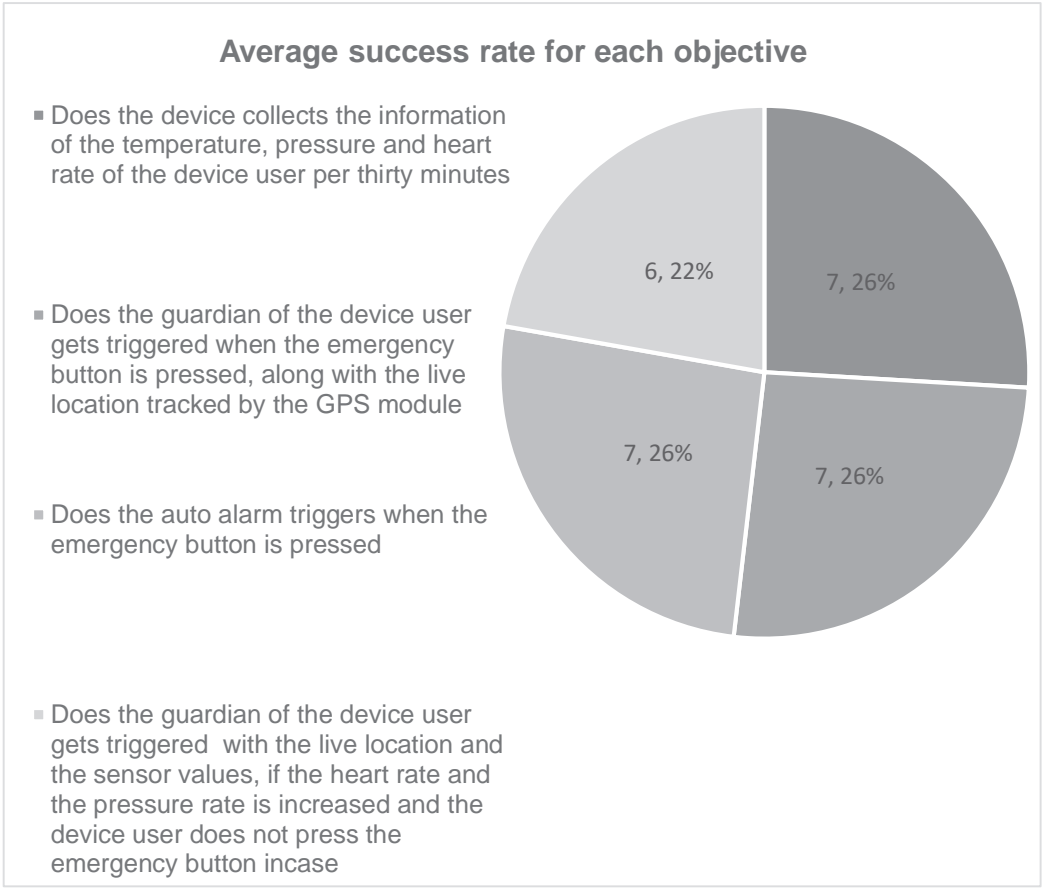


Figure 2: Average success rate for each objective after the results analysis of the device testing

6. Conclusion

Through this study, it concludes that, Safety of women is a very significant problem nowadays in Sri Lanka. Every women has to face different situations at home, outside in public areas and transportation that they get physically harassed by many which has lead to many physical harassment cases which are not even has been brought into the media or public. Not only security concerns, the health conditions of young and pregnant women is considerably in danger. High consuming of fast food, less sleep and rest because of work and environmental pressure, less health

maintenance practices has caused more issues among young ladies and pregnant women in the present. By considering the health and security concerns of women in Sri Lanka, an IoT device was proposed to be implemented to overcome these concerns and issues. Then the designed IoT module has been implemented and tested among 15 real time users. The evaluated test results conveys the idea that, the proposed device is performing and functioning well with a considerable success rate of sensors functioning. This proposed prototype can be further improved in order to increase the functionality, user satisfaction and security concerns and can be implemented in a real environment which can be helpful, and can be used to improve the safety measures and health monitoring aspects of women in Sri Lanka.

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Session 03
Health Sciences



Isolation of Mesenchymal Stem Cells from Human Umbilical Cord using Tissue Explant and Enzymatic Digestion: A Method Comparison

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Abstract

Human mesenchymal stem cells (hMSCs) play a major role in the rapidly growing field of regenerative medicine. The umbilical cord (UC) has been identified as a rich source of MSCs. However, the current MSC isolation methods from UC have associated problems such as long culture cycles and low yield of primary MSCs. Optimization of these methods is necessary to increase the efficiency and reproducibility of obtaining good quality MSCs for large scale clinical applications and future research in the field of regenerative medicine. Therefore, the aim of this study was to isolate MSCs from human UC using tissue explant and enzymatic digestion methods and carry out a comparative analysis of the two methods to determine cell culture efficiency. UC samples were collected from healthy mothers after informed consent. For the tissue explant method, UC sample was cut into 1 mm pieces and were grown in complete media (DMEM, 2 mM L-glutamine, 10% FBS and 1% penicillin-streptomycin) at 37 °C in a 5% CO₂ incubator. For the enzymatic digestion method, two protocols were followed. In one protocol, the UC pieces digested with 0.1% trypsin for 16 hours were pelleted and the entire pellet along with the partially digested tissue pieces were incubated in complete media. In the other protocol, the UC pieces were removed after 0.1% trypsin digestion and only the pelleted cells were cultured. The morphology, adherence time and growth of primary cells isolated from above methods were observed. Adherent cells with large nuclei were observed in cultures of trypsin digestion method. The adherence time of primary cells in both protocols of trypsin digestion method was the same. However, the culture of only the cell pellets from trypsin digestion showed a higher number of adherent cells. The isolation of hUCMSCs using tissue explant method did not show typical fibroblast-like, thin spindle-shaped MSC morphology. Thus, the tissue explant method was unsuccessful. Overall findings of this preliminary study proved enzymatic digestion method to have a higher efficiency in isolating MSCs from UC compared to the explant method. Findings also proved that 0.1% concentration of trypsin is potent enough for primary cells to detach from tissue pieces and grow in culture. Modifications may be required for the explant culture method to suit stem cell research laboratory settings in Sri Lanka. However, further studies need to focus on the multi-differentiation ability of hUCMSCs and their immunophenotypes to confirm the purity and success of the isolation of MSCs.

Keywords: Mesenchymal stem cells, Tissue explant, Trypsin, Umbilical cord

1. Introduction

Stem cells are a prominent subject in the era of modern science research. Human mesenchymal stem cells (hMSCs) are undifferentiated, multipotent, and non-hematopoietic adult stem cells possessing self-renewal and differentiation ability into multiple cell lineages. They demonstrate fibroblastic, spindle-shaped phenotype (Chamberlain *et al.*, 2007, Rathnayake *et al.*, 2016). MSCs are found in many tissues such as bone marrow, umbilical cord (UC), Wharton's jelly (WJ), dental pulp, and synovial fluid (Han *et al.*, 2013; Ullah *et al.*, 2015). The UC is an abundant, primitive, non-controversial (Seshareddy *et al.*, 2001), non-invasive and primary source of MSCs (Beeravolu *et al.*, 2017). Isolation of hUCMSCs has become of great importance in the field of biomedical research, as it shows promising results in cell therapy, regenerative medicine, treatment of chronic diseases and tissue repair (Ullah *et al.*, 2015) and may bring about promising, cost-effective treatment and cure to life threatening diseases that have no effective cure yet. Moreover, its genome is naive and regarded to have gone through very little or no changes in response to environmental stress and aging, unlike embryonic stem cells and induced pluripotent stem cells (Beeravolu *et al.*, 2017).

Tissue explant and enzymatic digestion are two widely used hUCMSC isolation methods (Mushahary *et al.*, 2018). However, these methods are suboptimal as they have associated problems such as low yield of primary MSCs and long culture cycles with variable proliferation potentials, making it a challenge to acquire enough numbers of cells (Beeravolu *et al.*, 2017; Han *et al.*, 2013). Many laboratories attempt to optimize and develop their own isolation protocols to acquire the optimal yield, quality, viability, function, and integrity of the MSCs (Hassan *et al.*, 2019; Widowati *et al.*, 2011). This is vital to support clinical applications in large scale and produce favourable outcomes in the future of regenerative medicine.

Therefore, this preliminary study was performed to test/optimize the conditions and methods of hUCMSC isolation and identify an efficient and reproducible method to further develop stem cell research for laboratory settings in Sri Lanka.

2. Methodology

2.1 Sample collection

Two fresh umbilical cord (UC) samples were aseptically collected from two health mothers who underwent elective cesarean sections at the University Hospital of General Sir John Kotelawala Defence University, after informed consent. UC samples were collected in sterile stock bottles containing complete MSC culture media (DMEM, 10% FBS, 2 mM L-Glutamine, 1% Penicillin-Streptomycin) and transported to the laboratory on ice at 4 °C. The study was conducted in accordance with the Helsinki Declaration and ethical clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, General Sir John Kotelawala Defence University. No additional discomforts or risk occurred to the mothers as the UC is a natural waste that is discarded after delivery.

2.2 Isolation of MSCs from human UC using tissue explant method

The UC was washed with ice-cold PBS to remove blood clots. Blood vessels and WJ were also removed. UC was cut into 1 mm pieces and inoculated in a 25 cm² culture flask containing complete MSC culture media (DMEM, 10% FBS, 2 mM L-Glutamine, 1% pen-step) and incubated at 37 °C for 3 days in a 5% CO₂ incubator. Culture media was replaced on the 7th day of incubation and tissue pieces were removed. Subsequent media changes were performed every 3-4 days as required.

2.3 Isolation of MSCs from human UC using enzymatic digestion with 0.1% trypsin

Two protocols were used. After washing and dissection of the UC, 1 mm sized pieces were incubated with 0.1% trypsin for 16 hours at 37 °C in a 5% CO₂ incubator. After incubation, trypsin was neutralized with culture media and pelleted. In the first protocol, the entire pellet along with the partially digested tissue pieces were inoculated in a 25 cm² culture flask with culture media. In the second protocol, the UC pieces were removed after 0.1% trypsin digestion and only the pelleted cells were cultured. Both cultures were incubated for 3 days at 37 °C in a 5% CO₂ incubator. 2 mL of additional culture media was added on day 3 and first media change was done on the 6th day of incubation. Subsequent media changes were performed every 7-12 days as needed.

2.4 Assessing morphological characteristics, adherence time, cell counts and cell viability

Morphological characteristics, adherence time and growth of primary cultured MSCs were assessed every two days using an inverted microscope. Cell count and viability

was assessed for the enzymatic digestion culture containing only the pellet on day 20.

3. Results and Discussion

3.1 Isolation of hUCMSCs using tissue explant method

The microscopic results obtained from tissue explant culture method are shown below in figure 1.

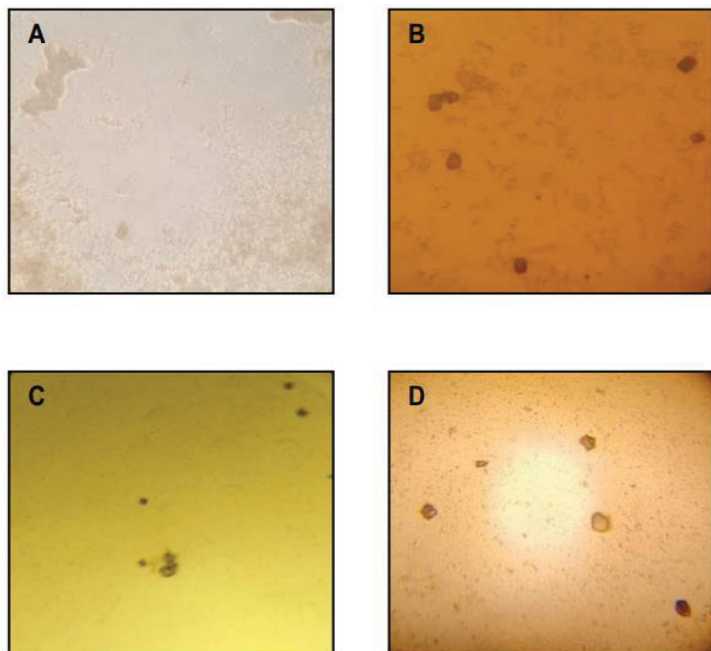


Figure 1 - Morphological characteristics of primary cells isolated with tissue explant method under an inverted microscope at passage 0

- A- Culture on day 3 (20x),**
- B- Primary cells on day 7 (40x),**
- C- Primary cells on day 12 (40x),**
- D- Primary cells on day 14 (20x).**

Cell-like structures growing in close contact with tissue pieces were observed on day 3 (Fig.1A). It was too early to confirm if these cells were MSCs as their morphology was irregular and cell protrusions weren't present. On day 7 (Fig.1B), larger cells, compared to day 3, were observed. Cell density was higher in areas with tissue explant pieces. However, cell extensions or spindle shaped morphology wasn't observed. On day 12 (Fig.1C), tiny colorless cell clusters spread throughout the surface and a few darker colored round cells were observed in the center and far right corner in a dispersed pattern. However, the morphology of these cells

wasn't consistent with that of MSCs as described in literature. On day 14 (Fig.1C), large cells with nucleus and shrunken cell membranes were seen floating on the media and cells appeared to be dead.

The cells from tissue weren't adhered to bottom of the culture flask. Since cells appeared to be dead on day 14, cell adherence time of this isolation method could not be recorded.

3.2 Isolation of hUCMSCs from both tissue pieces and pellet culture using 0.1% trypsin digestion

The microscopic results obtained from the enzymatic digestion culture of both tissue pieces and pellet are shown below in figure 2.

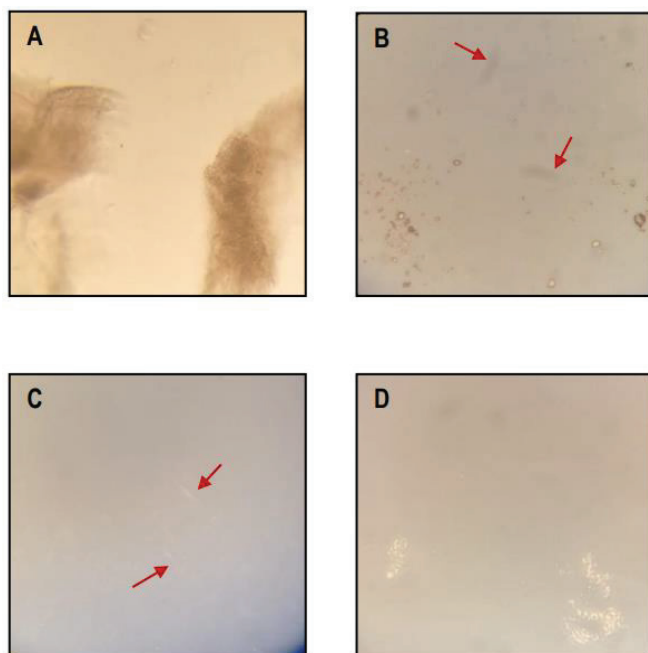


Figure 2 - Morphological characteristics of primary cells isolated with the enzymatic digestion (0.1%Trypsin) method after incubation of both tissue pieces and pellet obtained from the trypsin digestion under an inverted microscope (20x) at passage 0

- A- Culture at day 1,**
- B- Primary cells at day 6,**
- C- Primary cells at day 8,**
- D- Primary cells at day 26.**

On day 1 (Fig.2A), partial digestion of tissue pieces was observed. Tissue pieces were observed in the dark regions and tiny cells migrating from the explants on the

lighter region. On day 6 (Fig.2B), round-shaped cells were found in clusters in a dispersed pattern and fibroblastic-like cells (indicated by red arrows) were seen floating on the culture media. On day 8 (Fig.2C), few short spindle-shaped fibroblastic-like cells were observed in a dispersed pattern (indicated by red arrows). On day 26 (Fig.2D) tiny cell clusters of round-shaped cells were observed in a dispersed pattern. However, the morphology of cells observed on day 26 was not consistent to that of MSCs and were detached from the flask.

Appearance of adherent cells were observed at the edges of umbilical cord explants on the 8th day of culture. Cell counts and cell viability for this isolation method could not be obtained as the appropriate confluence was not reached for cell detachment.

3.3 Isolation of hUCMSCs from only pellet culture using 0.1% trypsin digestion

The microscopic results obtained from the enzymatic digestion culture of only pellet are shown below in figure 3.

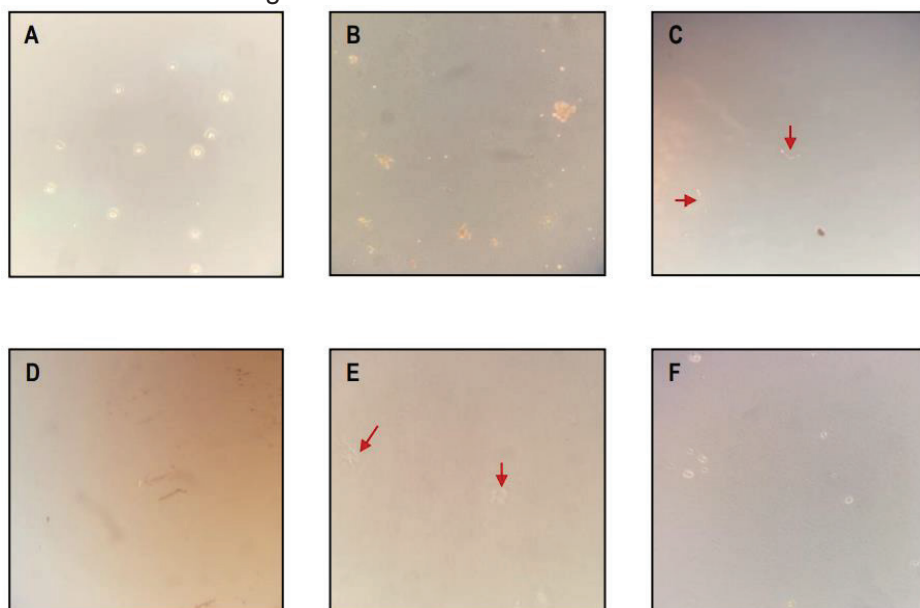


Figure 3 - Morphological characteristics of primary MSC like cells isolated with the enzyme digestion (0.1%Trypsin) method after incubation of pellet obtained from trypsin digestion under an inverted microscope (20x) at passage 0

- A- Culture at day 2,
- B- Primary cells at day 6,
- C- Primary cells at day 8,
- D- Primary cells at day 11,
- E- Primary cells at day 14,
- F- Primary cells at day 26.

The release of cells from partially digested tissues were observed on day 2 (Fig. 3A), confirming that 0.1% trypsin concentration is sufficient for the detachment of MSCs from tissue pieces. On day 6 (Fig.3B), clusters of round-shaped cells were observed in a dispersed pattern. Cells with tiny extensions and fibroblastic-like spindle shaped morphology was observed in two regions (indicated by red arrows) on day 8 (Fig.3C). On day 11 (Fig.3D), the fibroblastic-like extensions appeared to be larger than what was observed on day 8. Clusters of cells were observed in a dispersed pattern (indicated by red arrows) on day 14 (Fig.3E). On day 26 (Fig.3F), larger cells compared to day 14 were present. These cells were adhered to the bottom of the culture flask and had an oval shape with a nucleus at the center.

Appearance of adherent cells to the bottom of the culture flask was observed in culture on day 8. Cell counts and cell viability were assessed on day 20. The total cell count was 291,160 cells. While the viable cell count was 16,064 cells/mL which accounted for a percentage viability of 27.59%.

No spontaneous differentiation or contaminations were observed in any of the cultures. Most literature states that the yield of cells from tissue explants is low and culture cycles are slower than enzymatic digestion methods (Han *et al.*, 2013; Hiew *et al.*, 2016; Yoon *et al.*, 2013). This was observed in this research as well. Findings of this study showed that 0.1% trypsin enzymatic digestion method is better in isolation of MSCs from UC compared to the tissue explants method. There was no difference in the adherence times between the two protocols of enzymatic digestion method used. However, it was observed that the yield of primary cells obtained from culturing the pellet alone after digestion with trypsin was higher than the culture with both pellet and tissue pieces. In literature, non-adherent tissue pieces were removed and transferred to a new culture flask after incubation for 3 days (Beeravolu *et al.*, 2017). In this research non-adherent tissue pieces were left till the end of the complete culture cycle which may have accounted for the decreased primary cell yield in the enzymatic culture containing tissue pieces. Overall, findings of this research showed that culturing the pellet alone obtained from enzymatic digestion was more efficient in isolation of primary cells.

Concentration of the enzyme and digestion times were controlled as excessive use can damage cell membrane resulting in cells losing their adherence ability (Han *et al.*, 2013). Hence, in this study 0.1% trypsin concentration was used for a 16-hour digestion.

A concentration of 1% penicillin-streptomycin was used in this research and from observations it was proved to be a good antibiotic concentration as no contaminations were present in any of the cell cultures and cell viability was not affected either (Ryu *et al.*, 2017; Skubis *et al.*, 2017). However, if it had an effect on the adherence was not clear.

Zhang *et al.* (2012) stated that MSCs isolated from the entire UC can be produced in large scale over a short time period using a single enzyme method. Therefore, literature supports the finding of this research, as trypsin alone was sufficient in the isolation of hUCMSCs.

4. Conclusions

The results of this preliminary study confirm that enzymatic digestion method is a faster and more reliable hUCMSC isolation method than the tissue explant method. It demonstrated enzyme concentrations as low as 0.1% trypsin to be sufficient in isolating primary MSC like cells from UC without causing damage to cell membranes and affecting the adherence ability of cells. Future research is needed to further optimize the tissue explant method to suit stem cell research laboratory settings in Sri Lanka. Further, we need to focus on the multi-differentiation ability of hUCMSCs and their immunophenotypes to confirm the purity and success of the isolation of MSCs.

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Awareness of diabetic risk factors, dietary control, chronic complications, and use of traditional medications in Type II diabetes mellitus in Sri Lanka

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Abstract

According to multiple researches, awareness is proven as crucial factor in diabetic management and herbal remedies have been proven to provide positive impacts in diabetes treatments. Diabetes mellitus is global pandemic for non-communicable diseases with a record of 1.5 million deaths in 2019. With the development of suburban population, Sri Lanka too is faced with a major increasing trend in the incidence and prevalence of Diabetes, thus becoming the 3rd major cause of death due to non-communicable diseases according to the steps survey 2016. Sedentary lifestyle, improper diet and obesity are leading contributors for this alarming increasing rate. This marks the importance of the awareness of diabetes mellitus among the general population. The availability of resources rich with herbal medicines, Sri Lanka has the opportunity to looking into remedies for diabetes using this local herbs. primary data was obtained as responses from 1047 adults above 20 years of age, including participants from the nine provinces of Sri Lanka, to a close ended questionnaire including questions regarding awareness of diabetes and use of herbal medicines. Pearson's Chi square analysis was done to statically analyze the relationship between the socio demographic factors of the participants with the response to the questionnaire. According to the responses obtained, the frequency of the awareness of age as a risk factor was low. And knowledge on chronic complications like loss of sensation, coma, and cardiovascular complications was comparatively lower. Awareness of the negative impact of late meals, oil and red meat consumption on diabetes was lower. The diabetic status of the study population showed significant relationships at $p < 0.05$ with most of the parameters that indicated awareness, where individuals with higher blood sugar levels had a higher knowledge on chronic complications while the non-diabetic and the individual with their blood sugar regularly maintained had a better knowledge on risk factors and dietary factors. Improper resources of health education too associated with a low awareness, though majority of the items did not have statistical significances at 95% confidence interval. Around 50% of the study population preferred the use of herbal medication along with Western medication in diabetic treatment. This preference was significantly associated ($p < 0.05$) to age, province, gender, education level, resources of health education and the blood sugar status. This emphasizes the importance of standardizing the use of herbal

medication thus expecting a positive turn in the diabetic trend in Sri Lanka. In conclusion, an overall good knowledge on type 2 diabetes mellitus prevails among the study population, thus indicating a fair knowledge among Sri Lankans. The diabetic status and the resources of health education can be considered factors that contribute to cause a difference in knowledge. Majority of the study population has a positive attitude towards herbal medications in diabetes management.

Keywords: Type 2 diabetes mellitus. Awareness, risk factors, chronic complications, herbal medications.

1. Introduction

According to multiple research, awareness is proven as a crucial factor in diabetic management and herbal remedies have been proven to provide positive impacts on diabetes treatment. Diabetes is a long-term prevailing non-communicable global pandemic characterized as a condition of abnormal levels of glucose due to autoimmune, metabolic, or genetic backgrounds with a record of 1.5 million deaths in 2019 (Diabetes, 2021).

The burden of diabetes in Sri Lanka has increased over the past years and as indicated by figure 1 it is one of the major causes of death in Sri Lanka (Ministry of Health, Nutrition and Indigenous Medicine Sri Lanka, 2016) According to the STEPS survey Sri Lanka (2015), among the total adult population in Sri Lanka 7.3% males and 7.6% females were either diagnosed or on medication for diabetes (Ministry of Health, Nutrition and Indigenous Medicine, 2015).

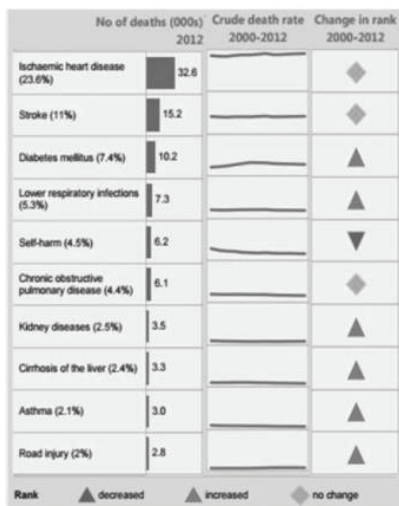


Figure 1 increasing burden of diabetes (Ministry of Health, Nutrition, and Indigenous Medicine Sri Lanka, 2016)

Knowledge and awareness are crucial in diabetic management. According to Islam *et al* (2014), awareness correlated to factors like education level, and gender, and the necessity of improvement in awareness is emphasized as it can be corporate to reduce the cost of healthcare and reduce complications.

According to WHO (2011), more than 75% of the world population relies on traditional medication along with western medication as an alternative therapy for T2DM. Sri Lanka is a country with rich biodiversity enriched in medicinal plants and herbs. In Sri Lanka, Ayurvedic medicine is considered the main traditional medication. Data gathered from ancient Ayurvedic books, transcripts, and knowledge acquired from ayurvedic physicians and patients, identified many plants commonly used in the treatment of T2DM in Sri Lanka (Ediriweera and Rathnasooriya,2009).

1.1 Aims and objectives

The main objective of this research is to study the awareness of T2DM among Sri Lankans and identify the common Ayurveda medicines used in Sri Lanka.

1. To assess the awareness of risk factors and chronic complications of T2DM and evaluate the awareness of dietary control among Sri Lankans.
2. Evaluation of the factors affecting the awareness of T2DM among Sri Lankans.
3. Identify the common types of Ayurveda medications used for T2DM in Sri Lanka.
4. Evaluating the reasons for the preference for traditional medication among Sri Lankans.
5. Assess the correlation of factors like age, gender and education level to the preference for using herbal medication in Sri Lanka.

2. Methods

The research is based on primary data administering surveys with close-ended questions. Probability Single-stage cluster sampling considering each province a cluster was followed. The main tool used was a questionnaire including 57 questions distributed among 3 categories. Sociodemographic information included a question about the respondent's age, gender, province, education level, employment status, and resources for diabetic education. Diabetes-related questions were categorized into questions regarding sugar levels, symptoms, risk factors, diet patterns, and chronic complications. Questions regarding knowledge and preference of herbal medication were included finally. Pearson's Chi-square tests of independence were performed to test the null hypothesis.

3. Results and analysis

Figures 2, 3, and 4 indicate the rate of awareness among the sample population. As indicated by the figures the rate of awareness of each factor is high in most of the parameters thus indicating a good awareness among the sample population.

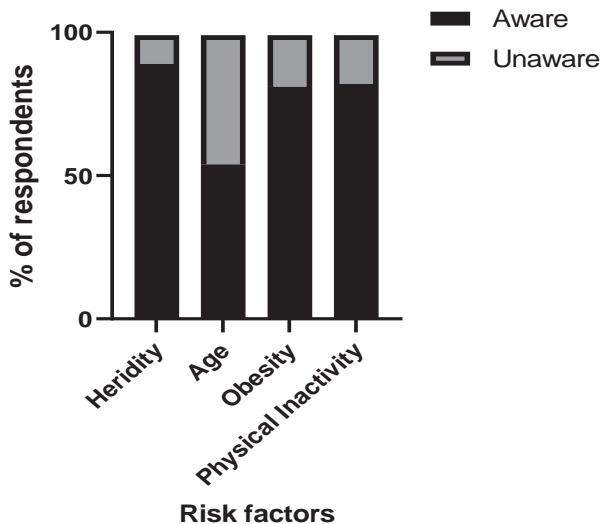


Figure 1: Awareness of individual risk factors

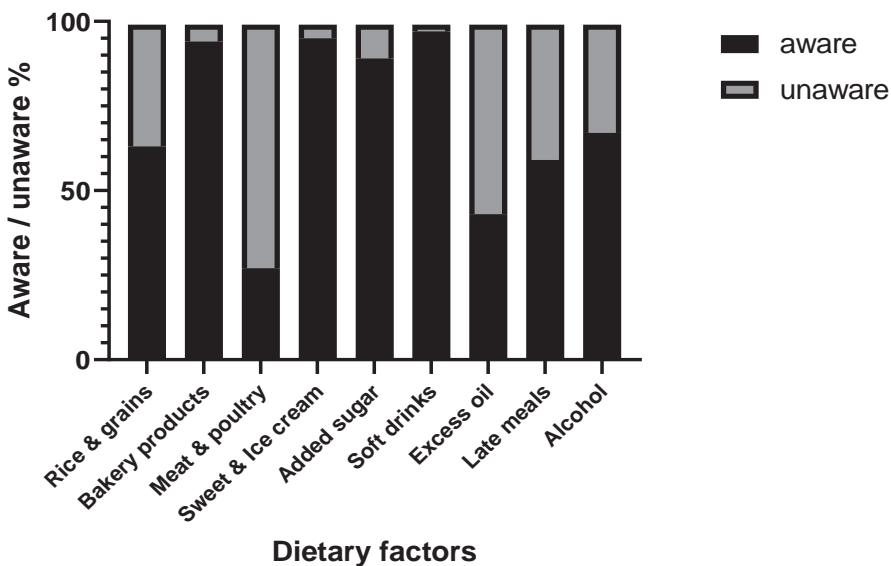


Figure 2: knowledge of unhealthy diet practices

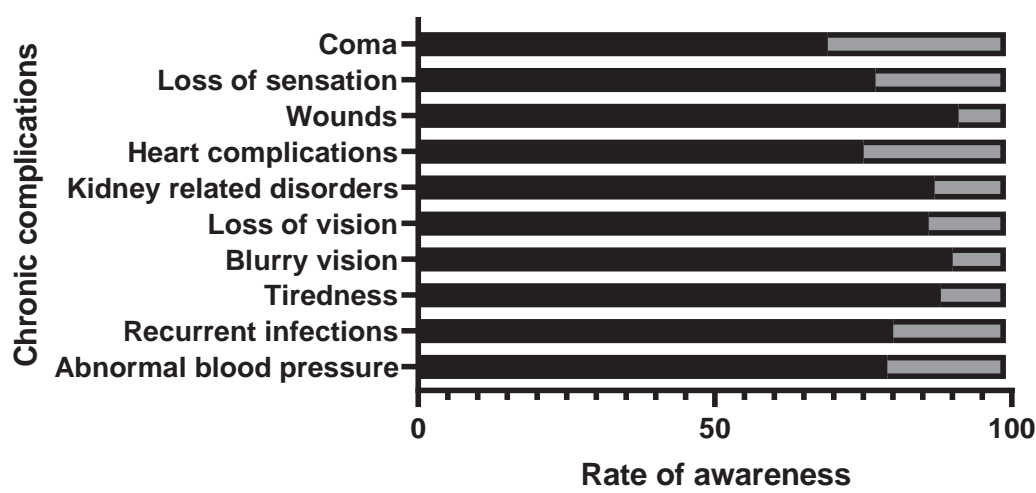


Figure 4: Overall awareness of chronic complications

Pearson's Chi-square tests for independence to analyze the factors affecting the awareness depicted that most of the items analyzed in the questionnaire did not have significant associations $p>0.05$ with age, education, or province. Diabetic status as indicated by table 1, was observed to have a significant relationship $p<0.05$ with the awareness of the parameters analyzed.

Table 1. Pearson's chi-square relationship between sociodemographic factors and the awareness

	Age	Province	Blood Sugar	Source	Education
Heridity	Not Significant	Not Significant	Significant	Not Significant	Significant
Age	Not Significant	Not Significant	Significant	Significant	Significant
Obesity	Not Significant	Not Significant	Significant	Not Significant	Significant
Physical Activity	Not Significant	Significant	Significant	Significant	Significant
Abnormal blood pressure	Not Significant	Not Significant	Significant	Significant	Not Significant
recurrent infections	Not Significant	Not Significant	Significant	Not Significant	Significant
Tiredness	Significant	Not Significant	Significant	Significant	Not Significant
Blurry vision	Significant	Significant	Significant	Significant	Not Significant
Loss of vision	Significant	Significant	Significant	Significant	Not Significant
Kidney related disorders	Significant	Not Significant	Significant	Not Significant	Not Significant
Heart complications	Significant	Not Significant	Significant	Significant	Not Significant
Wounds	Not Significant	Not Significant	Significant	Not Significant	Significant
Loss of sensation	Significant	Not Significant	Significant	Significant	Not Significant
Coma	Significant	Not Significant	Significant	Significant	Significant
Rice & grains	Not Significant	Not Significant	Significant	Not Significant	Significant
Bakery products	Not Significant	Significant	Significant	Not Significant	Not Significant
Meat & poultry	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
Sweet & Ice cream	Not Significant	Significant	Significant	Not Significant	Not Significant
Added sugar	Not Significant	Not Significant	Significant	Not Significant	Not Significant
Soft drinks	Not Significant	Not Significant	Significant	Not Significant	Not Significant
Excess oil	Significant	Not Significant	Significant	Significant	Not Significant
Late meals	Significant	Not Significant	Significant	Significant	Not Significant
Alcohol	Not Significant	Not Significant	Not Significant	Significant	Not Significant

More than 50% of the respondents claim to be aware of kothala himbatu, kola kada, ranawara tea, bitter gourd, adathoda used as a remedy for T2DM. Figure 5 depicts the therapeutic preference among Sri Lankans.

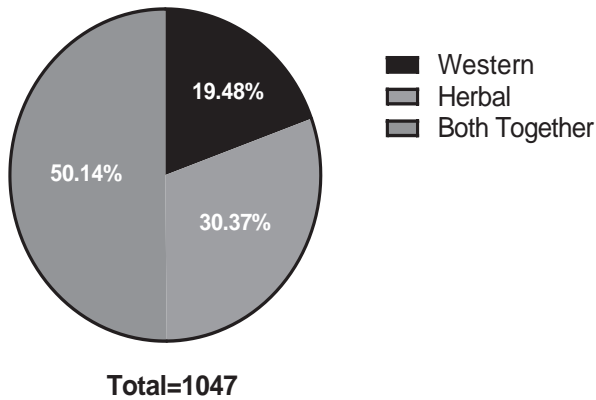


Figure 5: therapeutic preference of Sri Lankans

The preference of the sample population was analyzed with the sociodemographic factors using Pearson's Chi-square analysis to test the significance of the relationship between them. Age had a weak significant association with the choice of seeking alternative medication for T2DM ($p=0.000$, Chi square=26.200, $df=6$, Cramer's $V=0.112$). A significant association with a very strong relationship existed between the geographical location and the treatment preferred for T2DM as represented by figure 3.15 ($p=0.000$, Chi square=176, $df=16$, Cramer's $V=0.290$). Male gender was associated with a higher preference for herbal medication 35.02%. females had a higher tendency for standardized western medication. This difference had a weak significance, but the majority of both genders preferred the use of herbal medications together with western treatments ($p=0.012$, Chi square=8.851, $df=2$, Cramer's $V=0.092$). The relationship between the education level of the respondents and their preference for the treatment was weak but significant ($p=0.039$, Chi square=19.100, $df=10$, Cramer's $V=0.096$). 70% of the respondents who got information from local health care preferred the use of both types of treatment options together resulting in a moderately significant relationship as shown in figure 3.16 ($p=0.000$, Chi square=35.402, $df=8$, Cramer's $V=0.130$).

4. Discussion

The reported response from the sample population depicted a good knowledge of the multiple factors used to assess diabetic knowledge. Among the 1047 total participants, more than 50% awareness rate was observed for most of the items included in the questionnaire. The high score among Sri Lanka for awareness of diabetes reflects the positive aspect of Health Care education in Sri Lanka but there are critical gaps identified which are quite similar to existing evidence in Sri Lanka like Herath *et al* (2017). Studies regarding diabetic awareness in developing countries like Jordan (Khlaifat *et al*, 2020), Bangladesh (Islam *et al*, 2014) report a limited knowledge of diabetes among the public which is contradictory to the current study.

Though previous research like Muninarayana *et al* (2010) addresses that there is poor knowledge among rural areas, the evidence obtained through this sample population suggests that there is little to no difference in variation of knowledge irrespective of the province. But the diabetic status of the respondent was found to be an important component in the variation of knowledge. An interesting observation here was individuals with regular monitoring and maintaining their blood sugar levels had a better awareness of risk factors while individuals with no regular monitoring had poor knowledge of chronic complications and dietary factors. Education through health care professionals indicates a better knowledge of majority of the items analyzed. But only 5.73% of the sample population depended on local health staff. Yun *et al* (2007) report that in Malaysia 54% of the sample population depends on health care professionals which compared to Sri Lanka is much higher. This emphasizes the importance of the role of local health professionals in the health education of the public. Islam *et al* (2014) report on mythical concepts delivered to the public through informal media sources in Bangladesh. Educational programs with the aid of the social and mainstream media through local health care professionals using A standardized guideline program like American Diabetes Association guidelines can be used in this process special focus should be dedicated to the healthy population at risk.

The overall responses that indicated the preference for the use of herbal medications was high (80.5%) among the sample population. This is similar to the results reported by Medagama *et al*, (2014). But studies in Westernised countries like Australia report a lower rate of 46.3% use of alternative medications (Manya, Champion, and Dunning, 2012). Significant association of the provinces with the choice of medication implies the fact that alternative medications are centered on demography. The reported results can be used as a base for educational interventions and mass education programs to create awareness.

5. Conclusion

The results demonstrate an overall good knowledge of diabetes among Sri Lankans, and it also identifies some critical gaps like the lack of knowledge of Age as a risk factor, and low knowledge of chronic complications like cardiac complications, loss of sensation, and coma. Low education level, diabetic status, and unstandardized resources of health education were identified as factors resulting in low awareness. The majority of the respondents were aware of the general herbal remedies available in Sri Lanka and most of them had a positive attitude toward herbal remedies in T2DM. Age, gender, education level, diabetic status, resources, and geographical location were correlated to the preference for alternative therapy in T2DM.

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Factors affected in awareness of labor pain management among antenatal mothers and effective pain management methods used during labor

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ABSTRACT

Childbirth is frequently going through by pain. Many communities have sought to avoid pain treatment for reasons. Pain affecting on adverse effects to the both mother and to the fetus. If the untreated pains are occurring on the labor mothers get very much of disadvantages by it and this is causing to get hyper ventilation and also many kinds of systemic errors in mothers' body in order to the generating pains lower to severe with reaching delivery the fetus by dilating birth canal.

There are lot of factors are affected on awareness about pain management methods for the deliveries. In safer manner is the knowing about effective and suitable one is which is the is most important to the mothers. There are pharmacological and non-pharmacological methods are in the practice. Mostly women are like to use opioids, epidurals as pharmacological methods and massage therapy, breathing techniques are as non-pharmacological methods.

If the mother is not aware on labor pain relief methods that is fairly missing taking a labor analgesic method during their delivery process.

Key words: awareness, Labor pain, antenatal mothers, associated factors

1. Introduction

Labor pain is often regarded as one of the most painful processes that humans can endure. As a result, more effective types of reduce labor pain are being sought in order to reduce the pain and stress experienced by the mother during childbirth. If mothers are aware on labor analgesia is best to use during their child birth process.

As a result, effective pain management methods are can use for reduce the labor pain. There are many kind of pain management methods and mainly two kind of types are in practice in order to reduce practice (Delwatta et al., 2019).

Prenatal education manages the good level for a healthy pregnancy. Prenatal education encourages antenatal care, facing to labor, and postnatal care (Armstrong, 2000). Mainly the hospital setting they provide educational sessions

and health care professionals are used to give health education on pre-natal knowing points for give better care in their hospitals. (Armstrong, 2000).

In a developing country like Sri Lanka there is a birthrate of 15.1% per 1000 population that is much importance and should give prenatal education on their pregnancy period. Considerable factors should be identified for awareness on labor pain management methods and should be address on it. There should be a greater impact on selecting and using a labor analgesic on their delivery process.

2. Methodology

This research was mainly designed to analyze the research objectives of collecting, summarizing, categorizing and analyzing the academic journals and articles of the topic of the awareness of labor pain management among antenatal mothers and effectiveness of pain management during labor. A comprehensive literature review was performed with identified journals and articles to analyze the research objectives of chosen above topic. Articles published in relevant to the topic “available pain management method”, “awareness regarding the labor pain management among ante-natal mothers” and “effectiveness of pain management used during labor” covering the period 2012 to 2020 were gathered to analyze the research objectives.

Choosing the literature review as the methodology is benefitting in advancing the researcher’s knowledge about the subject area and to collect useful information and recent finding about the research topic. Literature review as the methodology includes the stages of identifying and searching appropriate literature, summarizing the literature and analyzing the findings and information available in previous literatures of the same topic. Literature review methodology is commonly following qualitative data analysis method such as thematic analysis.

According to Thomas G. Carpenter Library (n.d.) use of literature review as a methodology to analyze the research objectives are brining following benefits and advantages.

A. identifying of the current level of studies relevant to the chosen research subject

B. analyzing of research gap in the previous researches about the research topic that require more researches.

This research study analyzing was based on secondary data study and used literature review method by using previous researches, previous web articles, and many more available internet sources.

Excluded selected appropriate literatures deeply reviewing for generate terms and themes. This made the searching fast, The key terms are “ Available labor analgesics”, “ Awareness regarding the labor pain management among antenatal mothers”, “ Factors affecting on using a pain reliving method”, “ Analyze the effectiveness of pain management used during labor”, “ Mothers attitude towards labor analgesia”. The below result has been obtained from the search result.

The data analyzing method is thematic analyzing method for analyze this research issues. In this research is based on secondary data and qualitative research, Thus generating themes for analyze the themes by thematic analyzing

3. Results and Discussion

In this research the researcher is firstly attempting to find answers for the research objective 3 that is looking to find out the factors affecting on using a pain management method. The research objective 4 is about the analyzing effective method for managing labor pain used during labor also attempting in the analysis using the identified 8 literatures.

In here identified number of recurring codes in all 8 literature and few other codes not recurring in few literatures relevant to the topics "Available labor pain management method", "Awareness of labor pain method among mothers", "Factors affecting on using a pain management method" and "Effective labor pain management method". Among the factors affecting on using a pain management method, "education status", "Young mothers", "Multiparous mothers" were found in literature 3, 4, 5 and 6. Among the Effective labor pain management method, "massage techniques", "Opioids", are found in literature 1. "Epidural", "Opioids" are found in literature 2. "Massage techniques", "Breathing techniques", "Acupuncture" is found in literature 7 and "Epidural" found in literature 8.

5.2. Topics developed and themes generated

Literatures	Factors affected on using a labor pain management method	Effective pharmacological methods	Effective non-pharmacological method
1		Opioids #Pethidine	Massage techniques
2		Epidural Opioids #Pethidine	
3	Educational status Young mothers		
4	Educational status		
5	Educational status	Epidural	

	Young mothers		
6	Multiparous mothers Educational status		
7			Massage techniques Breathing techniques
8		Epidural	

Summarize literature supporting 7 themes

Themes	Lit.1	Lit.2	Lit.3	Lit.4	Lit.5	Lit.6	Lit.7	Lit.8	Total
Educational status			✓	✓	✓	✓		✓	5
Young generation			✓		✓			✓	3
Multiparous mothers						✓	✓		2
Opioids	✓	✓							2
Epidural		✓			✓			✓	3
Massage techniques	✓						✓		2
Breathing techniques	✓					✓	✓		3

According to the generated themes in this research in order to the literature review, affected factors using a labor analgesia are educational status, young generation and multi parous mothers. There were 5 theme findings for the theme under educational status. Supported literatures were from literature 3, 4,5,6,8.

There were three findings for the theme under young generation, it was supported by literature 3, 5, 8. And finally there were 2 findings for the theme under multi parous mothers, it was supported by literature 6, 7.

According to the findings there is a most affected issue for using a labor analgesia is educational status. Then young generation like to use labor analgesia than other ages and previous experienced mothers like to use a labor analgesia other than primiparous mothers.

4. Conclusion of research

According to the themes generated and finding of this research there are two pharmacological effective methods are using by mothers and those are epidurals and opioids such as pethidine. Anyhow founded non-pharmacological methods are breathing techniques and massage techniques. Thus, all methods are can found in our country to use as a labor analgesic. In this research find out some factors which affected on awareness regarding the labor analgesia. Those are educational status, age and previous labor experiences. Those are mainly affected on awareness of labor analgesics among antenatal mothers.

In this research there are many themes excluded and point out many solutions for the research issue. After the analysis and conclusion gotten by this research there are many recommendations can be given to the next level. There are Increase awareness program, Increase government & private sector involvement on pre-natal education, Increase media literacy, Reduce gap between literacy and level of pre-natal education session, Facilitate on participate antenatal classes at any stage of pregnancy without any barriers, Personal involvement by health care workers are my recommendations on this research findings thus can give awareness on labor analgesia for pregnant women and can minimize the issue.

Giving a suitable pain relief method with aware regarding labor pain is much important.

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STRUCTURAL AND MORPHOLOGICAL ANALYSIS OF GRAPHENE OXIDE USING VEIN GRAPHITE AT DIFFERENT MINES, SRI LANKA

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Abstract

Graphene can be considered as a minimally limited layer of graphite. Graphene has a monolayer of sp^2 hybridized carbon-carbon atoms arranged in a two-dimensional hexagonal lattice structure. The most common chemical route to get graphene is through the reduction of graphene oxide (GO), which is obtained during the exfoliation of graphite. GO is an atomically thin, semi-aromatic network of sp^2/sp^3 bonded carbon atoms intermittently decorated with oxygen-containing functionalities. These functional groups include hydroxyl (OH), epoxy (C-O-C), carbonyl (C=O), and carboxyl (-COOH) species, with OH and C-O-C bending the dominant groups across the GOs basal plane. These abundant oxygen groups lead to its hydrophilicity and allow excellent dispersion and stability of GO in many common solvents that attract significant interest for applications in electronic devices. Modify the Tour method was used to synthesize three different graphite samples (Sri Lankan vein graphite sample collected from Kahatagaha graphite mine; Sri Lankan vein graphite sample collected from Bogala graphite mine; and expanded graphite sample). The sulfuric acid, boric acid, $KMnO_4$, and H_2O_2 were the chemicals used for the preparation of GOs. For purification purposes, HCl and DI water were used. The structure was confirmed by Fourier Transform Infrared spectroscopy (FTIR-ATR), Scanning Electron Microscopic (SEM) images, Raman analysis and X-ray diffractograms (XRD). This study concludes that the change of the graphite source leads to different morphological and structural GOs. Using XRD data, the d-spacing of graphite and GOs was found to be 3.34 Å and 9.66 Å, 3.36 Å and 8.14 Å, and 3.34 Å and 8.09 Å in Kahatagaha, Bogala, and expanded graphite samples, respectively. Using Raman spectra, the I_D/I_G ratio of the Kahatagaha, Bogala, and expanded graphite samples was 0.89, 0.87, and 0.94, and the three types of GOs have ~ 2.3 number of layers.

Keywords: Graphene Oxide, Expanded graphite, Modified Tour's method

1. Introduction

Graphene-based materials are playing a great role in the world in every aspect. Among these, graphene is one of the most recent miracle materials. In particular, it has many applications in the electronics world since it is the thinnest, transparent, strongest, and conductive material (Habte et al., 2019). Synthesis of graphene oxide (GO) is achieved by placing graphite in concentrated acid in the presence of an oxidizing agent. The Tour method demonstrated a less hazardous and more efficient method for graphite oxidation and its modified versions are presently the most commonly used methods for the oxidation of graphite (Becerra-Paniagua et al., 2019). This study was carried out using vein graphite from the different mines of Sri Lanka and three different graphite samples were selected, as starting materials. Different graphite samples were used to compare the final GO's morphologies and structures. This was mainly carried out using sulfuric acid, boric acid, and potassium permanganate excluding sodium nitrate which emits toxic gases into the environment. Even though this method is green.

2. Experimental

GO was synthesized using three different Sri Lankan vein graphite samples from Bogala and Kahatagaha graphite mines and expanded graphite samples separately. Graphite powder (3g) was added to a mixture of H_2SO_4 and H_3BO_3 (acid ratio of 300 ml: 3000 mg) at 20 °C under reflux and magnetic stirring for 30 minutes. Then, KMnO_4 (24g) was slowly added to the beaker. Then, KMnO_4 (24g) was slowly added to the beaker. The reaction mixture was maintained at 40 °C under reflux and magnetic stirring for 60 min. Then the mixture was poured into the ice bath and DI water (600 ml) was added. The solution was heated to 70 °C and kept there for 30 minutes while stirring. The reaction was finished by adding 90 ml H_2O_2 (50%). After the centrifugation, the resulting powder was purified 3-5 times with dilute HCl and DI water until the pH of the solution became neutral. In each wash, the mixture was centrifuged and the supernatant was decanted away. The obtained precipitate was dried overnight at 60 °C to give the solid product. The GO sheets were obtained by adding 100 ml of DI water to 10 mg of the dried powder and were exfoliated with an ultrasonic bath for 2 hrs. Structural evolution of the product was done using Raman analysis, X-ray diffractograms (XRD) and Fourier Transform Infrared spectroscopy (FTIR-ATR). Morphological analysis was done using scanning electron microscopic (SEM) images.

3. Results and Discussion

XRD spectra of graphite samples and GOs shown in figure 1. The presence of diffraction peaks at 9°-10° confirms the (001) plane in Gos. The mean value of crystalline size (D), d-spacing and number of layers (n) of GO samples were calculated using Bragg’s law and Scherrer equation (Sharma et al., 2017). The d-spacing of graphite and Gos were found to be 3.37 and 9.71 Å, 3.36 and 8.14Å , 3.34 and 8.09 Å respectively in samples of Kahatagaha graphite, Bogala graphite and expanded graphite.

$$d = \frac{\lambda}{2 \sin \vartheta} \tag{1}$$

$$D = \frac{k\lambda}{\beta \cos \theta} \tag{2}$$

$$n_l = \frac{D}{d} + 1 \tag{3}$$

Where, λ is the wavelength of X- ray used (1.5406 Å), θ is the half of the diffraction angle present in the diffractogram at around $2\theta \sim 9.1^\circ$. The value of the k depend on the shape of crystallite and corresponds to the diffraction angle of θ . For spherical shaped crystallites cubic unit cells, the value of k are taken as 0.89 (Sharma et al., 2017). The calculated values of d-spacing, D and n_l for synthesized GO powder are 9.71Å, 1.41nm and 2.45 for Kahatagaha sample, 8.14Å, 0.98 nm and 2.20 for Bogala sample and 8.09Å, 0.98nm and 2.21 for expanded sample.

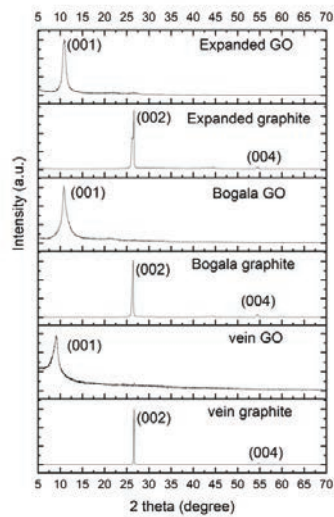


Figure 1: XRD pattern of GOs and graphite samples

All the peaks of the Raman spectra fitted the Lorentz curve fit as shown in figure 2. The intensity ratio (I_D/I_G) between the D and G bands in Raman spectra is frequently used for characterization of diamond-like carbon films in order to estimate the number and size of the sp^2 cluster (Becerra-Paniagua et al., 2019). The (I_D/I_G) ratio of the samples of Kahatagaha graphite, Bogala graphite and expanded graphite are 0.89, 0.87 and 0.94 respectively.

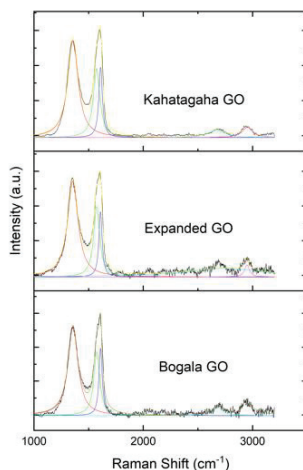


Figure 2: Raman spectra of graphite, synthesized GO using Bogala graphite powder Kahatagaha graphite powder and expanded graphite sample

The surface functional groups of GOs were investigated by Fourier-transform infrared spectroscopy (FTIR). The infrared spectra of GO were processed using Origin Pro, and are shown in Figure 3. In the case of GO, a broad absorption band in the range of $3670\text{--}2900\text{ cm}^{-1}$ indicates the presence of free and intermolecular bonded hydroxy groups (Ain, Haq, et. Al, 2019). The peak at $\sim 1720\text{ cm}^{-1}$ represents the stretching mode of carbonyl (C=O) bonds in both ketone and carboxylic acid groups located on the edge of the GO sheets (Becerra-Paniagua, et al., 2019). The peak at $\sim 1550\text{ cm}^{-1}$ can be attributed to the C-C vibrational bonds in the aromatic rings ($1600\text{--}1550\text{ cm}^{-1}$) of the graphene skeleton (Becerra-Paniagua et al., 2019). Peak at $\sim 1400\text{ cm}^{-1}$ corresponds to the bending mode of hydroxyl groups (O-H) over the basal plane (Becerra-Paniagua et al., 2019). The peaks at $\sim 980\text{ cm}^{-1}$ and $\sim 1220\text{ cm}^{-1}$ represent the bending and asymmetric stretching modes of the epoxy C-O-C group, respectively, and the peak at $\sim 1040\text{ cm}^{-1}$ is the characteristic vibration of alkoxy C-O groups. The peak at $\sim 1278\text{ cm}^{-1}$ corresponds to phenolic groups Ar-OH , with the C-OH stretching vibrations at $\sim 1375\text{ cm}^{-1}$ (Becerra-Paniagua et al., 2019).

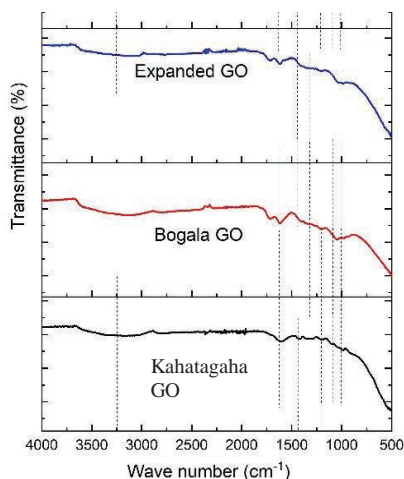


Figure 3: FTIR spectra of synthesized GO using Bogala graphite powder Kahatagaha graphite powder and expanded graphite sample

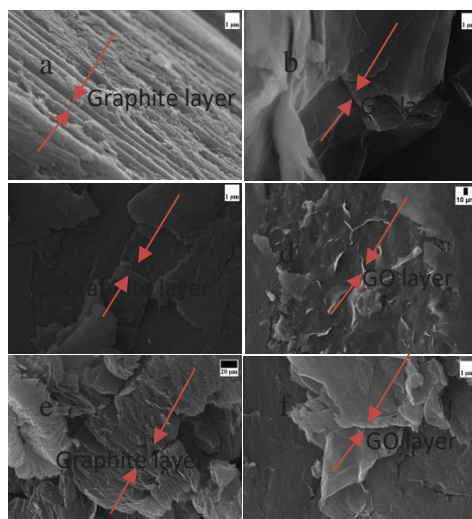


Figure 4: SEM images of (a) Kahatagaha vein graphite, (b) synthesized GO sample using Kahatagaha vein graphite, (c) Bogala graphite powder, (d) synthesized GO using Bogala graphite powder, (e) Expanded graphite, (f) synthesized GO using expanded graphite sample

The surface morphology of the synthesis GOs was examined using SEM. Figure 4(a) shows SEM images of Sri Lankan natural vein graphite with individual needle-shaped particles, implying that the Kahatagaha graphite sample is the starting material for the GO synthesis process. Figures 4(b), 4(d), and 4(f) depict a surface with a loose sponge structure and a thin wrinkle sheet.

4. Conclusions

In summary, GOs powders were successfully produced by the modified Tour method. Analysis results indicated the GOs could be prepared successfully. This study concludes that the change of the graphite source leads to different morphological and structural GOs with a lower number of layers.

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Establishment and Validation of a Multiplex Polymerase Chain Reaction (PCR) for Detection of Pathogenic Fungal Species in Clinical Specimens

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Abstract

Invasive fungal diseases like Candidiasis and Aspergillosis have become more important causes for the mortality and also morbidity of people mainly who are hospitalized. Although discovered anti-fungal agents are potentially used for their treatments for patient management, diagnosis with the accurate infection would be really supported for clinicians to cure the disease with the use of most effective anti-fungal agents. Traditional diagnostic methods for fungal diseases have been replaced with emerging molecular diagnostic techniques with high accuracy and specificity along with less time consumption. The goal of the present study was to establish and validate a Multiplex PCR assay at Lanka Hospital Molecular diagnostic laboratory, Narahenpita, Colombo 05 for identification of fungal pathogens like *Aspergillus fumigatus*, *Candida tropicalis* and *Candida glabrata*. Most of the invasive fungal diseases are caused by the above mentioned species and definitive diagnosis would really helpful for efficient treatment without going through a general plan of anti-fungal therapy. Six reference culture samples (n=6), two from each fungal species were obtained from the Microbiology department at Lanka Hospitals Diagnostics (LHD) for the optimization of multiplex PCR assay. Fungal genus and species-specific primers were selected based on Luo and Mitchell, 2002. Reference culture samples obtained from Microbiology laboratory were used for optimization of PCR programme and the analytical validation of the PCR assay at the Molecular laboratory. The analytical sensitivity was performed using dilution series for each fungal pathogen selected and analytical specificity was done with ten different bacterial, viral and fungal positive nucleic acids and evaluated the performance using the optimized multiplex PCR assay. Invasive known positive clinical specimens (n=10) such as peritoneal fluid, cerebrospinal fluid and bronchoalveolar lavage etc. were used for the clinical evaluation of optimized assay. Most of the clinical specimens were indicated *Candida tropicalis* (n=5) and rest were detected as *Candida glabrata* (n=3), *Aspergillus fumigatus* (n=2) under clinical diagnosis and it was matched with the study performed Jayasekera et al., 2015 under prevalence of fungal infections in Sri Lanka. Clinical specificity of the assay was evaluated using known negative (n=10) clinical samples and both parameters were 100% accurate. The finding of this study would support for accurate diagnosis of fungal pathogens which is for better patient management with accurate treatment options to prevent most of the fungal infections rather performing a general practice to cure fungal diseases. Hence anti-fungal agents are quiet strong therapies leading to several side effects by the suspected patient.

Key Words: *Aspergillus fumigatus*, *Candida glabrata*, *Candida tropicalis*, multiplex polymerase chain reaction, invasive fungal infections

1. Introduction

Fungal infections have become a more challengeable task for most of the healthcare professionals since people are getting infected with many immunocompromised diseases gradually. In the current world cancers and HIV like infections have been showing remarkable evidences for such drops in the immunity in man resulting in providing better room for fungal pathogens to become invasive and making the condition more and more severe (Casadevall, 2018). Yeasts and moulds are the two basic forms of fungi that have been discovered and when consider different types of infections there are systemic infections which cause due to the direct entry of causative agent to lungs or becoming invasive through the site of skin opening such as a wound. The other type of infection is superficial infections mainly cause due to dermatophytes and sometimes cause yeasts and some non-dermatophyte moulds (Garber, 2001). In order to treat for fungal infections like Aspergillosis and Candidaemia, diagnosing the exact pathogen such as *Aspergillus fumigatus*, *Candida tropicalis*, and *Candida glabrata* in the clinical specimen would enable the consultant to decide the exact antifungal agent without considering general practices. When consider the global treating for infections caused by fungal pathogens has been treated in a way precise due to the development and intervention of novel strategies on laboratory medicine leading for successful management of patients (Chen *et al.*, 2018). Designing of specific primers or species-specific primers has been the major component on successful development of the multiplex-PCR assay. The development of the multiplex-PCR is difficult when compared to single reaction PCR using single set of primers, but it will really useful in routine analysis of different targets which may leads to definitive diagnosis within a short period of time and cost effective. In diagnosis of invasive fungal pathogens from clinical specimens, extracted genomic DNA was subjected to PCR assay using different genus and species specific primer pairs of multiple species leading to accurate diagnosis of the infected pathogen.

2. Experimental

Confirmed fungal cultures for species *A. fumigatus*, *C. tropicalis* and *C. glabrata* (6 isolates) were obtained from the Microbiology Department. Fungal gDNA extraction was carried out using QIAmp DNA Mini Kit (Qiagen, Germany) according to the manufacturer's instructions. Fewer colonies inoculated using a micropipette tip and added into 1mL of phosphate-buffered saline (PBS). Then the solution was concentrated to 200 µL using 180 µL of tissue lysis buffer (ATL Buffer), 25 µL of proteinase k (PK) and 1 µL of zymolase enzyme (50 µg/mL) (Ceygen Biotech, Sri Lanka) and then it was vortexed and pulsed. Solution was then incubated for 20 minutes at 56°C. Then 200 µL of Lysis buffer (AL buffer) was added and the sample was incubated at 70°C for 10 minutes. Ethanol, 96-100% (200µL) was added and transferred the whole solution (610 µL) to a QIAamp mini spin column. The gDNA bounded column was then purified with AW1 and AW2 buffers respectively. Finally the dried column was eluted to 100 µL of AE buffer followed by 1-2 minutes room

temperature incubation. A multiplex conventional PCR amplification was optimized and performed in a total volume of 25 µl consisting Master mixer Go Taq®Master (Promega company, U.S.A) containing MgCl₂, specific primer pairs, Taq DNA polymerase enzyme. Optimized PCR assay was validated using a broad spectrum of pathogenic species to test analytical specificity. Analytical sensitivity was performed to determine the minimum limit of detection (LOD). Performance of molecular based assay was evaluated using 10 clinical specimens each for clinical specificity and clinical sensitivity. The post PCR products were examined under UV tran illuminator followed by gel electrophoresis.

3. Results

Followings are the amplified DNA fragments separated after performing the optimization PCR assays using gel electrophoresis.

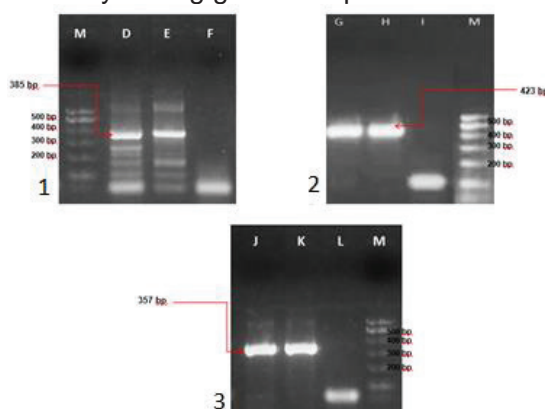


Figure 01 – Agarose gel electrophoresis of *A.fumigatus* optimization PCR.

Lane M – 100 bp DNA length ladder, Lane D – Reference sample with only AFUM1 and AFUM2 primers, Lane E – Reference sample with multiplex PCR primer panel, Lane F – Negative control

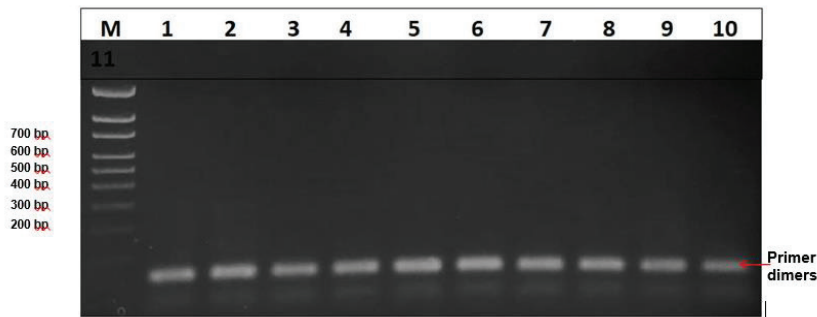
Figure 02 - Agarose gel electrophoresis of *C. glabrata* optimization PCR.

Lane G - Reference sample with only CGL1 and CGL2 primers, Lane H - Reference sample with multiplex PCR primer panel, Lane I – Negative control, Lane M – 100 bp DNA length ladder

Figure 03 - Agarose gel electrophoresis of *C.tropicalis* optimization PCR.

Lane J - Reference sample with only CTR1 and CTR2 primers, Lane K - Reference sample with multiplex PCR primer panel, Lane L – Negative control, Lane M – 100 bp DNA length ladder

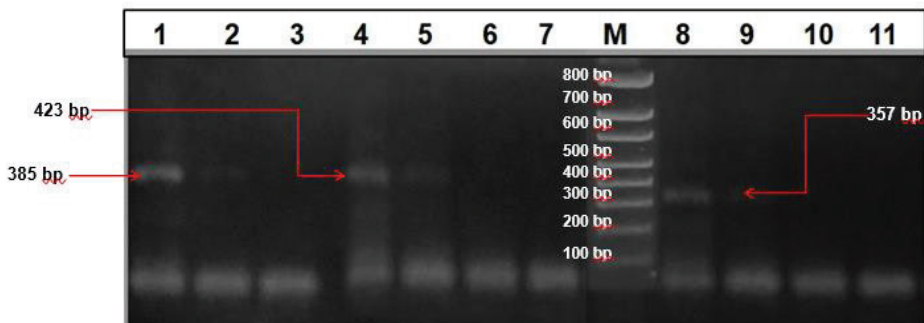
A variety of genetic material of varying pathogenic species were tested and evaluated using the optimized multiplex PCR assay and confirmed that it specified to the respective fungal species only, and none of the other tested pathogens have not shown any product in the gel shown in figure below.



Agarose gel electrophoresis of positive nucleic acids of varying pathogenic species were analyzed using the optimized multiplex PCR assay.

Lane M -100 bp DNA length ladder, Lane 1 – *Pneumocystis jirovecii*, Lane 2 – Parvo virus, Lane 3 – *Varicella zoster virus*, Lane 4 – *Leptospira*, Lane 5 - *Campylobacter*, Lane 6 – *Epstein barr virus*, Lane 7 – *Toxoplasma gondii*, Lane 8 – *Chlamydia trachomatis*, Lane 9 – BK virus, Lane 10 – Cytomegalovirus

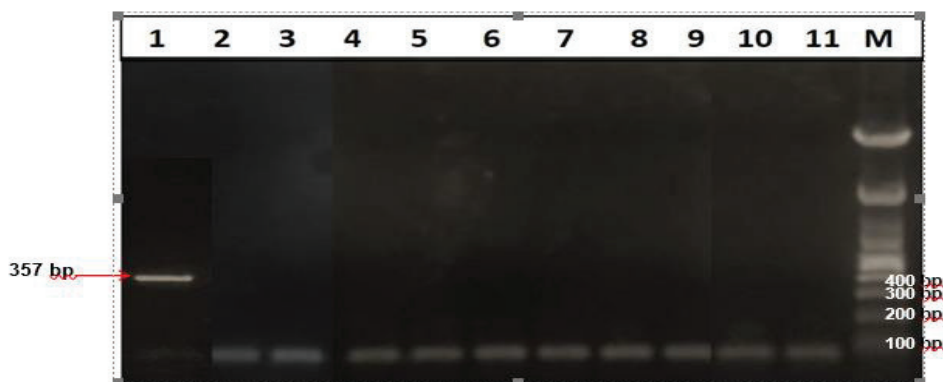
Following on gel electrophoresis represents the results of analytical sensitivity of the PCR assay.



Agarose gel electrophoresis of dilution series performed for all the three species with varying DNA concentrations to find the LOD of the optimized assay.

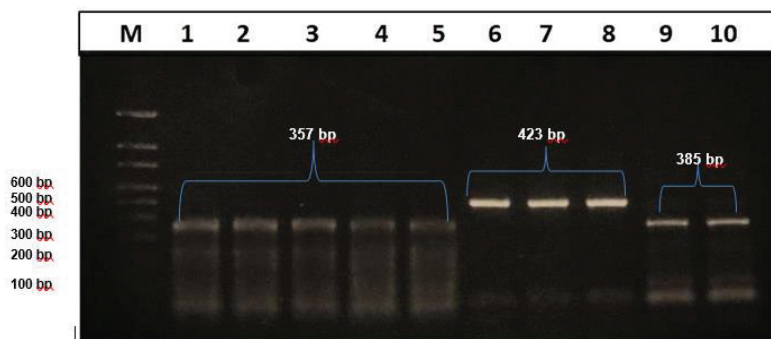
Lane 1 – 10^3 *A.fumigatus*, Lane 2 - 10^2 *A.fumigatus*, Lane 3 – 10^1 *A.fumigatus*, Lane 4 – 10^4 *C.glabrata*, Lane 5 – 10^3 *C.glabrata*, Lane 6 – 10^2 *C.glabrata*, Lane 7 – 10^1 *C.glabrata*, Lane M - 100 bp DNA length ladder, Lane 8 – 10^4 *C.tropicalis*, Lane 9 – 10^3 *C.tropicalis*, Lane – 10^2 *C.tropicalis*, Lane 11 – 10^1 *C.tropicalis*

Gel electrophoresis results of clinical/ diagnostic specificity is illustrated in figure below.



Agarose gel electrophoresis to evaluate the diagnostic/clinical specificity using the optimized molecular based diagnostic assay

Lane 1 – Positive fungal DNA, Lane 2 to 11 – Fungal gDNA which were confirmed as negative for fungal cultures by the department of Microbiology, LHD, Colombo.



Agarose gel electrophoresis of DNA fragments after performing the conventional multiplex fungal PCR optimized to evaluate the clinical/diagnostic sensitivity.

Lane M -100 bp DNA length ladder, Lane 1-5 – Known positive gDNA of *C.tropicalis*, Lane 6-8 - Known positive gDNA of *C.glabrata* and Lane 9 and 10 – Known positive *A.fumigatus* positive gDNA.

4. Discussion

The most common and significant problem that would face by clinical mycologists are difficulty in differentiating the exact fungal species which has been infected by the patient and several cases have been reported with clinically misdiagnosed by mycologist and that would cause for inappropriate treatment of the patient and the broad range of anti-fungal therapeutics which would not be answered. Since there are a variety of fungal species with similar morphological features (Wang et al., 2015), experts in the field are facing difficulties in identifying the actual pathogen

after performing standard microbiological diagnostic assays mainly by culturing in the laboratory. Although, the discovery of antibacterial agents is at the forefront along with effective clinical trials, limitation of the scientific publication and limited research facilities in Sri Lanka have been caused to reduce the clinical trials for development of anti-fungal agents. Moreover, this would be due to the structure and the formation of the fungal cell wall (Kang *et al.*, 2018). There are quantities of metabolic and structural targets in bacteria which show immense differences to human body as they are prokaryotes, while fungi are eukaryotic organisms with similar characters to both the fungal pathogen and the host with toxicity which leading to one of the most barriers for medical mycology researchers (Chatrath, Kumar and Prasad, 2022). The other challenge which is faced by scientists and clinicians is the results obtained from in vitro experiments have not been compatible with the results extracted from experiments done in vivo. To overcome this particular challenge, the first attempt should be identification of most accurate fungal pathogen which caused the infection. However, the available laboratory identifications of fungal infections has not really helpful to find the best solution since those microbiological detection assays cannot issue the reliable results for fungal pathogen with low analytical specificity which would not be accurate as much as the clinicians expected (Khot & Fredrick, 2009). Even though the detection is accurate, the resistant caused by certain fungi to respective fungal therapeutics has to be avoided which is called as primary resistance but the selection should not be secondary resistant or drug induced to the particular drugs used (Chen *et al.*, 2021).

5. Conclusions

Compared to other available diagnostic methods, molecular identification is the most reliable way with both high analytical and clinical specificity and sensitivity and the work presented here has concluded that the assay established in the local laboratory is cost effective and time saving method than the available microbiological techniques.

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Investigation the Effectiveness of Multiplex Nested Polymerase Chain Reaction for genotyping of Hepatitis C Virus.

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Abstract

The genome of the HCV has several types of variations which caused for genotyping and sub typing. HCV genotypes have variations with different clinical profile which are caused to chronic post transfusion hepatitis, liver cirrhosis and hepatocellular carcinoma in HCV infected patients. It has been taken great effort to establish therapeutic strategies against HCV infection during the past decades for prediction of the clinical course and the outcome of antiviral therapy. Therefore, laboratory identification of HCV genotypes is important for effective treatment and it would be an epidemiological marker for to prevention and control of the disease spreading. PCR technique is the most-effective, easy performable way for the HCV genotyping and also HCV RNA detection. Objectives of the present study were to establish laboratory diagnostic assay for definitive diagnosis of genotypes of HCV and to determine of HCV genotypes in clinical samples. A multiplex nested PCR for HCV genotyping was established and evaluated at the Molecular Diagnostic laboratory of the Lanka Hospital Diagnostic (Pvt) Ltd (LHD), Narahenpita, Colombo 05, Sri Lanka using the reference samples (n=5) and serum samples (n=10) which were obtained from the Molecular Diagnostic laboratory of LHD. HCV genotypes specific primers, used for multiplex nested PCR were selected based on those reported previously on Ohno et al., 1997. Established nested PCR products were analyzed by the agarose gel electrophoresis. Genotypes 1a, 1b, 2b, 4 and 3a were detected in selected 15 serum samples. Most samples were indicated genotype 1b (n=6) followed by genotype 1b (n=4), genotype 2b (n=3) by 1 samples from 4 and 3a respectively. According to the study of Ohno et al., 1997 most common subtype in Sri Lanka is 1b and reported genotype prevalence order is 1b>1a>2b>3a>4 in Sri Lankan population which confirmed our results. Multiplex Nested PCR assay can be used to inexpensive and sensitive and accurate results to patient to diagnose alternative to HCV genotype and capable to test routing diagnostic laboratory. It may have led to take out better treatment, patient evaluation, reduce the HCV spreading, improved treatment optimization and moreover, In Sri Lankan patients may be a

valuable observation to huge-scale genotyping project with national level to the worldwide. Which have taken results with six genotypes, most prevalent genotype was to be 1b with this study.

1. Introduction

Hepatitis C virus infection (HCV) is globally significant health issues caused by the RNA virus of the family *Flaviviridae* (Senevirathna *et al*, 2011; Choo *et al*, 1989). It is a blood-borne virus causes of chronic viral hepatitis, and also cirrhosis and hepatocellular carcinoma. This infection has become one of the most serious health impact in the world because it is the most common cause of malignant and severe liver diseases in many countries (Afshari *et al*, 2014; Khaja *et al*, 2006). Recent epidemiological studies have indicated that the prevalence patterns of hepatitis C virus (HCV) vary widely in different continents and countries (Kumar *et al*, 2017; Senevirathna *et al*, 2011). The transmission of virus to the host mainly indicate though using infected blood and blood products for un-sterilized surgical instruments, dental surgical instruments, blood transfusion, common needle injection, the use of illegal drugs, the sharing of daily use things of an infected person and acupuncture. Sexual transmission and interfamilial transmission also have reported as the route of virus transmission. Hepatitis C virus genome is the diminutive single-stranded positive sense RNA (ssRNA) molecule of approximately 9.6 kb in length. HCV genome sequence exhibits significant genetic heterogeneity and divergence which based to several classifications. Although, recent classification of HCV includes six major genotypes such as 1a, 1b, 2a, 2b, 3a, 3b, 4, 5a, and 6a with 70 subtypes (Franco *et al*, 2007). The genotypic classification of HCV is the key factor for geographical and demographic differences and molecular epidemiology studies. Further, clinical manifestation, therapeutic decision - making, vaccine development, response to prognosis and treatment of HCV infection and the study of chronic HCV infection also based on classified genotypes and subtypes. Therefore, clinical and laboratory diagnostic tests to determine HCV genotypes is important for antiviral treatment, development of health planning and policies (Kumar *et al*, 2017; Afshari *et al*, 2014).

2. Methodology

Molecular based assay for HCV genotyping was optimized with the selected primers, Ac2 and Sc2 which are the antisense and sense outer primers to core region of the HCV genome. The inner primers which are used for nested PCR for amplifying of specific genotypes. There is a specific band size to amplify for the genotypes which are the following PCR. Genotype 1a has a 208 bp size, 234bp size for genotype 2a, 337bp for genotype 3a, and 3b genotype has 232bp, and genotype 4 has 99bp composition, 320bp for genotype 5a and 336bp for genotype 6a. The sequences and nucleotide positions of the primers of this study is shown in result section Table 1.

Table 1: Details of primers used for genotyping, as described by (Ohno *et al.* 1997)

Primers	PCR round	Sequence (5'–3')	Nucleotide position
Sc2	1	GGGAGGTCTCCTTCGTAGATCGTAGACCGTGC ACCATG	24-3
Ac2	1	GAG(AC)GG(GT)AT(AG)TACCCCATGAG(AG)TC GGC	417-391
Mix A			
S7	2	AGACCGTGCACCATGAGCAC	12-8
S2a	2	GGATAGGCTGACGTCTACCT	40-60
G1b	2	CCTGCCCTCGGGTTGGCTA(AG)	222-203
G2a	2	CACGTGGCTGGGATCGCTCC	178-159
G2b	2	GGCCCCAATTAGGACGAGAC	325-306
G3b	2	CGCTCGGAAGTCTTACGTAC	164-145
Mix B			
S7	2	AGACCGTGCACCATGAGCAC	12-8
G1a	2	GGATAGGCTGACGTCTACCT	196-177
G3a	2	GCCCAGGACCGGCCTTCGCT	220-211
G4	2	CCCGGGAACCTTAACGTCCAT	87-58
G5a	2	GAACCTCGGGGGGAGAGCAA	308-289
G6a	2	GGTCATTGGGGCCCCAATGT	334-315

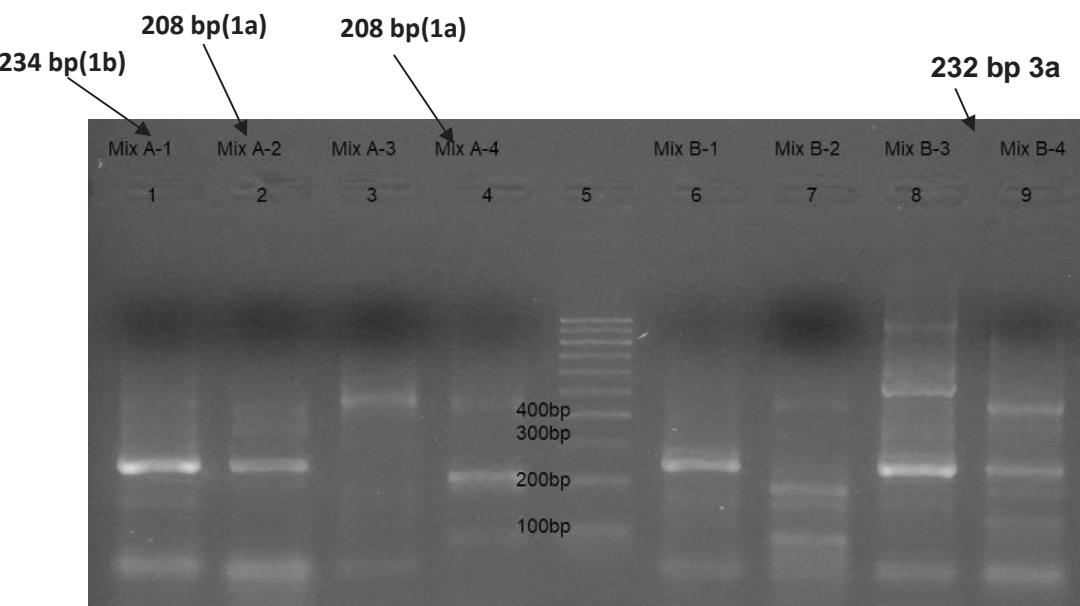
When the optimization of Multiplex Nested PCR, A conventional Multiplex Nested PCR was performed according to the method described by Kumar *et al.*, 2017 with some modifications using primers that were selected according to those reported previously (Ohno *et al.*, 1997) and reference RNA of HCV Genotypes. The PCR products were analyzed using a gel electrophoresis apparatus on a 1% agarose gel stained with ethidium bromide to examine the amplicon sizes by visualizing PCR products under a UV detection system.

3. Results

Results was obtained by using 15 samples collection and it performed five genotypes such as 1b, 1a, 2b, 3a and 4 (Figure 1 and Figure 2) . Most prevalence genotype according to this study were 1b and 1a, 2b, 3a and 4 which was previously confirmed and reported (1b>1a>2b>3a>4) in Sri Lankan population. There was ten of females indicated HCV genotype and other five for males in this research. This identification given which are the HCV genotypes infected to the Sri Lankan population by using molecular method and genotype 3b, 5a and 6a has not reported any results for this 15 samples related to HCV genotype.

Figure 1: Agarose gel electrophoresis of the PCR products of the HCV genotyping- Laboratory testing - unknown sample 1, 2, 3, and 4

Lane 1 – sample 1 - Mix A-1, Lane 2 - sample 2 - Mix A-2, Lane 3 – sample 3 - Mix A-3, Lane 4 - 4 - Mix A-4, Lane 5 - Marker (100bp ladder), Lane 6 - sample 1 - Mix B-1, Lane 7 - sample 2 - Mix B-2, Lane 8 – sample 3 – Mix B-3, Lane 9 – sample 4 - Mix B-4



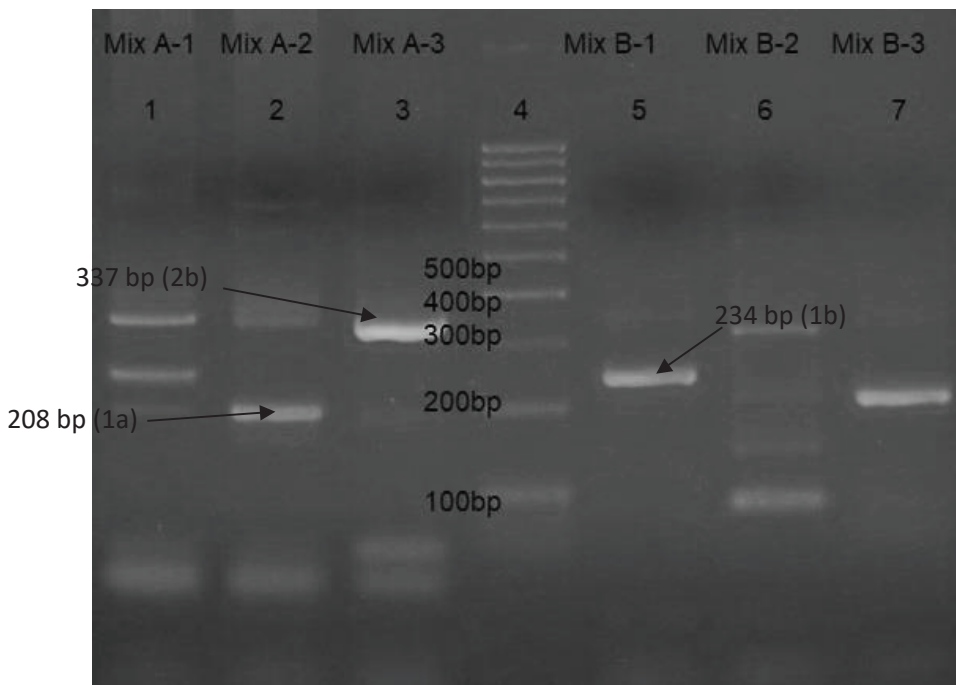


Figure 2: Agarose gel electrophoresis of the PCR products of the HCV genotyping- Performance evaluation- Known sample 5, 6, and 7

Lane 1 – sample 5 - Mix A, Lane 2-sample 6 - Mix A, Lane 3 – sample 7 – Mix A, Lane 4 - Marker (100bp ladder), Lane 5 - sample 5 - Mix B, Lane 6 - sample 6 - Mix B, Lane 7 – sample 7 – Mix B

PCR products of the multiplex nested PCR were analyzed using the agarose Gel electrophoresis which patterns of PCR products were used to get various genotypes. All of this study samples were tested by multiplex nested PCR of Mix A or Mix B and analyzed by agarose Gel electrophoresis. Mix A related with HCV genotypes 1a, 2a, 2b and 3b and also Mix B allowed to detection of the HCV genotypes 1a, 3a, 4, 5a and 6a with specific detections. Mix A and Mix B designed with some of specific genotype products and different sizes of PCR harvest and which helped to evaluate the gel images easily.

4. Discussion

The goal of this study was to establish molecular based assay in a local molecular diagnostic laboratory to determine the local prevalence of HCV infection and overall 15 samples were tested for HCV genotyping, Of the 15 samples, 5 were known samples that used for optimization and evaluation of the multiplex nested PCR and other 10 unknown samples were tested with the optimized assay. Of the 15 samples, six samples were detected for genotype 1b, four samples have shown genotype 1a, three samples have shown genotype 2b and genotype 3a and 4 has detected by one sample. As a result of this study, 1b is the most common subtype in Sri Lanka. HCV can be identified genetically heterogeneous which strains grouped in to six major genotype and this virus is considered as the major

geographically distributed infection of the world (Senevirathna *et al.*,2011). Multiplex Nested PCR method is the most convenient and cost-effective technique to test or analyst genotype of HCV in Sri Lanka. According to the results, subtype 1b has the highest prevalence and subtypes 3a and 4 have shown the lowest prevalence. Subtypes 1a and 2b reporting frequent prevalence than others. However, subtype 2a, 3b, 5a and 6 did not identified as prevalence in this study.

Multiplex, Nested PCR method acts very important role for finding HCV genotyping in Sri Lankan population. There are number of advantages and few disadvantages with this method when comparing other methods. When observation and testing the HCV genotyping using this Nested PCR, there are two types of primers have been selected to reduction the non-specific binding to enhance the specificity which PCR reaction. Nested PCR method the best way to identify 16s RNA analysis and the microbial identification and chemical, additional reagents not require to performed the conventional PCR reactions. Genetic polymorphism and phylogenetic analysis are some of benefits and sensitivity, 100% accuracy and specificity given with this method.

5. Conclusion

According to this study, most prevalent genotype was 1b. Multiplex Nested PCR assay is a cost-effective, 100 % accurate test for HCV genotyping with minimal labour involvement in a routing molecular diagnostic laboratory. Further, this test may lead to perform better treatment, patient evaluation and reduction of the spreading of HCV infection at the national level and also globally.

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Evaluation of the Radioactivity of Building Materials and Estimation of Their Health Hazard Levels in Sri Lankan Context

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Abstract

Out of 20,950,037 of population, nearly 23530 of new cancer cases which lead to 14013 of patients' death, are reported (International Agency for Research on Cancer, Sri Lanka, [1]). Due to building materials, there are two possible risk of cancer formation. One of such effect is irradiation of the human body by gamma-rays and other one is irradiation of the lung tissues by Rn^{222} . Both causes are vital and cannot ignore any longer as cancer risk on lung placed 3rd in row [2]. It can be predicated that Radon held somewhat responsible on the part of lung cancer formation. Authors have no intention on directly related increase of cancer risk during the past decade [3] with the building materials yet Sri Lanka never assess risk factors by considering construction and building construction materials which is major engagement of mankind. It is high time to evaluate the radiation level in construction materials used in Sri Lanka and associated risk of them. If the level is beyond the threshold limit, it is vital important to bring regulation forward by respective authorities.

Keywords: Radioactivity, Building Materials, Health Hazard, NORM, TENORM

Introduction

Radioactive materials containing radionuclides of natural origin are known as NORM (naturally occurring radioactive material). Some minerals have significant levels of natural radionuclides that are extracted and processed with other elements. Some industries involve processes that concentrate natural radionuclides and then may cause some risk to the workers and members of the public if the exposures are not under control. These naturally radioactive materials that are concentrated by some industries are known as TENORM (technologically enhanced naturally occurring radioactive material). The industries which used extracted and processed radioactive materials are usually monitored and controlled by Radiation Protection and Regulatory Authorities. The most important radioactivity source in TENORM is isotope products of the uranium and thorium

decay chains. The presence of radioactive materials of natural origin in geological formations are well known. The materials containing natural radionuclides found in most building materials particularly in those with mineralogical origin, natural radioactivity is evident. Generally, radioactivity in building material originates from the natural decay chains

U^{238} , Ra^{226} and Th^{232} as well as from the primordial radionuclide K^{40} . External radiation exposure by gamma radiation and beta particle emissions plus internal exposure due to inhalation of Rn^{222} cause chronic exposure of the public. Due to increasing indoor habitation of persons - in average about 80 % of live-time persons stay indoor - external and internal exposure caused by building materials are of increasing importance. The element that generates almost half of the natural radiation is radon. Radiation exposure of the population can be increased appreciably by the use of building materials containing above-normal levels of naturally occurring radionuclides of terrestrial origin, as high as 1600 Bq kg⁻¹ for K^{40} in granites, 700 Bq kg⁻¹ for

Ra^{226} in phosphogypsum and 360 Bq kg⁻¹ for Th^{232} in granites. The most common medical complications are radiation sickness and cancer. Moreover, radiation affects the lungs by developing lung cancers.

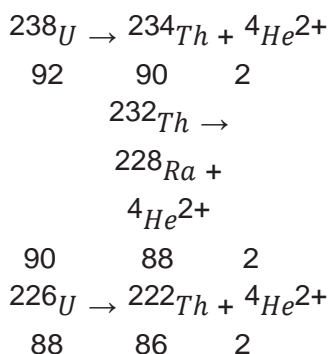
Civil engineers often focus their attention on the ultimate limit states of the bearing capacity and the quality of the structure. However, they forget that buildings are primarily intended to serve people. Mentioned in below are some examples of radioactive effects of concrete, which may be neglected in the process of design and construction. However, their impact on people's health and even life is significant.

Natural radioactivity (ionizing radiation) comes from natural radioactive elements present in soil, rocks, air and water. Examples of such natural sources include:

- cosmic rays penetrating the lower layers of the atmosphere;
- minerals, mostly rocks and derivatives thereof;
- secondarily, animated nature: plants and animals;
- Radiation resulting from human activity (mining of radioactive elements (uranium), the processes of burning fossil fuels containing radioactive elements).

Radioactivity is the transformation of the atomic nucleus, which is accompanied by the emission of radiation. Natural radioactivity is the spontaneous emission of α , β and γ radiation by naturally occurring unstable isotopes of elements. Alpha radiation is a reaction of radioactive decay in which helium nucleus ${}^4He^{2+}$ (the alpha particle) is emitted.² A stream of such particles emitted by decaying nuclei is

called α radiation.



Literatures shows that a man remaining in a closed or isolated and poorly ventilated room for 16hours a day receives a dose of 3 mSv (milisievert is the unit that specifies the amount of radiationreceived by a living organism). This dose is similar to the dose of natural radiation a person receives in 1 year (2 mSv per year is the IAEA recommendation and 1mSv per year is the Sri Lankan standard recommendation for general public). Comparing to the medical imaging: during an X- ray of the limb a person receives a dose of around 0.01 mSv, during X-ray of the chest receives adose of around 0.1 mSv and computer tomography of the brain 2 mSv. Surprisingly, the above- mentioned exposure thus corresponds to having lung X-rays every few days.

This situation cannot be neglected furthermore in Sri Lankan context. Even if we do not have uranium mines which produce radon concentration can reach as much as 30 000 Bq / m³, nuclear

power plant which produce radionuclide as byproducts, we do have massive building made of building materials such as brick, sand, steel, concrete, stone and roofing materials which has minor level of radionuclides atoms and their effect can be classified as follows;

(1) irradiation of the human body by gamma-rays

(2) irradiation of the lung tissues by Rn^{222} , particularly its decay products which are all solids, and the polonium radioisotope are alpha-emitters.

Moreover, scientist believe that there is high chance of radiation contamination of mineralogical aspect and air contamination due to Second World War and recent nuclear power plant accidents.

In 2011, R. Hewamanna *et al*/has founded the radiation activity level of clay bricks used in Sri Lanka 35, 72, and 585 Bq kg⁻¹ for ^{226}Ra , ^{232}Th and ^{40}K respectively. Further this study states that local clay bricks do not pose a radiological hazard [4].

Therefore, this is high time to analysis the cumulative radioactivity level of building materials (allinclusive) which we are currently practicing and evaluating their health hazard level for general public. This will facilitate to provide adequate measurement and regulation if the dose level exceeded the IAEA recommendation or the local recommendation.

Such study can be conducted by following proposed method. The radioactivity of building materials which are widely used in building constructions are red clay bricks, white bricks, concrete bricks, ceramic tiles, cement of Portland Type I with less than 3% fly ash and Type II withfly ash of 20%, sand and gravels, granite tiles and blocks, phosphogypsum and/or natural gypsum boards, perlite, isolating materials, steel and all type of roofing materials will be measured as bulk. The radioactivity of building materials can be determined in the Atomic and Nuclear Physics Laboratory, by direct gamma-ray spectroscopy for the materials with relatively high radionuclide concentrations. The materials with relatively low radionuclide concentrations will be analyzed using the gamma-ray spectroscopy of high-purity Ge detector by powdered sampling materials.

Recommendations

1. Evaluation of radiation level in of major construction materials
2. Evaluation of suspected area in Sri Lanka
3. Introduction of regulations if necessary
4. Introducing reinforced materials in place of radioactive construction materials

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ATMOSPHERIC CONDITIONS MONITORING SYSTEM FOR SMART CITIES

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Introduction

During the past couple of years, air pollution caused by the industries and transportation mechanisms have caught the attention of health officials as well as the public. In the present, it has drawn severe attention due to its long-term impacts towards humans and nature. This paper examines the need of air quality monitoring as an effective approach towards minimizing the emission of greenhouse gasses, dust and other air pollutants. Hence, air quality monitoring systems have become a pivotal technology in most of the urban development plans. While most of the existing systems are capable of measuring air quality to a reasonable degree, the deployment and operational costs, power consumption are rated high. Further, the time to collect the data and present them at end user applications such as mobile apps is also high. Therefore, this project proposes a real-time, solar-powered air quality monitoring system that operates using the LoRa technology. The proposed system comprises an array of gas sensors including ozone, carbon dioxide, carbon monoxide and nitrogen dioxide. The combination of these technologies enables the deployment of long-range, massive scale wireless sensor networks (WSN) that are almost autonomous after deployment.

Experimental

The array of sensors consists of a MQ 7 carbon monoxide level sensor, GP2Y1010 dust level sensor, DHT 11 temperature and humidity sensor. Each transmitter(s) includes a Node MCU ESP 32, the array of sensors, NEO 6M GPS module to identify the location and a LoRa SX 1278 module for communication. Additionally, the transmitting node(s) is powered using a solar panel.

The transmitter node will transmit encrypted values of the sensor array and GPS data to the receiver to ensure system security. The entire prototype is built using two receiving nodes. We have been able to complete and test a

fully functional transmitter. However, the sensors of the array need proper calibration to deliver reliable results.

The receiver consists of a Node MCU ESP 32 micro controller, a LoRa SX 1278 module. The in-built Wi Fi facilitates the receiver to connect with the real time database. The system contains a receiving node to receive data from the transmitting nodes. The receiver is connected real time to the Firebase DBMS. Also, the receiver is capable of identifying the transmitting nodes separately.

Results and discussion

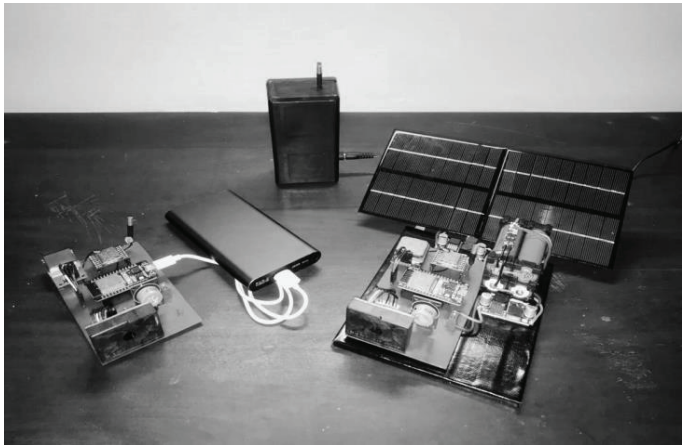


Figure 01 Prototype of the system

The modules were setup in three different environments (urban and rural) and the data were gathered during a single day. The results are shown in the figures 02, 03 and 04.

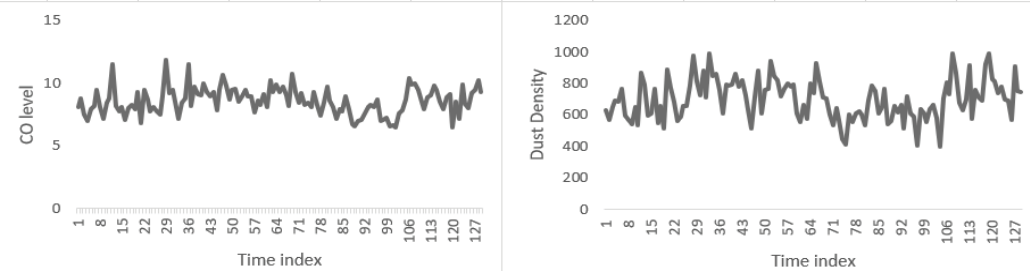


Figure 02 CO and dust density variations during a day in an urban area.

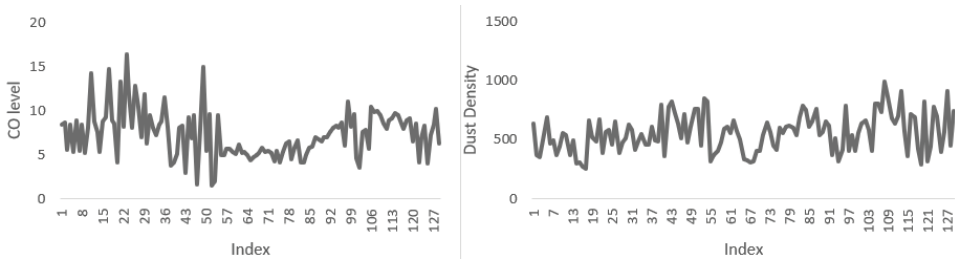


Figure 03 CO and dust density variations during a day in a sub-urban area.

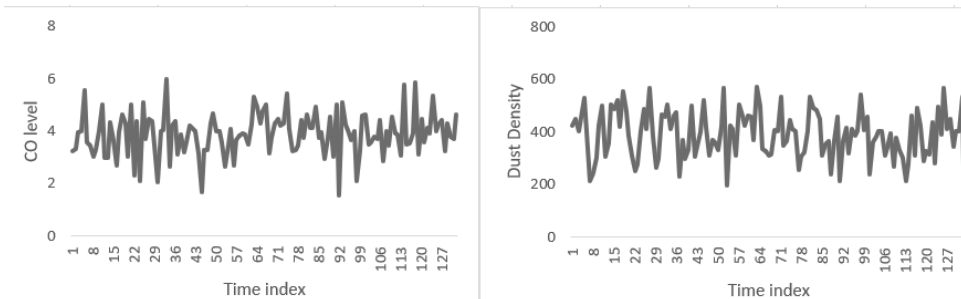


Figure 04 CO and dust density variations during a day in a rural area.

The results clearly show that the CO and dust density is high in urban areas compared to rural areas. The main reason is the high traffic density and the industrialization in urban areas. Since the urban area we selected was not a heavily industrialized area we can expect even higher pollution in heavily industrialize areas.

Conclusion

Atmospheric conditions monitor is expected to be a smart solution for monitoring air quality, humidity, and temperature. Apart from the transceiver units the mobile application and the saved previous historic data will be able to predict the atmospheric conditions. Through the self-powered off grid power system the system will be an easy to install system with less maintenance. Diagnosing the system will be entirely available from the mobile application itself. Furthermore, through automatic discovery and LoRa technology any transmitting unit will be connected to the receiving unit within a couple of seconds. The system is expected to be designed with a minimum number of connectivity issues.

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Implying the Need for Mental Health Education as a Mandatory Subject in Secondary Education.

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Abstract

According to the WHO, suicide is the fourth leading cause of death among 15–19-year-olds. Although, 90% of those children who die by suicide showed signs of mental illness prior to their death, only 46% had been medically diagnosed with a mental health condition. In Sri Lankan context, as the officials of 'Sumithrayo Sri Lanka' stated, the suicide rate of children, has increased in the year 2020 & 2021 compared to the last years.

This study was conducted using the probability sampling method that involves random selection of students who are in the 16-19 age group. And the sample size was 50. After searching and reviewing various sources, I decided to use the questionnaire of MHLS with 35 items and six attributes that were measured and developed by O'Connor et al. The face and content validity were used for validation of MHLS.

It was found that the average MHL score of a student is 112.26 which is lower than the expected score to say that the child has a good MHL in the focus. When comparing the attributes of this survey, the most appropriate answers were received to the first section of the questionnaire which checks student ability in recognizing mental disorders. And the lowest appropriate answers were received for the fourth section which checks students' knowledge in professional help available concerning mental health issues.

If children learn about mental health in school, they will manage better in life. Hence, it is all the more necessary and critical that children learn about mental health education in their curriculum.

Keywords: WHO, Mental health education, MHL, MHLS, Validity

1. Introduction

Mental health challenges are often unescapable, bearing upon many developmental outcomes. Besides, many mental health conditions start during adolescence. This poor mental health can have several damaging effects on children's lives. According to the World Health Organization (2021), suicide is the fourth leading cause of death

among 15–19-year-olds. Although, 90% of those children who die by suicide showed signs of mental illness prior to their death, only 46% had been medically diagnosed with a mental health condition. In Sri Lankan context, according to a report published in a seminar by Dr. Neil Fernando, head of National Institute of Mental Health, almost 4,000 people die by suicide in Sri Lanka every year and his statistics show the majority of victims were aged 15 to 44. (Altruistic et al., n.d.) The latest statistics for Sri Lanka show a suicide rate of 15 per 100,000. Though death by suicide has decreased in Sri Lanka, the number of attempts remain high, making the island nation worse than some Gulf and South American countries in terms of suicide attempts, as stated by Colombo South Teaching Hospital Child Adolescent Psychiatrist, Dr Jayamal de Silva. He most importantly said, “Even after teaching students life skills for the last two decades mostly from grades 7 to 9, we still saw young adults between the ages of 15-25 commit suicide.” (EconomyNext, 2020) Further, as the officials of 'Sumithrayo Sri Lanka' stated, the suicide rate of children, has increased in the year 2020 & 2021 compared to the last years. (Sumithrayo | Sumithrayo Org, 2020) Therefore, with so many children experiencing mental disorders at such an early age, it's shocking that less than half of these individuals will get the help they need while the others are left undiagnosed and untreated, due to the lack of knowledge in 'Mental Health Education'

Even though, not everyone struggles with mental illness, which is fortunately true. However, every person does have a brain that is subject to change, automatically making the topic relevant to every individual. Nevertheless, learning about mental health and practicing skills to improve mental health are extremely different. Schools hire a wide variety of counselors, social workers, and psychiatrists to help students struggling with emotional or mental health concerns. While this is true, and a potential affirmation to my mental health education implementation proposal, it does not holistically address the situation. In-school support is often given only to students who are mentally ill, or who have other psychiatric issues. In physical education class, schools don't only teach students who are physically unfit how to care for their bodies. Why then, do schools only intervene when a student's mental state is the opposite of healthy? As a society, we focus too much on mental illness and not enough on mental health. School environments should be proactive, not reactive. The mind and body are not separate. What affects one, affects the other. So why is physical education mandatory, but not mental health education?

2. Methodology

Herein, to make strong statistical inferences about the whole group, this study has used probability sampling which involves random selection among the students who were in the 16-19 age group. And the sample size was 50.

Data collection tools included a demographic section and a Mental Health Literacy Scale (MHLS), a questionnaire that was developed and evaluated by Matt O'Connor in 2015. (O'Connor and Casey, 2015)

First of all, the questionnaire was piloted with 10 students from the school to find out any difficulty in understanding the words, phrases or any failure in conceptualization. So that, in case of any problem, the participants' comments can be applied to the questionnaire (face validity). Therein, many students commented on, not understanding the terms of those mental disorders. Therefore, included the definitions of each and every psychological term in the questionnaire. After that, the questionnaire was provided to a specialist in the field of psychology for the purpose of evaluating the questionnaire (content validity). After collecting the expert's evaluation, necessary changes were made so that the questionnaire would be fit into the Sri Lankan context.

The mental health literacy scale is a single-factor measure. The questionnaire has 35 questions and six attributes. In this questionnaire, the lowest score is 35 and the highest score is 160. The first 15 items are scored on a 1-4 scale with items 10, 12 and 15 being reversed scored. Items 16-35 are scored on a 1-5 scale with items 20-28 being reverse scored. The total score is produced by summing all items. Higher scores indicate a better Mental Health Literacy (MHL) status. And a score of 120 or above is considered as having a good knowledge in mental health. In here the six attributes were taken as the independent variable while the MHL score has been taken as the dependent variable.

Students were recruited in a classroom setting. Each student was given the study information sheet, the consent form, and the questionnaire. They were asked to read the study information sheet, sign the consent form, if they agreed to participate in the study, and then answer the questionnaire. Before collecting the data, I informed the principal about this and got their approval as well. At the time the completed questionnaire was collected, I clearly stated again that participation in the survey was voluntary. This information was also included in the consent form. The response rate was 100%. After the survey was administered, the questionnaires were checked for completeness and all of the 50 completed questionnaires were included in the analysis.

3. Results

This study is expected to evaluate the Mental Health Literacy Scale (MHLS) among the adolescents in Sri Lanka. Hence from the collected data, it is found that the average MHL score of a student is 112.26 which is lower than the expected score (120) to say that the child has a good MHL in the focus. According to the collected data, only 9 students (18%) have achieved that expected value.

Further, female students' average MHL score is greater than the male students' average MHL score, where grade 13 students show the highest average MHL score in this survey. The highest MHL score obtained by a student is 150 while the lowest MHL score is 87.

Table 01: Frequency distribution of demographic data

Gender	Sample Size	Percentage	Average Score of the MHL
Male	30	60%	108.7
Female	20	40%	117.6
Grade	Sample Size	Percentage	Average Score of the MHL
11 (Age - 16)	12	24%	110.4
12 (Age - 17)	13	26%	108.5
13 (Age - 18 to 19)	25	50%	115.1
Residence	Sample Size	Percentage	Average Score of the MHL
Western Province	44	88%	112.4
North – Western Province	06	12%	111.0

When comparing the attributes of this survey the most appropriate answers were received to the first section of the questionnaire which checks student ability in recognizing mental disorders, and the lowest appropriate answers were received for the fourth section which checks students' knowledge in professional help available concerning mental health issues.

4. Discussion

All the responses were analyzed under each one of the below six attributes.

1. Ability to Recognize Disorders
2. Knowledge of risk factors and causes
3. Knowledge of self-treatment
4. Knowledge of professional help available
5. Knowledge of where to seek information
6. Attitudes that promote recognition or appropriate help-seeking behavior

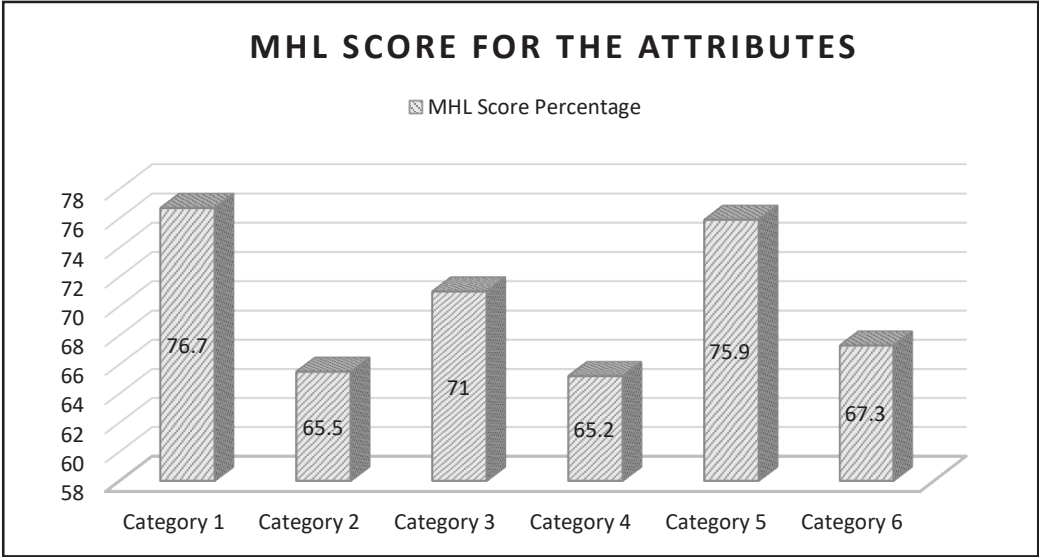


Figure 01: The column chart of the MHL score for each attribute

Considering all the responses from each of the attributes, it is clear that the students have not answered successfully for the reverse scored questions and specially the 2nd, 3rd and the 6th attributes of the questionnaire.

5. Conclusion

It is clear that our children are at great risk and clarifies why this is another crucial reason to make mental health education a requirement in schools. Without being taught the realities of mental health difficulties, children won't understand the impact. The only way this will change is if we educate them, just like physical health is taught, a compulsory lesson taught within our schools would make all the difference. Since teens spend most of their day at school, it just makes sense to have mental health awareness and education become part of the curriculum. Knowing the role mental health plays in their lives would allow them to become happy adults. And it all starts by making it a mandatory subject in secondary education.

6. Recommendations

This study aimed to evaluate the Mental Health Literacy Scale (MHLS) among the adolescence in Sri Lanka. It is noteworthy that there is no specified instrument for evaluating MHL in Sri Lanka up to now. Hence, it is recommended to use this questionnaire to assess the MHL of different target groups with larger sample size, for educational and clinical research purposes. It is also worth questioning the usefulness of MHL.

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A study to examine the satisfaction level of secondary school students' scientific knowledge in day-to-day activities

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Abstract

There is a significant link between science education and 21st-century skills. When science is taught with a focus on skills, it promotes critical thinking, problem-solving, and digital literacy even while improving knowledge and student engagement. Quality education must create productive people and critical thinkers. The current education system in Sri Lanka is exam oriented. Written tests are used to assess a child's ability to memorize information. Hence, under the local curriculum skills of a student are measured only using these memorizing powers. Furthermore, this system prevents children from thinking. This study aims to determine whether students have the skills to apply science theoretical knowledge to day-to-day activities and their satisfaction level with learning science.

To examine the hypothesis and objectives, I used a questionnaire and collected data from 100 samples of students who are between the ages of 14 to 17. Respondents were randomly selected from around the Colombo district and collected data were qualitatively and quantitatively analyzed. The results showed students' satisfaction towards learning science is at an average level and applying scientific concepts to everyday situations is also weak. In addition, the study showed the relationship between students' satisfaction level with learning science and application skills in practical situations has poor correlation.

Hence, these results suggest that the curriculum of science needs to improve more focusing on developing students' practical skills. Most of the educational policies of the country do not pay much attention to the trends and innovations on time. Therefore, the local science education system needs to be more focused on improving the skills and learning methods that are matched to new trends in the world to produce an intelligent generation.

Key words: Science education, application of science, scientific knowledge, satisfaction level

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1. Introduction

Science education is very important for the development of student's critical thinking and decision-making skills. Through proper science education, students get better knowledge about the way and why things happen in their surroundings. Moreover, science education assists to boost critical thinking, helps children think rationally and solve issues, stimulates the natural curiosity to discover the secret of the environment, and teaches the way how specific devices work. Proper science education from childhood is needed to create great posterity. This research is conducted to exhibit the satisfaction level of junior secondary students in science education and evaluates students' usage of scientific knowledge for everyday activities.

Objectives:

- To identify whether students have skills to apply science theoretical knowledge to day-to-day activities.
- To identify whether students are satisfied with the local science curriculum.
- To recognize students are learning science with practical in the classroom.
- To identify whether the local science curriculum is useful for school students.

2. Research Methodology

This study is based on both quantitative and qualitative research approaches. Hence, this study is mixed-method research. The data were collected from students who are learning in grades 9, 10, and 11 under Sri Lankan local science syllabus. Between 14 - 17 age limit of students is selected to collect data in this research. The reason for selecting this age limit is because these students have physical experiences in the science classroom. Students are selected randomly around the Colombo district. The sampling method is a random sampling method. Sample size is 100 in this process.

Data collection is done through a questionnaire that consists of 2 main parts. In the 1st part, data analysis hopes to be done according to qualitative data analysis methods by interpreting simple graphs and explaining the students' perceptions. The second part is a small question paper to evaluate students' science application skills. After evaluating the second part, I hope to give marks for that part and conduct statistical analysis, including finding the mode mean and median. In addition, I hope to do a correlation analysis by combining both the first and second parts.

When collecting the data, the following points were taken into consideration. All the participants are free to choose to participate without any pressure. All students are able to leave any question on the questionnaire at any point without any negative repercussion. Therefore, this study ensures the ethical considerations of volunteer participation. In this study, data were taken from students between the ages of 14

to 17. Hence, before the gathered data I informed them to ask permission from their parents to participate in this questionnaire.

3. Results

Satisfaction level of learning science subject in school

This question is based on the general objectives of this research. Below pie chart shows students' percentage according to their satisfaction level of leaning a science subject.

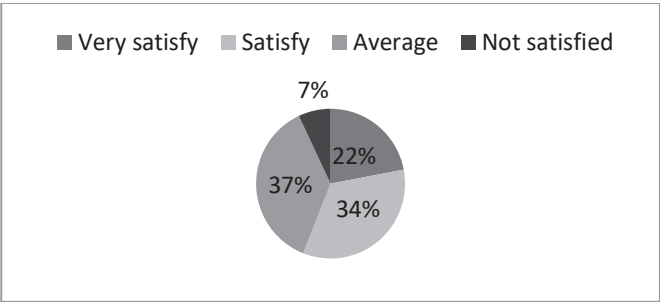


Figure 4.3: satisfaction level towards the learning science

Results of applying learned scientific concepts to everyday life

12 short answer type questions are given to students and marks are allocated according to their answer. Below column graph represents the students' frequency according to given Score ranges.

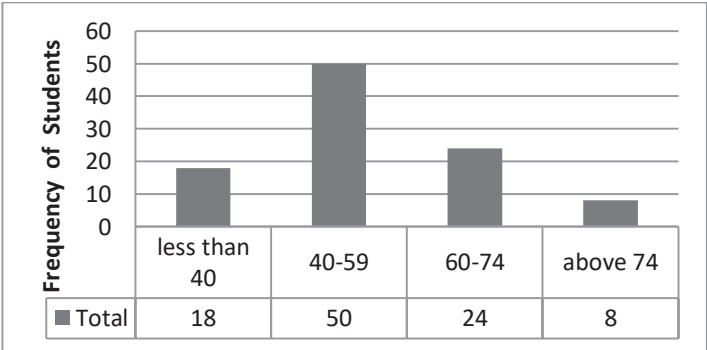


Figure 4.10: practical situation questions paper scores

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4. Discussion

Findings are assisted to identify whether students have an average satisfaction level in learning science subject. This may be due to the high workload of students. Therefore, students do not have enough time to focus on extra activities related to science like innovations. Another thing is student satisfaction with a subject can be depending on the teacher. If a teacher is active and teaches with variety it will increase students' satisfaction. Teachers' education has an impact on the students' education. Hence, first, we need to increase the quality of teacher education to increase students' satisfaction.

By incorporating scientific concepts into everyday life, the day-to-day task can be done easily. Therefore, students should be aware of the application of the learned scientific concepts to everyday life. From the above results, we can conclude students do not get proper application skills through the current science education system. When marking the questionnaires I realized many students do not know simple scientific things like the way current generates, the foreshadowing of natural disasters, simple applications of static electricity, and application of density. What it shows is the inability of students to think and create something on their own. As a whole, it seems students have low skills to apply science theoretical knowledge to day-to-day activities.

The reason for this is more attention of students on theoretical things than practical things. And many students' learning goal is to perform well in their examinations. So they are mostly scoring by memorization. It does not improve their skills and critical thinking. We need to nurture students with science to face the various crises that lie ahead. Then we will be able to create a generation of students who will not collapse in the face of the coming crisis. Hence, science education needs to be full of more practical things.

5. Conclusion

As a result of this whole study proved students' satisfaction level towards the learning science subject is at an average level and findings also show students' usage of scientific concepts in everyday situations is in a weak condition. Local science curriculum is a useful one because students have an average satisfaction level about that but it needs to upgrade by putting more practical components to increase students' application skills. The final conclusion is the need to implement a local science curriculum focusing more on developing students' practical skills.

A Comparative Study between Ability Group and Mixed Ability Group on Science Subject

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Abstract

This research study present the findings of a comparative study between the ability group (homogeneous) and mixed ability group (heterogeneous) on science subjects. Children have different levels of comprehensibility from one student to another therefore using the same teaching technique for all of them are not effective. Generally middle school science curriculum design to establish subject matter through group activities and practical activities. It allows students to work in a cooperative learning environment. Therefore identifying effective grouping methods by considering students ability level is important. Students are systematically divided in to groups based on ability. This ability grouping concept is still in a controversial stage in Sri Lanka and beyond as well. This study compared ability group and mixed ability group students' performance and it focused on impact for lower ability level students' performances. Through a quantitative research design research was conducted and using a purposive sampling method thirteen poorly performed students were selected. Pre-test and post-test marks were statistically analyzed to determine the most effective grouping method for lower ability students. Results indicate that there was statistically significant difference in effect on students' performance between the heterogeneous and homogeneous grouping types. Study was only focused on lower achievers performances therefore it opens new paths for future research studies.

Key words: homogeneous, heterogeneous, comprehensibility

1. Introduction

Educational systems all around the world have been debating the best way to distinguish students according to their individual levels of ability for a significant amount of time. Ability grouping can be done in several ways. According to (Chris Berry, 2002) provide six types of ability grouping methods used in schools around

the world. Following are a few of them, Tracking (homogeneous grouping) method, Banding method, Mix ability grouping (heterogeneous grouping) within class ability grouping, and Cross age grouping (cross grade grouping). In this research study used this homogeneous and heterogeneous grouping to compare the performance of the students.

The word ability grouping refers to grouping students together based on performances, strengths, and talent shown in the classroom. Students are classified as average, normal, or below average, and are placed in group with students of similar ability levels. This is also known as a homogeneous grouping. Heterogeneous grouping, referred as mixed ability grouping, which represent students' at all academic levels. In the mixed ability group, they were purposefully mixed because of their differing levels of academic achievements. Each group contain students from all academic levels. Studies have revealed that grouping students both heterogeneous and homogeneous in specific situations can be beneficial for the below average, average, and above-average students in different ways. In this study both type of grouping methods will be tested and compared. It is still a topic of debate in the educational industry whether the concept of homogeneous and heterogeneous groupings of students has any effect on students' performance. It inspired researchers to conduct a study to have a more in-depth understanding of this concept.

The Sri Lankan education system follows inclusive education. Inclusive education, as defined by the 2003 National Policy on Disability, is the ability of the educational system to react to the diverse needs and abilities of all students, regardless of their impairments, via the use of a learner-centered educational approach. The 2009 proposal for a New Education Act for General Education broadened the definition, recognizing that inclusion is about a child's right to attend school and rejecting segregation or exclusion of students based on their ability, gender, language, status, family income, disability, color, religion, or ethnic origin. Inclusive education is a system of education that meets the needs of all students, regardless of ability or need for accommodations, ensuring that no student is excluded. Therefore teachers are reluctant to group students based on ability because they might think it will violate the concept of inclusive education. However not every student learns at the same speed or has the same skills gained, especially those with learning difficulties. The children with disabilities, such as auditory processing problems, reading problems may be seriously affected to a degree where they can't stay in step with the school curriculum despite what practices or approaches are put in available to facilitate them rise up to meet their peers.

Therefore it seems there are many pros as well as cons in inclusive education. Hence it is worthy to step forward and figure out whether the concept of ability

grouping and mix grouping has any effect on the academic performance level of students. In addition, to evaluate which method of grouping, heterogeneous or homogeneous, is more beneficial for students who perform poorly, and to determine whether or not students are enhancing their skills and knowledge through the help of grouping when they participate in activities in the classroom.

2. Methodology

The researcher adapting to the quantitative research approach to understand the best student grouping method for poorly performed students in the classroom. This study compares two grouping methods called ability grouping and mix grouping. For the comparison, numerical data was obtained from the participants. Therefore, a quantitative approach was the ideal approach to conduct this research study. The quantitative approach helped to generate and reveal the meaning to the objectivity hidden inside the data that had been collected. To identify the performance level of students' a pre-test was needed. For this research study, students' last science term test marks were considered for grouping students.

Homogenous group students grouped based on ability (table1). This homogenous group comprises three sub-groups. Students from the same ability level are included in one subgroup. Well-performed higher marks students in pre-test entered the first subgroup, average marks students entered the second subgroup, and lower marks were included in the third subgroup. The heterogeneous subgroups consist of all academic level students (table 2). The researcher mixed the students purposefully based on pre-test marks. There were four steps in the research data collecting process. In the first step, each group did 4 group activities, and the researcher conducted an individual evaluation. Then again, both groups did separate 4 group activities and conducted an individual evaluation. The exact process continued three times, and finally three individual evaluations were done to obtain numerical data altogether. After completing all three evaluations final post- test was done to both homogenous group and heterogeneous group. These post test questions consist of three lessons that have been completed throughout the study. Post-test marks were used for final data analysis. In each three-step the same two groups were maintained and throughout the study, the same subgroups were included to collect data.

In this research study, there were 78 students from grade six and eight classes. From the population researcher needed to select students based on "students' ability on science subject" for this research study. Since the research was designed systematically, a purposive sampling technique was used for the study. The data was treated using Statistical Package for the Social Sciences 25 (SPSS).T-test

analysis used to analyze data of the study. Conducting a paired t-test is appropriate in this situation since the student groups come from the same overall population. Mean of Pre -test marks and mean of post-test marks were used to identify the performance of students in the selected sample.

Table 1

Selected students for Ability group

Ability Group Students	
AS 1	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div> <div>All 8 students were in same group</div>
AS 2	
AS 3	
AS 4	
AS 5	
AS 6	
AS 7	
AS 8	

Table 2

Selected students for Mixed Ability groups

Mixed Ability Group Students	Group No
MS 1	1
MS 2	2
MS 3	3
MS 4	4
MS 5	5

3. Result and Discussion

Quantitative data of pre and post test scores were collected from the Evaluation tests. To compare results of the test, a series of t-tests were used to compare pretest scores, post-test scores, and point increase. Between pre- test and post -test there were a series of evaluations completed to study the effect of grouping as homogeneous and heterogeneous.

In the beginning, no one has taken the group leadership in lower ability group therefore group works were not successful but when advice given by the time leaders began to emerge from those poorly performing students. Mixed ability group was seems nice concept because students can share their knowledge with peers and push forward lower level students but when consider mixed ability group at first glance this mixed ability grouping seems like it improves performances of poorly performed students by peer force but in many groups in the study, it has negatively affected the students.

This study was focused to improve the poorly performed students' performances. Since focused students in the same group in ability group teacher was easy to reach to students. Teachers can customize the rate at which students with similar academic ability are taught. Compared to mixed ability groups, students were actively participating in work by the time not falling behind. Teachers did not need to rush students who needed more support because the same ability students were in the same place teachers can easily reach students. Teacher can customized the instruction according to the level of the group members then it was more productive and can effectively manage the time. When consider mixed ability group It was a touch rushed while providing more support such as checking books ,giving advices to those selected children because the teacher needed to reach out to all of the students who were performing poorly, and most of the time, the same advice was provided multiple times, consuming more time.

T-tests were used to determine the results and significance of student grouping. After the post -test, the mixed ability group experienced a lower average point increase as a result of the treatments than the ability group did. According to ability group t-test poorly performed students have showed significant different in their performances.

4. Conclusion

In this grouping strategy, peer influence affected students' overall performance. It influenced either negatively or positively. This mixed ability grouping, on the other hand, benefits not just lower achievers, but also average achievers. When average students connect with bright students, they are more inspired than average students. In ability group, lower achievers are the group of students who need much guidance, therefore it was easy in this grouping method rather than in a mixed ability group. In an ability group, the teacher can deliver individualized instructions and pay more attention to the students' needs. In general, both groups had positive and negative effects. But ability grouping positively affected on lower achievers' performances but it was not motivated average and above-average students. The mixed ability group helped average students' more than low performers and high

achievers. Superficial, inclusive education appears to have an impact on grouping and educating students based on their abilities, but closer examination reveals that this is not the case. The reason for this is that each child's ability to comprehend, grasps, and conceive differs one to another. As a result, the capacities of children in each area are not equal. In this case, it is more effective to provide an education designed to meet the needs rather than an all-encompassing equal education.

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IMPROVING CONCEPTS OF MATHEMATICS USING VARIOUS TECHNIQUES

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Abstract

This research is action research. A mixed national school was selected for this purpose. Out of a group of grade 8 students, five weak students were selected from the observation made using the documentation review and observation method. Lack of basic knowledge was the main reason for these students to be weak in Mathematics. Therefore, the research process was formulated with three main objectives. To improve the basic mathematical knowledge, to improve the analyze and solve the problem and to develop the skills, creativity and attitudes. The research process was designed with those objectives in mind. That is, scores in both pre- state and post-state instances comparative analysis. For this twelve lessons were planned to be taught using twelve different methods. Three lessons per week were planned to collect data over a period of four weeks. Later the lesson plans were implemented. During the lesson, the skills, creativity and attitudes of the students were observed and recorded. At the end of the lesson plan, students are asked to answer the same question paper again. The scores obtained at that time were used as post- state scores. The scores thus obtained were comparatively analyzed on several occasions. There, in the first instance, each student was analyzed individually. That is, by observing the average value of the total sum of marks obtained in the pre-state and post-state stages for the twelve lessons. Here it is concluded that the process is successful if the post state is higher than the pre state stage. In the second round, the average score of the total number of points scored for the twelve courses was obtained. Then if the value of the post state stage is higher than the pre state stage then it can be concluded that the research process as a whole is successful. Microsoft Excel was used for this data analysis.

Several tables were used to collect this data and graphs were used to represent the data. The website literature review, observation, reflective journals, open and ended survey questions, abstract, internet was used to obtain information for the relevant data. This research is very important not only for students but also for teachers. That is, attention should be paid to every student in the average classroom. The process used for this research can be applied to all students. An appropriate research process for teachers to improve their students' core subject knowledge, eliminate classroom monotony and improve students skills.

1. Introduction

Mathematics is one of the first sciences to work on human development. There are many branches of mathematics in science, such as related to numbers, including geometric forms, algebra, etc. It is used in every aspect of life. For example, driving, time tracking, some jobs, etc... Therefore it helps us to understand the world and provide an effective way to build mental discipline. It also helps in analytical thinking. Also while solving mathematical problems, you can practice logic, decision making, data collection, analysis and solving. For these reasons Mathematics has been included in the school curriculum as a well – organized subject. Mathematics is a major subject in the school education system. In addition, mathematical knowledge plays a crucial role in understanding the content of other school subjects such as Science, Social Studies, and Music and Art. Mathematics is also offered independently in some post school curricula. Some other curricula offer integrated courses that combine Mathematics and other disciplines.

The teacher has a role to play in the school pedagogy. Its main goal is to teach the subject correctly and to complete the syllabus on time. But the students studying in a classroom are different. For this reason, we need to focus more on students with weakness. Since Mathematics is a subject as well as a lifelong necessity, it is the duty of the teacher to prepare the students to be gifted students. Some students were found to be failing Mathematics for a variety of reasons. Those are the lack of basic knowledge, uniform teaching pattern, personality issues also stood out. The teacher should be more tactful in imparting basic knowledge. Use of different methods. We can teach simply by using what is available in our environment and using the experience of our students. Students then learn how to use the subject in practice in addition to subject knowledge. They also direct their ideas across different ranges without being confined within one framework. They can also improve their logical ability, comparison, observation, analysis, etc. This is within Mathematics it is also important for other subjects such as Science, Sociology, Geography etc.

To avoid the monotony, we can use a variety of entertaining activities. And the use of different methods. Lessons adjustment can be made to enlist the support of students, and the teaching style can be changed as students are distracted. It can also affect personality development. That is, there should be good communication between the teacher and the students. Students should be given opportunities to ask questions, answer questions, and solve problems. Attitudes can be easily changed by giving students the opportunity to lead, to stand out, and so on.

Students in an entire classroom are different when considering the above situation. They acquire knowledge according to their learning style. Among them are the most gifted, moderate, and weaker students. Following are the instances in which weak

students have been identified on the basis of their proficiency in Mathematics and observations made. For this a group of grade 8 students were studied and they are as follows.

- Less participation for the Mathematics period.
- Less performance is shown for the Mathematics examinations.
- Less attention is given to the Mathematics related activities (class work, home work)

I want to study the students Mathematics subject performance and the reasons for this. Improving student progress in a short period of time and a complex task. It is a task that puts pressure on the teacher. But in grade 8, I identified methods that could be used to develop the Mathematical concepts. And I as described above, through this research study directed my realization to the following questions to improve Mathematics skills and motivate grade 8 students with poor Mathematics performance;

1. What are the most effective strategies to improve the basic math knowledge?
2. How to improve the self – confidence of students?
3. How to solve Mathematics problems using simple methods?
4. How do those strategies help to improve math knowledge among students?

Planning the research process

I planned to collect research data over four weeks, three lessons per week. Here marks were obtained in both pre-state and post-state stages. Students are given the opportunity to answer without any instruction in the pre-state stage and get marks. After teaching the lessons using the relevant methods as planned in the post-state stage, the marks obtained for the question paper were counted again. The scores obtained in these two cases are compared and conclusions are drawn.

2. Methodology

There was a specific time frame for this research. In this first stage, a topic was selected and confirmed. Later permission was obtained from the principal, the teacher in charge of the subject and the students' parents for the research. Then the data collection began according to a plan. The plan was to complete three lessons in a week. Accordingly, the total time taken for the twelve lessons is four weeks. Each lesson is given a calculated question paper on two occasions. That is, pre-state stage and post-state stage. Answer the question paper without any advice at the pre-state stage. Their scores were obtained separately. The lesson was then

touched according to the methodology chosen. Then he gave me the same question paper again to answer. The scores obtained in this case are shown as post-state scores. All these scores are obtained and analyzed with relative average scores. The research data led to conclusions that could indicate the success or failure of the research. The content and scores of the observation question were used to determine some variation in performance related to each of these lesson areas.

The primary purpose of the first process was to improve basic knowledge. This is done using various basic methods. In addition to the method used in the example above, different methods were used for each lesson. They are as follows;

Lessons	Methodologies
1.Data representation and interpretation	Observation method
2.Numbers pattern	Exhibition method
3.Area and Perimeter	Lecture method
4.symmetry	Observation method
5.Mass	Discussion method
6.Solids	Practical method
7.Tessellation	Reference method Art and craft method
8.Square Root	Question method
9.Fractions	Revision method
10.Directions	Pair work
11.Time	Example method
12.sets	Group work

The second phase focused on problem solving. Here they were taught how to solve different types of problems, improve their reasoning skills and answer in a timely manner.

In the third stage of the cycle, students' attitudes, skills and creativity develop. Data on this were collected through observations during the study process. At the end of all the teaching sessions I was given the same question paper again and scored. The average value of the scores obtained at the end of all processes was obtained. Accordingly, before and after cases are compared and conclusions are reached.

3. Result

Chart 1: Average marks of twelve lessons pre-test and post -test

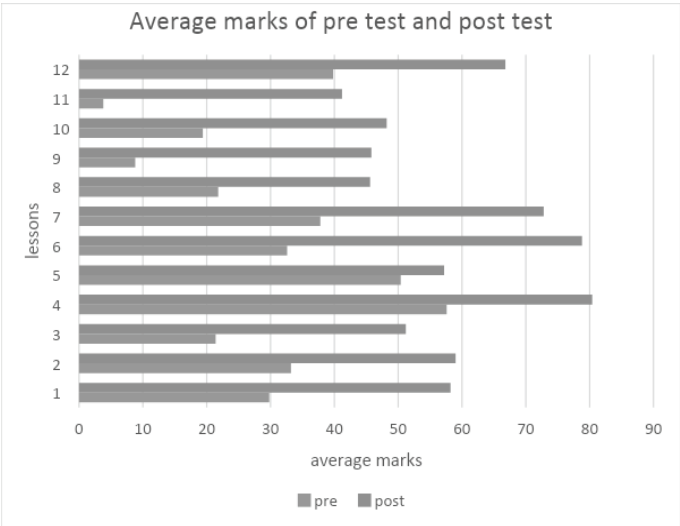
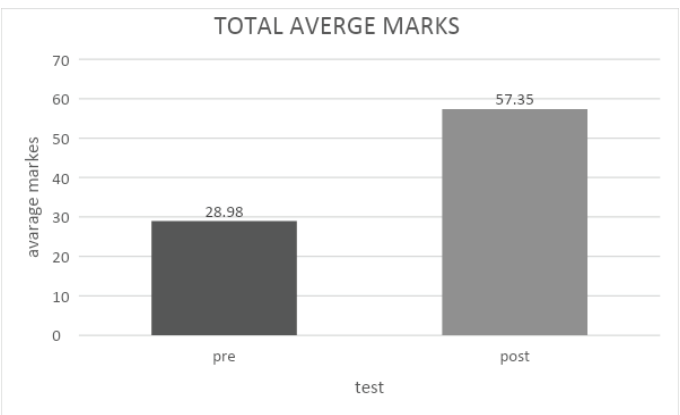


Chart 1 shows the average scores of each individual. Hence it is easy to check students' progress. It can also be easily observed that there is a high level of progress in the pre -state and post-state scores of each student. The vertical axis shows twelve lessons and the horizontal axis shows the average marks of the pre-state and post -state.

Chart 2: Total average marks of pre-state and post-state.



This 2 chart shows the total average of the twelve marks obtained by the five students for the twelve separate lessons. The average value of the total of the marks

obtained separately for the pre-state and post-state in twelve lessons is obtained. This makes it easier to study the success of the whole process.

4. Discussion

Clear marks when considering pre-state and post-state opportunities. There is a discrepancy. That is, the post-state score is higher than the pre-state score (chart 2). We can conclude that the basic subject knowledge has been successfully imparted and the methods used for it have been successful. But when doing this methodology, they had to face various problems. Still, the methods used to solve the problems made it easier to complete the research.

There were successful as well as unsuccessful methods within the twelve methods mentioned in table 3 above. In some cases, they also had to face various difficulties. The main problem is that the school I chose was a mixed national school. The language problem was often seen here. Not knowing some Sinhala words and not knowing the correct meaning were notable. That is, when a single question is asked in two ways, the same answer must be given. Gives contradictory answers to a question without giving correct answers. For example, “solve the problem below” golf sent to “evaluate problem below” different answers are provided for the same answers. Together with the Sinhala teacher, the students were taught the most commonly used words and their meanings in Mathematics. Later, those methods were able to succeed in various ways. This was mainly required for question method, discussion method, example methods etc.

Another problem is that time is not enough. That is, the duration of schooling is reduced and the time spent on certain activities is reduced. For example, students were not given enough time for technical activities such as group activities and Art and craft. Due to this reason, in addition to subject knowledge, time management training could be provided. Homework also provides opportunities to monitor the tendency of homework to be better than before. Some students were less focused on their lesson. When using the lecture method and the correction method it is more observable. While teaching the lesson, they were given the opportunity to ask a question from a randomly selected student or bring it to the blackboard and solve a problem. This method was able to maintain the student's attention, reduce the student's fear and increase their present. There was also a shortage of equipment for certain activities (compass). In such cases, teaching is done using videos. In most cases substitutes from the surrounding environment were used and the student experience was used.

I saw that some students were shy in the classroom. But they are given the opportunity to describe the data they found, which reduces their fear of coming forward and commenting. They also had the opportunity to identify student

weaknesses such as lack of activism, lack of unity, and lack of mutual support, and in addition to subject knowledge, these techniques were also important in minimizing those weaknesses. Primarily, the success of the methodology depends on the cooperation of the teacher and the student. At the end of it all this can be further confirmed by comparing post-stat scores and pre-state scores, student participation and student feedback.

5. Conclusion

If we conclude from the data observation, those active strategies had a positive impact on student's attitudes. In addition positive attitudinal changes such as a support, team spirit, effort, and interest were observed in practice. A change in their behavior in the classroom and being active in certain intelligence- based activities was notable. There was an increase in school attendance and voluntary participation, and there was a tendency to do homework as well. According to the students' ideas, these methods are also successful.

In analyzing the data, on the basis of the average test score pre-state and post-state, we can conclude that the same methods are generally successful. Although some of the methods used earlier have failed, the methods used later have been shown to be very successful. It is well represented by table 1. The result of 12 lessons were observed separately. There are 12 different methods used to teach them. As shown in table 3. In this case, some of the problems that arose during the use of certain methods had to use separate remedies. (For example, language problems) After using various techniques for these, I can conclude that I was able to use my mathematics teaching methods easily and successfully.

Analysis of the mean value of the results obtained from the research showed a clear increase in the mean value of the results. It can be seen from chart 12. According to the chart 13, assuming a minimum score of 10 per student, the student's score after the post -state is about 37, an increase of 27. If the progress of the student who got the lowest marks out of the five students has increased in this way, the progress of the other students has also increased in general as compared to them. From the analysis of the data and the observation of the students, it can be concluded that the level of students has increased after the post-state stage and the methodology used has been overall successful.

IMPROVING CONCEPTS OF MATHEMATICS USING VARIOUS TECHNIQUES

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Abstract

This research is action research. A mixed national school was selected for this purpose. Out of a group of grade 8 students, five weak students were selected from the observation made using the documentation review and observation method. Lack of basic knowledge was the main reason for these students to be weak in Mathematics. Therefore, the research process was formulated with three main objectives. To improve the basic mathematical knowledge, to improve the analyze and solve the problem and to develop the skills, creativity and attitudes. The research process was designed with those objectives in mind. That is, scores in both pre- state and post-state instances comparative analysis. For this twelve lessons were planned to be taught using twelve different methods. Three lessons per week were planned to collect data over a period of four weeks. Later the lesson plans were implemented. During the lesson, the skills, creativity and attitudes of the students were observed and recorded. At the end of the lesson plan, students are asked to answer the same question paper again. The scores obtained at that time were used as post- state scores. The scores thus obtained were comparatively analyzed on several occasions. There, in the first instance, each student was analyzed individually. That is, by observing the average value of the total sum of marks obtained in the pre-state and post-state stages for the twelve lessons. Here it is concluded that the process is successful if the post state is higher than the pre state stage. In the second round, the average score of the total number of points scored for the twelve courses was obtained. Then if the value of the post state stage is higher than the pre state stage then it can be concluded that the research process as a whole is successful. Microsoft Excel was used for this data analysis.

Several tables were used to collect this data and graphs were used to represent the data. The website literature review, observation, reflective journals, open and ended survey questions, abstract, internet was used to obtain information for the relevant data. This research is very important not only for students but also for teachers. That is, attention should be paid to every student in the average classroom. The process used for this research can be applied to all students. An appropriate research process for teachers to improve their students' core subject knowledge, eliminate classroom monotony and improve students skills.

1. Introduction

Mathematics is one of the first sciences to work on human development. There are many branches of mathematics in science, such as related to numbers, including geometric forms, algebra, etc. It is used in every aspect of life. For example, driving, time tracking, some jobs, etc... Therefore it helps us to understand the world and provide an effective way to build mental discipline. It also helps in analytical thinking. Also while solving mathematical problems, you can practice logic, decision making, data collection, analysis and solving. For these reasons Mathematics has been included in the school curriculum as a well – organized subject. Mathematics is a major subject in the school education system. In addition, mathematical knowledge plays a crucial role in understanding the content of other school subjects such as Science, Social Studies, and Music and Art. Mathematics is also offered independently in some post school curricula. Some other curricula offer integrated courses that combine Mathematics and other disciplines.

The teacher has a role to play in the school pedagogy. Its main goal is to teach the subject correctly and to complete the syllabus on time. But the students studying in a classroom are different. For this reason, we need to focus more on students with weakness. Since Mathematics is a subject as well as a lifelong necessity, it is the duty of the teacher to prepare the students to be gifted students. Some students were found to be failing Mathematics for a variety of reasons. Those are the lack of basic knowledge, uniform teaching pattern, personality issues also stood out. The teacher should be more tactful in imparting basic knowledge. Use of different methods. We can teach simply by using what is available in our environment and using the experience of our students. Students then learn how to use the subject in practice in addition to subject knowledge. They also direct their ideas across different ranges without being confined within one framework. They can also improve their logical ability, comparison, observation, analysis, etc. This is within Mathematics it is also important for other subjects such as Science, Sociology, Geography etc.

To avoid the monotony, we can use a variety of entertaining activities. And the use of different methods. Lessons adjustment can be made to enlist the support of students, and the teaching style can be changed as students are distracted. It can also affect personality development. That is, there should be good communication between the teacher and the students. Students should be given opportunities to ask questions, answer questions, and solve problems. Attitudes can be easily changed by giving students the opportunity to lead, to stand out, and so on.

Students in an entire classroom are different when considering the above situation. They acquire knowledge according to their learning style. Among them are the most gifted, moderate, and weaker students. Following are the instances in which weak

students have been identified on the basis of their proficiency in Mathematics and observations made. For this a group of grade 8 students were studied and they are as follows.

- Less participation for the Mathematics period.
- Less performance is shown for the Mathematics examinations.
- Less attention is given to the Mathematics related activities (class work, home work)

I want to study the students Mathematics subject performance and the reasons for this. Improving student progress in a short period of time and a complex task. It is a task that puts pressure on the teacher. But in grade 8, I identified methods that could be used to develop the Mathematical concepts. And I as described above, through this research study directed my realization to the following questions to improve Mathematics skills and motivate grade 8 students with poor Mathematics performance;

1. What are the most effective strategies to improve the basic math knowledge?
2. How to improve the self – confidence of students?
3. How to solve Mathematics problems using simple methods?
4. How do those strategies help to improve math knowledge among students?

Planning the research process

I planned to collect research data over four weeks, three lessons per week. Here marks were obtained in both pre-state and post-state stages. Students are given the opportunity to answer without any instruction in the pre-state stage and get marks. After teaching the lessons using the relevant methods as planned in the post-state stage, the marks obtained for the question paper were counted again. The scores obtained in these two cases are compared and conclusions are drawn.

2. Methodology

There was a specific time frame for this research. In this first stage, a topic was selected and confirmed. Later permission was obtained from the principal, the teacher in charge of the subject and the students' parents for the research. Then the data collection began according to a plan. The plan was to complete three lessons in a week. Accordingly, the total time taken for the twelve lessons is four weeks. Each lesson is given a calculated question paper on two occasions. That is, pre-state stage and post-state stage. Answer the question paper without any advice at the pre-state stage. Their scores were obtained separately. The lesson was then

touched according to the methodology chosen. Then he gave me the same question paper again to answer. The scores obtained in this case are shown as post-state scores. All these scores are obtained and analyzed with relative average scores. The research data led to conclusions that could indicate the success or failure of the research. The content and scores of the observation question were used to determine some variation in performance related to each of these lesson areas.

The primary purpose of the first process was to improve basic knowledge. This is done using various basic methods. In addition to the method used in the example above, different methods were used for each lesson. They are as follows;

Lessons	Methodologies
1.Data representation and interpretation	Observation method
2.Numbers pattern	Exhibition method
3.Area and Perimeter	Lecture method
4.symmetry	Observation method
5.Mass	Discussion method
6.Solids	Practical method
7.Tessellation	Reference method Art and craft method
8.Square Root	Question method
9.Fractions	Revision method
10.Directions	Pair work
11.Time	Example method
12.sets	Group work

The second phase focused on problem solving. Here they were taught how to solve different types of problems, improve their reasoning skills and answer in a timely manner.

In the third stage of the cycle, students' attitudes, skills and creativity develop. Data on this were collected through observations during the study process. At the end of all the teaching sessions I was given the same question paper again and scored. The average value of the scores obtained at the end of all processes was obtained. Accordingly, before and after cases are compared and conclusions are reached.

3. Result

Chart 1: Average marks of twelve lessons pre-test and post -test

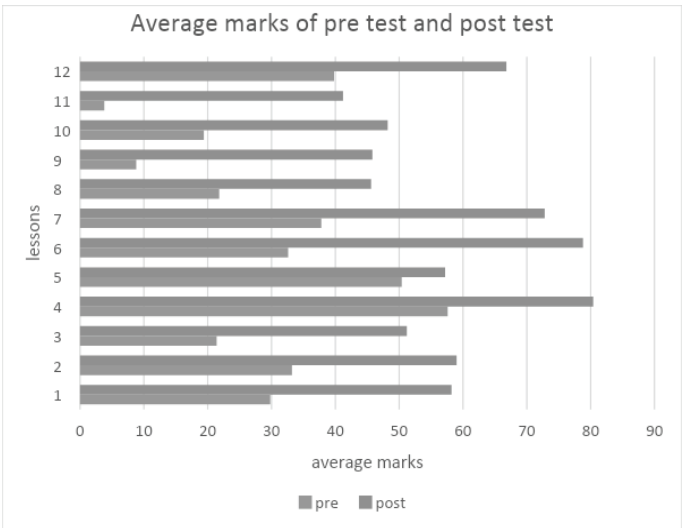
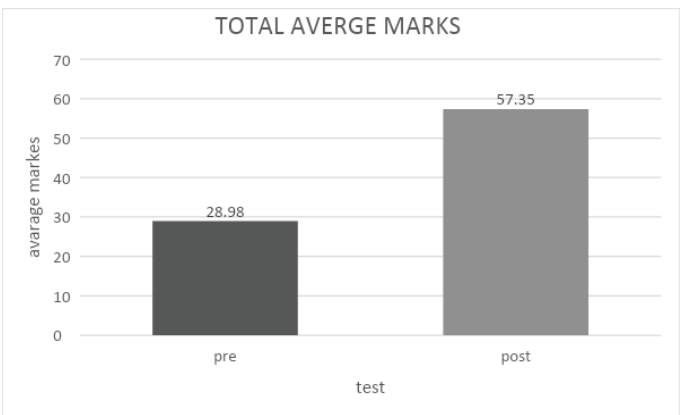


Chart 1 shows the average scores of each individual. Hence it is easy to check students' progress. It can also be easily observed that there is a high level of progress in the pre -state and post-state scores of each student. The vertical axis shows twelve lessons and the horizontal axis shows the average marks of the pre-state and post -state.

Chart 2: Total average marks of pre-state and post-state.



This 2 chart shows the total average of the twelve marks obtained by the five students for the twelve separate lessons. The average value of the total of the marks

obtained separately for the pre-state and post-state in twelve lessons is obtained. This makes it easier to study the success of the whole process.

4. Discussion

Clear marks when considering pre-state and post-state opportunities. There is a discrepancy. That is, the post-state score is higher than the pre-state score (chart 2). We can conclude that the basic subject knowledge has been successfully imparted and the methods used for it have been successful. But when doing this methodology, they had to face various problems. Still, the methods used to solve the problems made it easier to complete the research.

There were successful as well as unsuccessful methods within the twelve methods mentioned in table 3 above. In some cases, they also had to face various difficulties. The main problem is that the school I chose was a mixed national school. The language problem was often seen here. Not knowing some Sinhala words and not knowing the correct meaning were notable. That is, when a single question is asked in two ways, the same answer must be given. Gives contradictory answers to a question without giving correct answers. For example, “solve the problem below” golf sent to “evaluate problem below” different answers are provided for the same answers. Together with the Sinhala teacher, the students were taught the most commonly used words and their meanings in Mathematics. Later, those methods were able to succeed in various ways. This was mainly required for question method, discussion method, example methods etc.

Another problem is that time is not enough. That is, the duration of schooling is reduced and the time spent on certain activities is reduced. For example, students were not given enough time for technical activities such as group activities and Art and craft. Due to this reason, in addition to subject knowledge, time management training could be provided. Homework also provides opportunities to monitor the tendency of homework to be better than before. Some students were less focused on their lesson. When using the lecture method and the correction method it is more observable. While teaching the lesson, they were given the opportunity to ask a question from a randomly selected student or bring it to the blackboard and solve a problem. This method was able to maintain the student's attention, reduce the student's fear and increase their present. There was also a shortage of equipment for certain activities (compass). In such cases, teaching is done using videos. In most cases substitutes from the surrounding environment were used and the student experience was used.

I saw that some students were shy in the classroom. But they are given the opportunity to describe the data they found, which reduces their fear of coming forward and commenting. They also had the opportunity to identify student

weaknesses such as lack of activism, lack of unity, and lack of mutual support, and in addition to subject knowledge, these techniques were also important in minimizing those weaknesses. Primarily, the success of the methodology depends on the cooperation of the teacher and the student. At the end of it all this can be further confirmed by comparing post-stat scores and pre-state scores, student participation and student feedback.

5. Conclusion

If we conclude from the data observation, those active strategies had a positive impact on student's attitudes. In addition positive attitudinal changes such as a support, team spirit, effort, and interest were observed in practice. A change in their behavior in the classroom and being active in certain intelligence- based activities was notable. There was an increase in school attendance and voluntary participation, and there was a tendency to do homework as well. According to the students' ideas, these methods are also successful.

In analyzing the data, on the basis of the average test score pre-state and post-state, we can conclude that the same methods are generally successful. Although some of the methods used earlier have failed, the methods used later have been shown to be very successful. It is well represented by table 1. The result of 12 lessons were observed separately. There are 12 different methods used to teach them. As shown in table 3. In this case, some of the problems that arose during the use of certain methods had to use separate remedies. (For example, language problems) After using various techniques for these, I can conclude that I was able to use my mathematics teaching methods easily and successfully.

Analysis of the mean value of the results obtained from the research showed a clear increase in the mean value of the results. It can be seen from chart 12. According to the chart 13, assuming a minimum score of 10 per student, the student's score after the post -state is about 37, an increase of 27. If the progress of the student who got the lowest marks out of the five students has increased in this way, the progress of the other students has also increased in general as compared to them. From the analysis of the data and the observation of the students, it can be concluded that the level of students has increased after the post-state stage and the methodology used has been overall successful.

EFFECTIVENESS OF DEMONSTRATION IN SCIENCE PRACTICALS HELD ON ONLINE VS CLASSROOM TEACHING

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Abstract

In recent years, students have gotten low marks for the science subject. The main reason is that in recent years, schools have been changing from traditional classroom-based to online teaching. The purpose of this study is to investigate the effectiveness of science practical components on students' academic performances in online and classroom teaching. The population of this study is the students in Nakkawaththa National School in the Kurunegala area and sample consist nine students in grade 09^B. Quantitative data on students' academic performances have been analyzed by using SPSS software. The result indicated a difference between marks of students for science subjects when demonstrations in science practicals were held online and in the classroom. According to this study, the effective method for demonstrating practical science is classroom teaching.

Keywords: *Science education, SPSS, online evaluation, practical compo*

1. INTRODUCTION

Science subjects are based on both theoretical and practical components. Demonstration and hands-on activities are important in science education. But the problem is that school students get low marks for the practical components of the science paper. Students face many issues during the practical components of science regarding using the correct method. The main reason is that students have to study under the Covid-19 situation. Considering that online learning is unanticipated during the Covid-19 pandemic, instructors and students cannot be well-prepared. Every science teacher may face challenges in this situation because the task is focused on implementing online learning and implementing minds-on/hands-on activities in science learning. Some of the students show poor performance in their practical skills. They get high marks only for the theoretical part of the science exam paper. They will achieve a lower grade for the practical science components of the exam. The current pattern of school education was online mode, leading it to ignore the practical components of science. This research concerns the online & classroom teaching strategies that help improve the practical science skills of secondary-level students. This research compares demonstration effectiveness in science practicals held on online vs classroom teaching. The research question is What is the most effective way to demonstrate practical science? The main

objective of the study is to investigate the effectiveness of science practical works on students' academic performances in online teaching and classroom teaching.

2. METHODOLOGY

The population of this study is Nakkawaththa National School, and the sample size is nine students in grade 09^B at Nakkawaththa National School. Five practical components of grade 09 science subjects are taught two times online and classroom. Quantitative data has been collected from nine students at the secondary level. Nine students have been divided into three groups according to their marks on the science subject, and the data was evaluated individually and in the group. The researcher intends to evaluate the effectiveness of online teaching and classroom teaching using SPSS software and give marks using the criteria for both teaching methods. Following are the five practical components that ended up being carried out.

1. Factors affecting the pressure
2. Electroplating
3. Hydrometers
4. Refraction of light in a glass block & Refraction of white light through a prism
5. Simple machine, the process of the lever

Evaluation criteria for practical components (Highlighted areas of evaluation criteria in practical components are evaluated under the online and classroom teaching)

Name of the Practical	Evaluation Criteria								
	Following teacher instructions correctly	Correct observation & Record observation	Designing skill	Functioning of the product	Arranging the circuit correctly	Manipulating equipment correctly	Handling equipment safety	Drawing diagram correctly	Participation for observation
Factors affecting the pressure									
Electroplating									
Hydrometers									
Refraction of the light in a									

glass block & Refraction of the light through a prism									
Simple machine, the process of the lever									

3. RESULT AND DATA ANALYSIS

Each practical component is evaluated under the five evaluation criteria. The researcher has evaluated nine students (A, B, C, D, E, F, G, H, I) under the evaluation criteria for each practical component and collected data. Nine students are evaluated under two teaching methods as online and classroom teaching. The data analysis revealed that students performed better in classroom teaching than in online teaching.

4. DISCUSSION

In online teaching, the teacher cannot see students' learning, behaviour and skill. Teachers can only do the teaching. It is highly affecting students' learning, especially in practical components in the science subject. In classroom teaching, the teacher can see and observe the students, and he can make students' mistakes and develop their skills. Students perform well in science after the implementation of practical work. Students believed that science subjects are too complicated. They did the practicals, and after, they shared their knowledge with peers. It is the main importance of classroom teaching.

Limitations

The research limitations where the result of the study may not reflect all the secondary schools in the district as the study was carried out among students in a selected school. And also, there are some limitations to the data collection. The main problem is that some students have internet problems and have no proper online learning facilities. Because they cannot do the practical well, it is a significant problem in online learning. Another one is the

absence of the students due to the Covid-19 pandemic. It affected the collection of data.

5. CONCLUSION & RECOMMENDATION FOR FUTURE RESEARCH

According to the result and data analysis, all students showed better performance in classroom teaching than in online teaching. During the online sessions, all students showed weak performance. They reduced marks for evaluation criteria. Students got low marks for hand-brain coordination skills. Students showed low performance for online teaching when it was compared with classroom teaching. All nine students have low marks for practical components in online teaching due to weak hand-brain coordination skills. According to the result, all practical components of science depend on hand-brain coordination skills. This skill cannot be developed by looking at videos. It depends on doing practicals. Due to that reason, the effective method of demonstration in science practical is classroom teaching. The teacher can consider the below suggestions to do online teaching efficiently.

- A microphone is needed to capture audio.
- Instructors should construct narratives and whiteboards and then record onscreen activities following the whiteboard.
- Use the highlight box and dialogue tools to highlight actions or regions on the screen.
- Keep backup Captivate files for future revisions.

Practicals in science subjects depend on hand-brain coordination skills. Students develop their performance for the practicals. The teacher should need to improve their hand-brain skills. The effective way for demonstrating practicals in a science subject is physical classroom activity.

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IS COMMERCIAL ARBITRATION IN SRI LANKA SUFFICIENT FOR THE GROWING COMMERCIAL TRANSACTION?

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1. Introduction

As Sri Lanka is currently in a transitional phase where it is gradually entering into the world of commerce, inevitably it has to embrace alternate methods to resolve commercial disputes. Commercial arbitration is one such method which is accepted globally as successful. There are a number of reasons for using arbitration as a method of dispute resolution. However, two reasons stand above the rest. Firstly, arbitration is considered neutral compared to litigation. This is mainly because in arbitration both the parties can be involved in key areas, ranging from selection of the arbitrators to the place of arbitration and the law to be used in the proceedings. Secondly, the power of enforceability. In this instance it must be noted that the decision given at the conclusion of an arbitration is final and conclusive. Which means it is binding on all the parties involved and it is not open for further appeals. Such awards can be enforced by the prescribed court nationally or internationally.

2. Literature Review

Alan Redfern and Martin Hunter in their celebrated book on International Arbitration describe arbitration as a very simple method of dispute resolution. They are of the view that arbitration is an informal setup between the parties to a dispute conducted by a neutral third party. These parties may vary from individuals, corporations to states. According to the authors, arbitration is simply a group of people seated around a table in a room provided for hearing with the intention of solving the dispute. Therefore, it is important to note that arbitration proceeding is different to litigation that takes place in a formal court of law. In that case, it is safe to say that arbitration is more like a business meeting as oppose to legal proceedings.

Most laws pertaining to commercial arbitration are directed, administered and managed by a number of key institutions. Some of the most famous institutions are, International Chamber of Commerce (ICC), the American Arbitration Association (AAA), and the London Court of International Arbitration (LCIA). The authors further identify the United Nations Commission on International Trade Law (UNCITRAL) Model Law 1985 as one that has influenced many legal systems in the world to draft their arbitration laws. Additionally, the Convention on the Recognition and Enforcement for Foreign Arbitral Award 1958 too has been considered as a similar element. According to Redfern and Hunter, the central purpose was to protect the efficacy of arbitral process whilst reducing any intervention by the judiciary.

Dr. Harsha Cabral, a celebrated author in Sri Lanka who has specialised in company law and arbitration law, in his book "Law and Practice of Commercial Arbitration in

Sri Lanka” points out a valid definition for commercial arbitration. Commercial arbitration is a method of dispute settlement done by a neutral person called an arbitrator and the arbitrator is selected by the parties to the dispute. The selected arbitrator will then assess the evidence and the arguments presented to the tribunal and makes a final decision which will be binding on the parties as agreed before. Moreover, Dr. Harsha Cabral in his book *Law and Practice of Commercial Arbitration in Sri Lanka* explains that institutional arbitration is considered expedient as the institutions involved are equipped with procedures and infrastructure that is necessary to hold a full-blown arbitration process. He further identifies the Singapore International Arbitration Centre as a globally recognised and successful institutions to conduct arbitral proceedings. Dr. Cabral points out that the Institute for the development of Commercial Law and Practice (ICLP) is one of the key centres for arbitration in Sri Lanka apart from the Sri Lanka National Arbitration Centre (SLNAC).

“Arbitration law in Sri Lanka”, a book compiled by a celebrated author and also one of the prominent President’s Counsel with a very successful practice in Company Law and Arbitration Law has very descriptively pointed out the impact of foreign principles of arbitration on the domestic structure. The President’s Counsel in his book points out that the main legislature with regard to arbitration in Sri Lanka known as the Arbitration Act, No. 11 of 1995 (also considered as the first Arbitration Law in South Asia) was based mainly on the UNCITRAL Model Laws. He further states that as a result of the Swedish Institute of Legal Development providing technical assistance with drafting, the local Act has significant flavours of the then system of arbitration in Sweden and the Swedish Arbitration Act.

3. Research Methodology

This research largely focuses to assess the helpfulness and the effectiveness of the Arbitration Act, No. 11 of 1995 in Sri Lanka with regard to the recent growth in the number of commercial transactions in Sri Lanka. In order to do so, this research will be conducted on the positivist paradigm. Further, the epistemological deliberation will be drawn by way of publications, case law reports, journal articles and statutes. Therefore, both Black Letter Approach and International Comparative Research Method are used for this research.

4. Discussion and Analysis of the Findings

The Sri Lankan Arbitration Act enacted in 1995 as mentioned before was a turning point in Sri Lanka’s Arbitration system and also, it was considered as the first Arbitration Act to be enacted in South Asia. However, this Act over the years had caused some uncertainty between parties mainly due to the reason of being outdated. Some of the key issues of this Act are; uncertainty pertaining to the competence and the jurisdiction of the tribunal, uncertainty regarding the availability to appeal if the tribunal fails to give reasons for its award and the uncertainty prevailing over Chapter VII of the Act. In the Sri Lankan Act with regard to the doctrine of competence and jurisdiction there are a number of contradicting and

parallel issues. In the Act it is stated that, the tribunal may decide on its jurisdiction and further goes on to state that, any party to the dispute in an arbitral proceeding may apply to the relevant High Court (Commercial High Court) to determine any such question pertaining jurisdiction. This provision can be considered as one of the key issues related to jurisdiction of an arbitral tribunal in Sri Lanka as it clearly makes a parallel jurisdiction to both the arbitral tribunal as well as the Commercial High Court of the Province.

Although the Sri Lankan Act was based on the UNCITRAL Model Laws implemented in 1985, the initial Model Laws too had this same defect. However, in the year 2006 the Model Laws were amended in order to correct this issue of uncertainty with regard to competence and jurisdiction. According to the amendments, the tribunal has the power to decide on its jurisdiction, however, in the event a party thinks that the tribunal's decision regarding its competence to exercise jurisdiction is wrong, then that party shall make a plea not later than the submission of the statement of defence. As clearly seen above, the amendments in 2006 have rectified the issue that can be seen in the Sri Lankan Act by first giving the power to the tribunal to decide on its jurisdiction and if the parties are not content with that decision only, they may make an application to the specified Court. Therefore, it can be stated that the amendments in 2006 have negated the issue of parallel jurisdiction that can be seen in section 11 of the Arbitration Act No. 11 of 1995.

In order for arbitration to be effective in a legal system, a good arbitration law of the seat or a *lex arbitri* and efficiently functioning arbitration institutions are required. On the one hand, the arbitration law in Sri Lanka is primarily based on the 1995 Act which over the course of this research had proved to be a failure. On the other hand, there are two functioning arbitration institutions in Sri Lanka. Namely, the Sri Lanka National Arbitration Centre (SLNAC) and the Institute for the Development of Commercial Law and Practice (ICLP). The former is very commonly used on an ad hoc basis because the SLNAC does not have its unique institutional rules. This is a private non-profit Company by guarantee. It mostly acts as a seat of arbitration while providing other facilities to carry out an average arbitration proceeding in a somewhat systematic manner. In order to fix this issue suitable institutions with proper adequate infrastructure manned with skilful staff and other facilities must be provided. Therefore, in order to make arbitration effective in Sri Lanka, a set of skilled arbitrators need to be trained from a younger age where they are equipped with the basic and most commonly used traits and practices in commerce.

5. Conclusion

This research was led to ascertain the efficacy of the Sri Lankan Arbitration System in order to keep up with the increasing number of commercial disputes arising out of transactions. A number of issues were raised in the introduction of this research to be answered. Research techniques such as black letter approach and the comparative research methodology were used to analyse the findings of this research. The research questions; what is commercial arbitration and what are the features of commercial arbitration in Sri Lanka were answered in the literature

review by presenting information through books and articles of celebrated local and foreign authors. Furthermore, online article and case law were included to elaborate more on the concept of commercial arbitration.

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Greening, the DNA for Future Banking- Are the Customers Onboard?

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1. Introduction

The rising environmental and natural resource deterioration is a major problem that human beings are currently confronted with. Unsustainable human activities have been highlighted as the primary contributor to this alarming environmental trend (Henderson et al., 2017, pp. 317-332). In the past, the banking industry was mostly excluded from the list of environmentally damaging industries and perceived as an environmentally neutral industry. In the late 1980s, the need for a “Green Economy” for the sustainable development of the world was realized. This led to the comprehension of the impact of one of the most important economic agents, that is, the banks, on the global environmental degradation and resource depletion (SBP, 2015). The banking industry has an impact on both qualitative and quantitative economic development and growth. As a result, it is crucial in the process of promoting environmental sustainability and socially responsible investment (Jansson and Biel, 2011, pp. 33–41).

Banks can have a negative impact on the environment both directly and indirectly. The direct negative impact can be attributed to a bank's carbon footprint and resource consumption as a result of its regular operations. Banks in most emerging nations have extensive branch networks that consume a lot of energy and other resources like paper. The indirect environmental consequences of banks, on the other hand, are a major subject of concern. Through their financing of their clients' operations, banks have a huge impact on the ecosystem (Nath et al., 2014, pp. 45-62). The indirect negative impact of the bank's financing of businesses that harm the environment, such as coal, paper, steel, cement, fertilizers, power, textiles, and chemicals, can be more serious and dangerous (Ahmed, 2012, pp. 1-12). Thus, Banks are not actual polluters, but they do have financial ties to a number of businesses and are financial backers of several polluting investment initiatives.

Green Banking is defined by the International Finance Corporation (IFC) as; “A blend of bank's own direct environmental impact reduction, managing environmental and social risks in banks' decision-making processes and supporting businesses and industries that have a positive impact on the environment and society”. Several studies have looked into customer satisfaction with green banking activities on various levels. However, there is a scarcity of empirical work that captures both the features of green banking initiatives and the impact that

satisfaction with the features/attributes of green banking initiatives has on overall customer satisfaction with green banking. Customers' acceptance of a bank's innovative service and willingness to adopt such an initiative is critical from the bank's standpoint since they will establish the basis for a long-term engagement with customers.

This study thus aims to address the gap regarding green banking initiatives in the Sri Lankan banking industry by analyzing the customer expectations of green banking products and services, how these green banking initiatives impact their satisfaction, and finally how it develops consumer satisfaction and loyalty towards the bank. The goal of this study is to create a conceptual model that combines elements of green banking initiatives as independent factors and overall customer satisfaction with green banking as a dependent variable. The study's specific goal is to review the literature on green banking, green banking initiatives, features of green banking initiatives, and customer satisfaction in order to develop a conceptual model that shows a link between overall green customer satisfaction and customer satisfaction with green initiatives.

2. Methodology

The survey was conducted using a convergent parallel mixed method approach, in which the goal is to collect both quantitative and qualitative data at the same time, merge the data, and use the results to understand the chosen research problem. The rationale and strength of this approach is that one data collection form provides strengths that offset the weaknesses of the other, resulting in a more complete understanding of the given results. The flaw, on the other hand, is that it might be difficult to merge and then assess data that differs. Because the data will be collected in the form of a questionnaire, the recipient will be asked both quantitative and qualitative questions. The abductive technique approach is also used in this study, utilizing real-life empirical observations as the beginning point for the chosen research issue (Kovacs & Spens, 2006). Following that, theories from different disciplines are borrowed and applied to explain the observed occurrence that serves as the beginning point (Stock, 1997; Dubois & Gadde, 2002). The goal of the abductive methodological technique is to develop existing theories and apply them to a new situation (Kovacs & Spens, 2005). The study identified a target group of 18-60-year-olds in Sri Lanka, believing that this demographic best resembles the client base of a typical bank. In total, 161 participants were involved in the questionnaire, with all 155 responding quantitative questions and 53 responding qualitative questions.

3. Results and Discussion

While the majority of consumers are satisfied with the services and products provided by banks, just a lower percentage of customers have faith in how banks operate. While it's difficult to pinpoint why this occurs, the findings suggest that it could be related, among other things, to previous unfavorable experiences that have influenced the EKB model's Information Processing (Engel et al., 1968). Only a third of those polled believe it is critical to have a single bank for all of their banking needs. Consumers prefer to engage with numerous banks rather than focusing on just one, indicating a low level of actual brand loyalty (Beerli et al., 2004). Customers want to work with the bank that specializes in a certain product or can provide it at the greatest price.

When looking at the data, customers' knowledge of green banking products and their banks' green practices was unexpectedly low. To shed more light on the subject, consider the qualitative question of why banks have placed such a low priority on green products. Customer demand and product understanding are significant among the reasons given, and it is also stated that the banks have not pushed the issue hard enough for a variety of reasons such as banks are sluggish to do so since they regard themselves to be a more ecologically friendly industry. They also don't experience the kind of outside pressure from activists that many other industries do, which corresponds to some of the qualitative findings such as external pressure and institutional priorities. The financial component of green banking products was one of the primary themes highlighted, with banks either not believing they could improve their revenues enough or believing the costs involved with the introduction were too high. This line of thinking can be regarded as a deliberate commercial choice, namely that banks believe the products' payback is insufficient to justify the original investment.

According to research, bank consumers have a high level of price sensitivity. A majority of people would refuse to pay a higher monthly cost to buy green products. This is reflected in the majority of respondents' comments, which indicate that they would be inclined to switch banks if their current products were offered at a reduced price. As the qualitative results demonstrate, this may be due in part to the fact that many customers believe they should be rewarded rather than punished for picking a green product, or that they believe banking products are already expensive, making it difficult to pay extra in a tight personal economy. The youngest generation was shown to be the least sensitive to the price of green items, despite the fact that they were supposed to have the least disposable money. The younger generation has proved to have more care and knowledge towards the environment, as Ganesan & Bhuvanewari (2016) discovered and this study validated, demonstrating that one's interest in a subject has an impact on price sensitivity.

A majority of respondents said that a bank that offered a wide selection of green products would increase their happiness and confidence. Furthermore, data revealed a decreased likelihood of switching from a current green product to a non-green counterpart, as well as a loss in satisfaction with their present bank if other actors offered green banking products while theirs did not. These findings show that when customers are presented with the concept of green banking products, they have a favorable reaction, but when they are not, they have a negative reaction. Because the banking business is normally homogeneous, delivering identical products and having a difficult time differentiating themselves through product offerings (Javalgi & Moberg, 1997), the advent of green banking products appears to present a possibility for that differentiation.

4. Conclusion and Recommendations

Consumers do not expect their banks to develop specialized green products; instead, they have demonstrated a preference for corporate environmental responsibility. As a result, activities and the launch of products that improve the environment in addition to their primary function would be a welcome endeavor. While no obvious favorite product could be found, there was a good attitude toward products, and personal preference and attitude were highlighted as the driving factors behind the choices. Attitudes and preferences varied by segment, with women and the younger age being more enthusiastic about green banking. By the time of implementation, the younger generation will be older and have more purchasing power, and a new generation with comparable ideals may have emerged.

Instead of the mixed method approach utilized in this study, more focused quantitative or qualitative investigations would be conducted to acquire a better sense of the target group's preferences. This would allow for more detailed investigation and study of the subject. Individual knowledge levels on green banking products, on the other hand, were found to be extremely poor, as evidenced by the findings. This could have influenced general interest, as it's difficult to be interested in something you don't recognize or comprehend. As a result, using focus groups as a qualitative strategy in future investigations is recommended.

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Session 06
Management



Assessing the Impact of Promotional activities upon the Consumer

Buying Behavior-A Case Study of Sri Lankan Airlines

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Abstract

In 2019, when the Covid-19 pandemic made its presence known, most of the Countries underwent a complete lockdown including a small Island surrounded by the Indian Ocean, thus leaving all Companies in a state of turmoil. However, in comparison to other Industries, the Airline Industry was pruned to a greater vulnerability of devastation worldwide, due to a drop down in Passenger demand for travel. It is in this context of switching gears to a setting in the Island itself, Sri Lanka, of an International acclaimed and global winning Carrier, Sri Lankan Airlines, which is currently not in a financially viable position since the termination of its partnership with Emirates back in 2008. In any case this has made the Carrier to be more autonomous, controlled by the Government in creating its own brand value and world recognition, thus empowering to be what it is today. However, due to the high costs of tickets in comparison to other Aircrafts, travel demand is less. Almost every Aircraft tend to fail in optimization of Seat by the time of take-off which has resulted in the Carrier being worked with numerous empty Seats coming about in a colossal misfortune, and an indeed more noteworthy misfortune presently with the pulverization of Covid-19! The management has not given prominence to promotional strategies and the value of promotional incentives on the forefront of optimization of revenue to the Airline, particularly taking into thought its monetary position which comes about in an improbability of the Airline being able to purchase or lease Aircrafts with a limited fleet of just 25 Aircrafts! Thus, the Researcher conducted a case study to assess and survey the influence promotional incentives do have on the purchase behavior. Promotions were segmented into digital, traditional and event marketing.

The methodology adopted in this research was one of mono-method quantitative grounds, based on the philosophy of 'Positivism'. The technique utilized for the collection of data is that of a Questionnaire, unsurprisingly catering to the highest sample of the Krejice and Morgan table which requires the input of 384 respondents for the Questionnaire, representing an understandable population sample of over a 1,000,000+ Airline Passenger base. The sampling technique utilized was on the grounds of random/convenience sampling. In the setting of Covid19, the instrument used for the collection of data was Questionnaire

formalized and sent via Google form to Passengers, in order to gain faster efficient and effective feedback, due to a cross-sectional analytical time frame of approximately 4 months. In the context of sampling, the target population selected were participants from all walks of life irrespective of Country, culture, caste and creed bearing the potential of travelling with Sri Lankan Airlines. Whilst It was an excruciating parameter in obtaining Survey's each correspondent of Nationality, especially as elaborated, with the current situation of Covid-19, resulting in a temporary cease in demand for air travel, the sampling framework was narrowed down towards Passengers stemming mainly from Countries like London, Singapore and India. The application to theory development was one of a deductive approach, seeking which sub variable to abort. Further, an operationalization chart was utilized in the formation of such questions. The formalities of the questionnaire were structured in containment of five Likert scales, ranging from Strongly Agree (SA), to being vice versa Strongly Disagree (SD), The last 3 questions of the Questionnaire, 16-19 have been formulated on the foreseen circumstance of measuring the efficiency and effectiveness of promotional strategies in order to undertake a reliability analysis on the 4th variable which is the dependent variable on the context of ascertaining a fair factual based on the outcomes of the completed Questionnaire.

Findings of the research indicated that promotional incentives do indeed have an influence on the purchase behavior as a whole, however with certain rejections on one type of promotional incentive which tended to have a negative relationship with the purchase behavior, presumably Event marketing. A pilot survey of 384 was conducted amongst 400 Passengers travelling on Sri Lankan Airlines. Although 400 Questionnaires were distributed, 61 questionnaires were returned whereas 55 Questionnaires went unanswered. Participants of the Questionnaire selected mainly stemmed from Countries like London, Singapore and India due to reasons such as the operation of consistent inbound charter flights from these Countries in comparison to other Countries, some of which the Airline has not resumed flight operations to, due to the situation of Covid-19. This resulted in a framework of 284 participants and reliability analysis was carried out for Independent variables such as Digital Promotions, Traditional Promotions and Event Marketing, followed by the assessment of reliability on the dependent fourth variable of Purchase behavior. Due to insufficient questionnaires contributing in facilitating the correct perception from the Passenger, from previous Researchers, the Questionnaire has been formalized by the Researcher himself, Authors of the literature which contributed to the creation of the questionnaire have been recognized and cited under operationalization. Hence to verify the authenticity of the Questionnaire in terms of reliability and internal consistency, the Cronbach's alpha value was calculated.

The Cronbach alpha value is a test reliability technique which requires merely a singly test administration in facilitating a unique estimation of reliability for a given test where if the alpha value is below 0.7, internal consistency is low and the model is unacceptable. However, as per findings above the Cronbach alpha

values tended to be above 0.7 which thereby assures the reliability and internal consistency of the Questionnaire. This indicated that the correlation coefficient was high denoting the prevalence of a strong relationship between the targeted variables. The dependent variable of purchase intention carried the highest internal consistency with the alpha coefficient for the 16 values being 0.835 following soon afterwards by the variables of Event Marketing, Digital Promotions and Traditional Promotions with the alpha coefficients being that of 0.818, 0.805 and 0.746 respectively, thereby proving the existence of a strong relationship which in turn supports the overall aim of the objectives in deducing the relationship between the coefficients therein being one of a positive attribute. In addition to having obtained the alpha coefficients being one of reliability, investigation of the dimensionality of each scale was undertaken through a factor analysis, in order for the reduction of data which comprised of some contributing to more than 0.5, and some contributing even less than 0.5 which resulted in the removal of certain items in order to ascertain a fair factual of communalities on ethical grounds. As per findings, the correlation of Digital promotions, Traditional promotions, Event marketing and Purchase behavior all tended to have the correlation equal to 0.1. Thus, in both cases it showed that Digital promotions is related to digital promotions and likewise similarly the other variables of traditional promotions, event marketing and purchase behavior which in turn concludes that a perfect relationship is prevalent. The correlation coefficient (r) between digital promotions and the purchase behavior is 0.516 which is significant at 1% level ($r = 0.516$, $p < 0.05$). Hence there is a clear and strong association between digital promotions and the purchase behavior among Passengers travelling with Sri Lankan Airlines. This was also confirmed with the R-Square value of 0.298. There was also a prevalence of positive strong correlation between Traditional promotions and the purchase behavior. The coefficient was 0.482 ($p < 0.05$) which thereby showcases the positive association between these variables at 1% significant level. There was also an association between event marketing and the purchase behavior. This is confirmed with the correlation coefficient of 0.271 ($p < 0.05$) at 1% significant level. A Multiple regression analysis was undertaken and the results disclosed proved the solvency that the Model is best fit. According to the Model summary, the R-Square value is 0.298, which depicts that 29.8% of the variation in purchase behavior is explained by Digital promotions, Traditional promotions and Event marketing. The Durbin-Watson value of 1.176 was tending towards 2. An Anova table was conducted and findings indicated that the model tended to be of an excellent pairing with the probability value ($p < 0.05$). Thereby a coefficient table was analyzed and it was here that it was understood that digital promotions ($p > 0.05$, $t = 5.214$) and traditional promotions ($p > 0.05$, $t = 3.265$) were significant predictors of purchase behavior among the Passengers of Sri Lankan Airlines, whereas event marketing ($p > 0.05$, $t = -0.01$) was not a significant predictor amongst the Passengers of Sri Lankan Airlines. There were no serious multi-collinearity issues prevalent due to the fact that the 'Variation Inflation Factor'(VIF), for each variable tends to be less than 5. In the final hypothesis testing, it was found that Digital ($t = 5.214$, $p < 0.05$) and Traditional promotions

($t = 3.265, p < 0.05$) did have relationship with the purchase buying behavior whereas event marketing didn't support it ($t = -0.019, p > 0.5$).

Each sub variable was then examined in detail and discussed on how each could be improved, with special emphasis on event marketing especially as this form of promotion was rarely being done by Sri Lankan Airlines. Doing it right will certainly make a repetition of the Consumer buying process model in turn having a positive impact. However, the research did meet the overall aim and objectives of the research. Alongside giving interesting details about the purchase behavior patterns of Passengers. The researcher invites the reader to join him in delving this interesting study alongside managerial implications in enlightening the management the potential promotional incentives do have in influencing purchase behavior. In concluding the researcher leaves the door open for further research in different realms such as Identification of key constraints of Passengers that have an influence on the purchase behavior and identification of key demographics which hopefully would be another subject of further discussion by the Researcher!

AN INVESTIGATION ON THE FACTORS THAT AFFECT 'SEARCH ENGINE OPTIMIZATION' (SEO) IN DEVELOPING THE MARKETING SPHERES IN SRI LANKAN MULTI- NATIONAL COMPANIES

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ABSTRACT

In the digital world, the internet and web-based devices have become a predominant mode of marketing to attract a huge number of customers in a very optimistic manner compared to the other common methods and marketing strategies. Search Engine Optimization (SEO) has been greatly influencing the marketing aspects of different products and service-based industries. This research is focused on how SEO affects the marketing of the Multi-National Companies (MNC's) in Sri Lanka compared to conventional marketing methods in respect of a sustainable approach. Effective keyword use can help a website receive a higher rating, as well as enhance site traffic and attractiveness. The aim of this research is to investigate the 'Search Engine Optimization' methods that can be applied in digital marketing to introduce a new frame to the MNC's in Sri Lanka. The objectives are to identify the conventional marketing techniques, recognize their relationship with digital marketing, compare the uses and barriers of SEO, and produce a model to apply SEO to the MNC's. This research was carried out in a mixed method. From the past research data, the researcher identified 4 primary variables such as domain factors, page-level factors, backlink factors, and user interaction that will directly impact the success of SEO. An expert interview with a questionnaire was directed with 380 people related to internet access and content marketers at the first stage. The four different factors identified by the researcher are ranked according to the levels of involvement in the success of SEO from the statistical analysis of the responses received. SPSS 22 was used as the analytical tool to express the hypothesis in inferential and descriptive statistics using simple regression analysis. Based on the above statistical analysis results, the user interaction which were considered as the alternative hypothesis was accepted as the Top-ranking impact variable of the success of SEO. At the next level of the research, a random case of a web page from a Sri Lankan fast-moving consumer goods market was expected to be identified by collecting the primary data using web crawling and web searches with time from any trafficking methods (Using google analytic tools). Sustainability can be followed throughout the research, rather than traditional methods which is a new and rising thought in digital marketing.

Keywords: Search engine optimization; SEO in multi-national companies; Sustainable marketing; Conventional marketing technique to sustainable practice.

INTRODUCTION

1.1. Background of the Study

With the use of globalization, to ensure marketing success organizations use a variety of new marketing tools and strategies that are often different from each other. The current pandemic has changed the world in almost every aspect, affecting nearly every financial institution and industry, especially those reliant on personal interactions, forcing them to alter their marketing methods, some almost completely changing their way of marketing in order to adjust with the current situation in the world. Search Engine Optimization (SEO) is one tool that plays a huge role in service-based industries and several product's marketing platform. Stakeholders in particular organizations have also been greatly affected by the pandemic. Even without availability in the physical market, stakeholders are inclined to purchase and sell goods and services. The Figure below shows the people who use different search engines out of 5 billion users throughout the world.

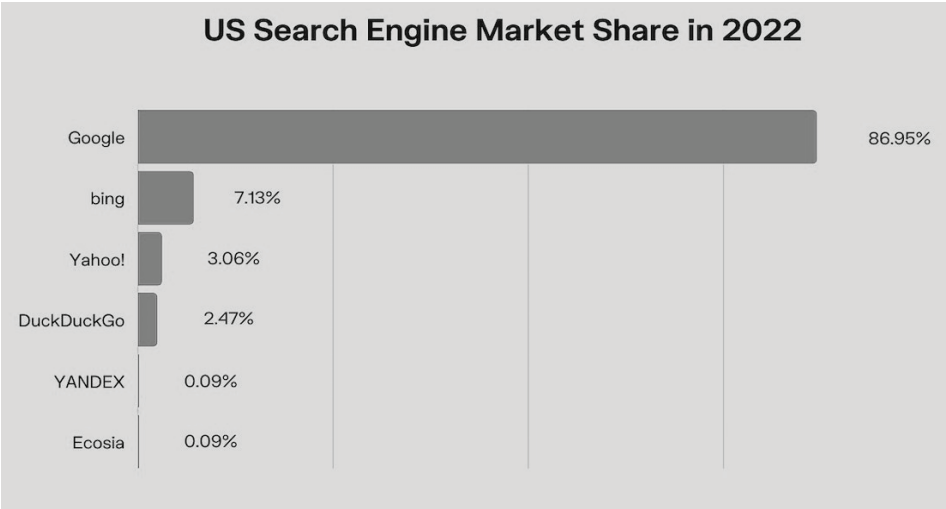


Figure-1.1: People around the world and the search engine usage. (Source: oberlo.com)

With the constantly progressing Internet and web designs, based on the ‘New Optimization techniques’ successes and flops can be identified. Because of this, we have particularly recognized critical factors that will support to improve search results status. Shih.B describes that, company’s increase website ranking through the use of search engine outputs.

Our research identifies several conflicts brought by companies when it comes to SEO, including the high cost of SEO compared to other paid advertisement methods. Since expense is a major factor in any company, they argue that SEO is not compatible with their business even with the positive outcomes SEO would have on their companies. This suggests that if they were to cut down the cost and had a more constant ranking, companies would be more likely to invest in SEO. Sen R provides a thorough explanation for SEO techniques, stating that it plays a major role in improving website ranking with the use of effective keywords, websites that

would be more attractive to the viewer, and by improving site traffic. Following are the new trends that bring search engines as a part of Search Engine Marketing (SEM). Dividing SEO into three core components will help to be familiar with it.

1. **Technical Optimization:** this involves completing activities that are not related to the content but improve SEO. This is usually not visible.
2. **On-page Optimization:** this is a method that ensures to provide the users with the relevant content. Providing the right keyword with the right content using a content management system will provide a greater user experience.
3. **Off-page Optimization:** recharge activities taking place outside the site to enhance search engine ranking. Recite reputation can be issued by driving with backlinks.

1.2. Significance of the topic

When users browse the internet with an idea to search for a specific product or service, they tend to click on the top suggestions that come up from the search engine, often disregarding the websites that come below. When your website comes at the bottom of search results, customers are not able to identify your website, which leads to decreased number of visitors in your website, and potential loss in sale opportunities. SEO is designed to help your website have a higher-ranking position on search results, thus increasing its visibility and appearance, which directly linked to increasing sales, the more people see your website, the more likely they are to use it. There are several aspects of a website that companies should greatly consider focusing on User experience. From the words of Spais, G. S. (2010) many researchers considered SEO as a part of their promotion management perspective which the management terms SEO as a dynamic technique for promotion.

LITERATURE REVIEW

According to Saunders (et. al. 2016)., A literature review is designed to be hypothetical to have theoretical research, several literatures and theories were extracted and thoroughly analysed to fit the title. Including diverse theories, the similarities and differences in Fast-moving consumer goods industries and digital marketing theory ideas were considered. The literature review was conducted in the following crucial titles.

Multinational companies in Sri Lanka

Multinational companies (MNC's) in Sri Lanka are given a greater value with all benefits which can be provided from the government. According to the article by Forhad Hossain in 2018, MNC's which are established and incorporated in Sri Lanka have some corporate assets and facilities in other parts of the world which is called "Parent Country". This idea was initiated for the purpose of coordinating global management. When it comes to the multinational companies around the world, the fortune 500 companies will have the top 500 annual ranking.

A major part of MNC's poses a competitive advantage with domestic businesses behaviours. Their major target will be export oriented. Theoretical analysis of MNC's is best known for foreign investments provided by Dunning (1998).

Conventional marketing strategies of MNCs

Conventional marketing is widely used to attract a huge number of audiences to build brand awareness, establish credibility and attract potential customers. Understanding the traditional marketing tools can help to build strategies that bring in a positive campaign for multinational companies. Conventional marketing media include radio, television commercials, billboards, and direct mail campaigns. Conventional marketing is important to reach audiences who spend time away from computers and social media. If the business goal is to appear the product to the local audience, conventional marketing is more recognisable.

Digital marketing and Search Engine Optimization (SEO)

Digital marketing is notorious for using digital technologies to market their services and products. Utilizing digital marketing modes like Twitter, Google Plus, LinkedIn, Facebook and other social media platforms is an efficient way of promoting the business. It Brings higher awareness to offer the products and services to customers through a digital platform. People around the world as an online community helped to establish a cross board relationship within the countries in the world (Tiago & Veríssimo, 2014).

Search Engine Optimisation is a process of getting people from natural search results which is free, organic, and editorial. This is an activity that attempts to improve the website search engine ranking. It can also be referred to as the quality control mechanism of websites. Unlike other digital marketing methods, search engine targets altering search results such as video search, local search, news, search engines and image search.

Study of SEO data analysis tools and data collection methods

In the current online marketing, there are so many Search Engine Optimisation factors that can work as a medium of advertising. Market analysts who deal with Search Engine Optimisation should have a great understanding of how their competitors are doing to stabilize a rank in Google. This information can make a difference with future SEO success or failure.

Every organisation uses different and essential tools to figure out how much traffic their competitors are getting from SEO. This is the reason why competitive analysis is an essential step when developing an SEO strategy. The more keyword we use, the better results can be shown in the competitors ranking position and estimated traffic. The process on which SEO tools work is by matching the keywords which are ranked for several domains. They consider Matrix manipulation of the 200 different factors and other statistical approaches. It has been planned to use google analytics tool to fulfil.



Figure-2.1: Basic SEO ranking factors for website crawling

METHODOLOGY

3.1. Methodology Introduction

The basis of this methodology chapter is the justification of the different choices and data collection types that were identified as answers for the Research question on the success of SEO. As an output for the research questions identified, a hypothesis has been developed.

3.2. Conceptual Framework

A conceptual framework involves the basic concept of research studies. The conceptual framework includes different theories and hypothesis which is developed by the researcher to formulate the research questions and problems. In my research, I have identified a set of dependent and independent variables. Initially 4 top different factors positively or negatively affect the success of SEO have been recognised out of them.

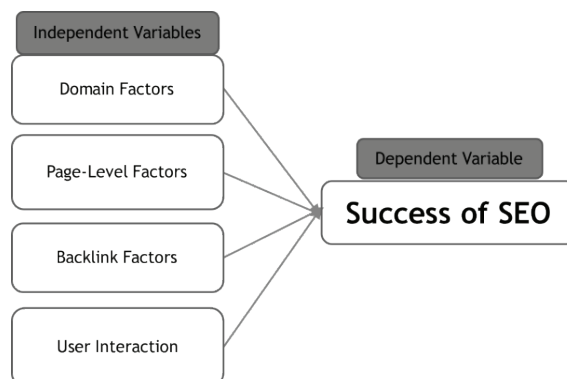


Figure-3.1: Proposed conceptual model developed for the research; Ranking factors of SEO (Source: Researcher Constructed based on Literatures)

3.3. Operationalization of Variables

According to Tariq (2015), operationalization of variables involves the developing of research procedure from the rare data series and analysing the data statistically to bring the connection with the present scenario.

The table below illustrates the operationalization of the different key variables identified from the conceptual model. These variables produce the dimension by connecting new measurable elements. Here, considering the first set of hypotheses, a questionnaire consisting of 21 statements was prepared as a data collection method of individual ideas from a selected group of people. Individual's interest level is expected to be collected using the Likert Scale which is the most extensively identified tool of measurement in conventional research.

Table-3.1: Operationalization of variables and their indicators (Source: Researcher conducted)

Concept	Variable	Indicator	Question number	Measurement
Independent Variable (Ranking Factors)	Domain Factors	Domain Age	Q1	Five-point Likert Scale
		Keyword Appears in Top Level Domain	Q2	
		Domain registration length	Q3	
		Domain History	Q4	
	Page-Level Factors	Keyword in Title Tag	Q5	
		Keyword in Description Tag	Q6	
		Content Length	Q7	
		Page Loading Speed via HTML	Q8	
	Backlink Factors	Linking Domain Age	Q9	
		# of Linking Root Domains	Q10	
		# of Linking Pages	Q11	
		Links from .edu or .gov Domains	Q12	
	User Interaction	Rank Analysis	Q13	
		Organic Click Through Rate for a Keyword	Q14	
		Direct traffic vs Repeat traffic	Q15	
		Pogo sticking	Q16	
Dependent Variable	Successful SEO	Be Keyword clever	Q1	
		Create stellar content	Q2	
		Use social media to grow the audience	Q3	
		Go local vs mobile	Q4	
		On-Page SEO	Q5	

3.4. Research Design and Philosophy

Every stage of the research process can be explained with more detailed descriptions using the layers of the research onion. This provides a proper research methodology and design with an effective progression.

Here are four types of research philosophies with the different data collection methods: Pragmatism, Positivism, Realism, and Interpretivism. In this the researcher has identified 'Interpretivism' as the research philosophy. The major reason for this method is that most people who are irrelevant to this concept will have very little idea on this and this may affect the quality of the data collected. Thus, it has been focused with a small qualitative number.

3.4.1. Research Strategy and choice

The researcher collected data from operational level workers from all sectors in different parts of Sri Lanka. The main issue faced was participants had to be identified with their knowledge level in social media and digital marketing. This research is having a quantitative study approach which makes a systematic investigation of collecting countable data to perform mathematical, statistical, or computational techniques.

3.4.2. Population and sample size

The population for this research is of huge numbers (1,000,000 internet users). This can only be narrowed with specific selected criteria. So many factors take part in limiting the population for the research. 380 individuals all over Sri Lanka who are related to internet sources and digital marketing were identified as a part of the sampling method to go through a questionnaire analysis. This sample value is identified from the reference of "the research methods for business" 4th edition- New York by Sekaran (2003).

3.4.3. Data Collection

the primary data was obtained from original sources with the direct efforts of the researcher. Secondary data were collected from articles, online journals, and other resources to further reinforce the research project. The referees for my research samples are the specific people who belong to the digital marketing sector with a wider understanding on SEO which is a part of the digital platform. The questionnaire was designed with three sections. 'Section-A' includes detail of the respondents and their preferences and interest level on the sources. 'Section-B' identifies 16 questions related to the 4 identified independent variables. 'Section-C' has 5 questions related to the dependent variable which is the success of SEO. Five-point Likert scale were used to measure questions on dependent and independent variables

3.4.4. Data Analysis

To summarize the sample/data set collected Descriptive statistics were used. Inferential statistics is where the results received from the samples of data collected are analysed and a large population is predicted from which the sample was drawn.

Regression Analysis

The regression equation is where a 'y' value is predicted if the value of 'x' is given. 'X' and 'Y' will be the two sets of a sample with the size of 'n'. The formula for regression equation would be,

$$y^* = a + bx$$

Where,

$$b = \frac{n \sum xy - (\sum x)(\sum y)}{n (\sum x^2) - (\sum x)^2}$$
$$a = \frac{\sum y - b \sum x}{n}$$

Correlation Analysis

Correlation analysis is where many factors show a relationship between each other, and that relationship is identified by a correlation with each other. Pearson's Correlation coefficient can be calculated from SPSS. One of the most used formulae is,

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

3.4.5. Reliability and Validity

Table 3.2: KMO and Bartlett's Test report

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Adequacy.	Sampling	.916
Bartlett's Test of Sphericity	Approx. Chi-Square	2273.961
	df	210
	Sig.	.000

Source: SPSS Output

Table 3.3: Reliability statistics report

Reliability statistics for the variables (Item-Total Statistics)				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Domain_Factors	15.5839	5.086	.706	.870
Page_Level_Factors	15.5053	5.027	.750	.860
Backlink_Factors	15.5472	4.959	.738	.863
User_Interaction	15.5691	4.928	.751	.859
Success_of_SEO	15.4575	5.174	.701	.871

Table 3.4: Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Domain_Factors	398	1.50	5.00	3.8210	.66924
Page_Level_Factors	400	1.50	5.00	3.9056	.65370
Backlink_Factors	396	1.00	5.00	3.8636	.67695
User_Interaction	398	1.00	5.00	3.8448	.67937
Success_of_SEO	395	1.20	5.00	3.9580	.64561
Valid N (listwise)	388				

Table 3.5: Pearson's Correlations

Correlations						
		Domain Factors	Page-Level Factors	Backlink Factors	User Interaction	Success of SEO
Domain_Factors	Pearson Correlation	1	.651**	.597**	.592**	.562**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	398	398	394	396	393
Page_Level_Factors	Pearson Correlation	.651**	1	.632**	.624**	.626**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	398	400	396	398	395
Backlink_Factors	Pearson Correlation	.597**	.632**	1	.682**	.574**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	394	396	396	394	391
User_Interaction	Pearson Correlation	.592**	.624**	.682**	1	.630**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	396	398	394	398	394
Success_of_SEO	Pearson Correlation	.562**	.626**	.574**	.630**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	393	395	391	394	395

3.4.6. Simple and Multiple Regression Analysis For Domain Factors

Table 3.6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.562 ^a	.316	.314	.53573

a. Predictors: (Constant), Domain_Factors

Based on Table 3.6, the R value was .562 and 31.6% of the variance of Success of SEO is caused by Domain Factors. The standard error of .5357 shows a greater deviation value of the actual result with the people's responses but the value is less than zero.

Table 3.7: Anova summary

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	51.805	1	51.805	180.500	.000 ^b
Residual	112.220	391	.287		
Total	164.025	392			

a. Dependent Variable: Success_of_SEO

b. Predictors: (Constant), Domain_Factors

Based on Table 3.7, The F value was 180.500 with significant value of .000 which implies that 31% variance of Success of SEO can be explained by Domain Factors. We conclude that the mean value is significantly different for at one single respondents' group of 391 valid results. ($F_{1, 391} = 180.500$, $p < 0.001$).

Table 3.8: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	b	Std. Error	Beta		
1 (Constant)	1.873	.157		11.896	.000
Domain_Factors	.544	.041	.562	13.435	.000

Dependent Variable: Success_of_SEO

Regression Equation for Domain Factors:

$$\text{Success of SEO} = 1.873 + .554(\text{Domain Factors})$$

The gradient of regression (b value of equation) is 0.544, which is significant at 0.000. The standardized beta coefficient predicts how the Domain factor can affect the success of SEO in the total population of internet users.

CONCLUSION AND RECOMMENDATIONS

4.1. Conclusion

Given below are the four hypotheses identified by the researcher concerning the independent variables that were accepted by the statistical results. This fulfils the primary objective of this research.

H1: Based on the above statistical analysis results, the domain factors which were considered as the alternative hypothesis can be accepted as the Second ranking impact variable of the success of SEO.

H2: Based on the above statistical analysis results, the page-level factors which were considered as the alternative hypothesis can be accepted as the Fourth ranking impact variable of the success of SEO.

H3: Based on the above statistical analysis results, the backlink factors which were considered as the alternative hypothesis can be accepted as the Third ranking impact variable of the success of SEO.

H4: Based on the above statistical analysis results, the user interaction which were considered as the alternative hypothesis can be accepted as the Top-ranking impact variable of the success of SEO.

4.2. Recommendations

To increase the number of people who get into the webpage, relevant and authoritative content can be published. Quality content is the number one driver and that cannot be substituted with any other methods. Specifically, an increase in site traffic can improve the authority of the site and its relevance. Quality content may consist of specific or multiple keywords, Emphasis and phrases, and natural languages with proper writing styles. Only when the contents are regularly updated with the timeline and people's interest, search engines can strongly exist. Regular updates of contents are the best indicator to show the relevancy of the site. Auditing and updating the contents with a set schedule and writing additional blocks with which keywords will boost the ranking of search engines naturally.

Designing the web page by including metadata in each page that brings other information about the contents will direct the audience into the expected page through the search engines. Metadata can be included in the title page, textual descriptions, and keywords.

4.3. Suggestions for further research

The research was carried out using a conventional questionnaire method with a short time scale. It is suggested to have future research using a different approach of data collection which can be extended as a path of the fourth objective of this research. The researcher suggests a qualitative data collection method using an interview approach.

Further, this research is based on search engines that have huge numbers of data in themselves that can be extracted through to a different approach. The method to extract quantitative data is by using Google analytic tools like Alexa, Google search console, and Google data studio. This is an easy approach to Data Collection and analysis which is readymade by search engines.

It is also recommended by the researcher to carry out studies in the introduction of the activity theory for promotion techniques via online. To remove the interaction of customers to focus on paper-based methods, human-computer interaction (HCI) is now existing as a research field and nowadays bringing a reputation in designing online applications.

IMPACT OF ECONOMIC POLICY ON SRI-LANKAN FINANCIAL CRISIS-2022 AND SUSTAINABLE APPROACH TO OVERCOME THE CHANGING COMPLICATION

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ABSTRACT

The current state of Sri Lanka's economy is a complete collapse with numerous issues. The twin deficits phenomenon, which brought and increase in budget deficit causing an upward shift in interest rate and exchange rate could be applicable. The implementation of economic policy during the previous years is one of the primary factors that push the country toward a financial crisis. Due to the financial crisis Sri Lanka faced many difficulties. The objective of this study is to identify the economic policy factors which causes the 2022 financial crisis and find out alternative sustainable approaches for the most impacted factors by introducing a model framework. This case study approach was chosen under mixed methodology because this research required thorough investigation and data collection. Factors influencing financial crisis were sort out by reviewing literatures while 400 responses obtained from random people to find the major impacted factors on financial crisis. The findings show that, out of many factors "improper financial management" and "fails to do feasibility study before changing to organic farming" were ranked top according to the AHP analysis. The steps to overcome the changing complication of the country are derived from the history of other countries worldwide and from an analysis of how they faced financial crisis and the steps that they took to overcome the complication. Further research it has been planned to expand the vision of financial crisis worldwide.

Keywords: Economic policy; Financial crisis; Impact of economic policy; Economic policy uncertainty; Sustainable approach to overcome financial crisis.

1. INTRODUCTION

In the past few years, several major challenges have emerged causing a financial crisis in Sri Lanka. These began with the implementation of economic policy in 2019. Policy uncertainty is an economic risk that is associated with an undefined future of the government and the regulatory framework as well as an undefined future of the economy (Al-Thaqeb & Algharabali, 2019). According to Baker et al. (2016) policy uncertainty delays the possibility of recovery from a recession. An essential component of achieving the overall goal of debt management is the control of risks related to the portfolio of public debt. To reduce risks related to its debt management activities, the Central Bank follows sensible risk management policies and

objectives (Wijeyasekara, 2010). As Bhowmick (2022) states, Sri Lanka was affected by a financial crisis due to poor economic policy management, including a hasty and disastrous conversion from conventional farming to organic farming, a tax cut made as a promise to the electorate, and an increase in external debt because of mismanagement of fiscal policies. The Sri Lankan tax system faces two major pressing challenges. One of these difficulties is the significant decline in tax-to-GDP ratios over the past three decades, which in 2020 reached its lowest level of 8.4 percent. This indicates that Sri Lanka's government revenue is extremely low, which leads to ongoing budget deficits and negatively affects macroeconomic stability. (Weerakoon & Hewage, 2017).

2. LITERATURE REVIEW

2.1. Economic policy uncertainty

Economic uncertainty refers to unanticipated changes that impact the economic ecology, as well as how such changes in fiscal or monetary policies or other government policies effect firms (Abel, 1983). Bloom (2009) stated that uncertainty has a ripple effect throughout the economy, as it slows economic growth.

2.2. Foreign reserve crisis

According to Wang & Freeman (2013) when a financial crisis arises, foreign exchange reserves can be crucial in lowering the risks of external debt and local currency crises as well as lessening the negative shocks of a rapid decrease in capital inflow or capital flight. Throughout Sri Lanka's history, import expenses have continuously outpaced export earnings, which has resulted in a trade deficit. As a result, a significant amount of foreign exchange earnings has been used for import expenses over the years. The government has been able to increase its foreign reserves due to debt servicing. Meanwhile, foreign exchange inflows to Sri Lanka decreased as a result of the Easter Sunday attack that adversely affected the tourism industry in 2019. This was due to the severe effects of the global pandemic on all of Sri Lanka's main foreign exchange earning sectors, including exports, remittances, and tourism.

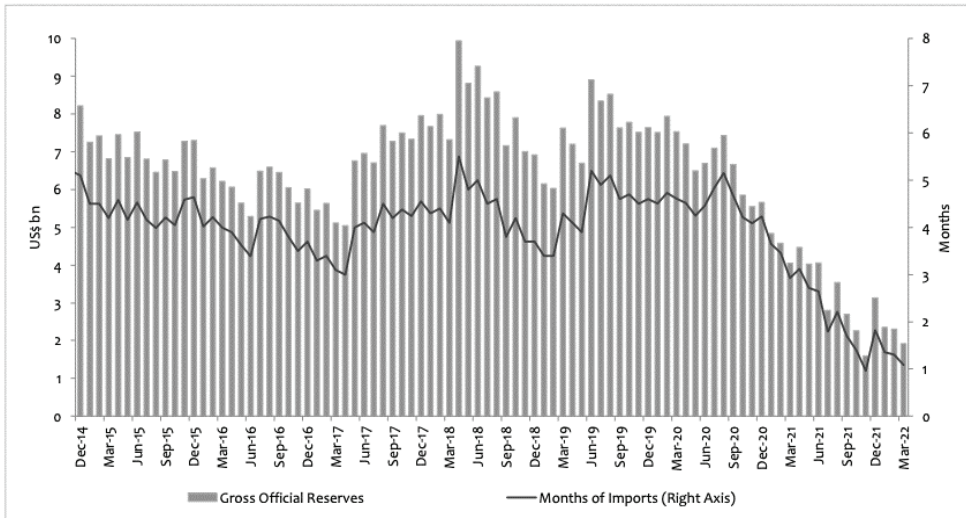


Figure 2.2.1: Gross official reserves

Source: Central Bank of Sri Lanka

Because of the foreign reserve crisis, the nation is experiencing acute fuel shortages, which are resulting in regular power outages and a lack of basic supplies such as food, medication, cement, and other essentials. As evidenced by the long lines outside of supermarkets, pharmacies, and petrol stations in many areas of Sri Lanka, there is a lack of vital products in many areas. The lack of foreign currency in the country has resulted in importers having difficulty obtaining Letters of Credit (LOCs) from banks due to the lack of foreign currency. Several containers remain at the Colombo port for several days because payments have not been made.

2.3. Factors that cause an effect on economic policy

Robert Barro (1996) examined a panel of 100 countries between 1960 and 1990 to determine the elements that influence economic growth. The growth rate of real per capita GDP can be attributed to several factors, including the rule of law, the size of government consumption, the level of democracy, the level of investment, the level of democracy, a lower inflation rate, and openness to trade. Based on a review of the factors that have a direct impact on economic policy, the tax cut implemented in 2019 to fulfill an election promise resulted in an estimated loss of approximately one million taxpayers between 2022 and 2020 as a result of the tax cut. As far as mainstream economic theory is concerned, tax cuts may be able to enhance the circulation of money in the economy and disposable income. The COVID 19 pandemic caused expenditures for various welfare measures. Further frictions on resource mobilization resulted in an increase in external debt and a widening of the budgetary deficit. Even though the entire budget deficit was financed by domestic sources, such as the Central Bank of Sri Lanka, the government decided to raise tax rates once more to generate revenue in order to pay off the foreign debt. The below chart depicts the revenue from tax before and after the tax cut. The

government faces a huge loss from tax revenue because of the election promise of the tax cut which is one of the main incomes for a country.

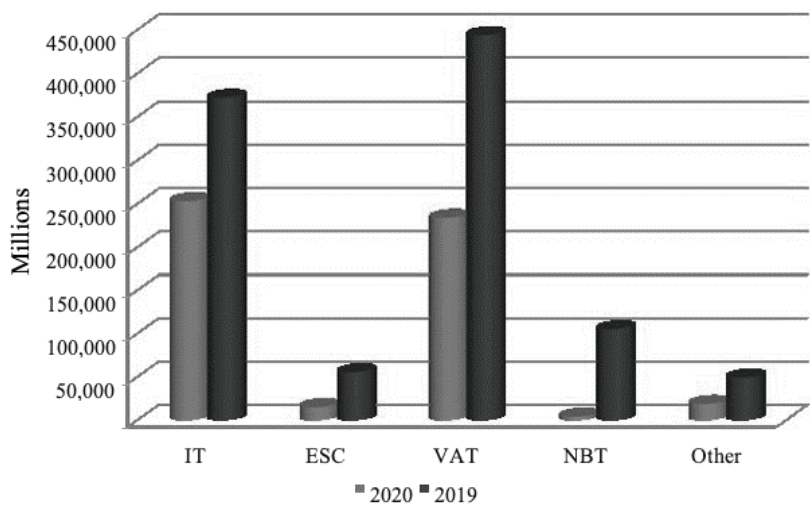


Figure 2.3.2: Revenue from Tax Comparison of the Year 2020 with 2019
Source: Inland Revenue Department

A sudden switch to organic farming in Sri Lanka when the government banned artificial fertilizer imports to reduce imports and improve eco-friendly agriculture. Because of a sudden switch to organic farming, the expected amount of harvest is decreased badly which causes a dangerous impact on the country’s economy. The country started importing rice to serve its people. The major commodity of exchange the tea industry faces a huge loss. The country’s export profit from agriculture such as tea, spices and tobacco fell. When changing to a new path step by step process will be the sustainable approach rather than a swift change.

2.4.1 Impact of economic policy on the financial crisis

Upreti (2015) stated that a country's economic health is adversely affected by poor governance while high level of government debt and foreign aid has negative effect on financial crisis. A sustainable country should be economically stable. As a result of the financial crisis, every sector in the country has been affected and ordinary people faced lots of troubles in day-to-day activity. Fuel stations were loaded with huge waiting lines because of fuel shortages when they run out of dollars to import crude oil. Fuel shortage creates more problems in running public transport, hospitals, electric power plant and school. Hospitals run out of life-saving medicines and major surgeries were postponed. Term examinations were postponed due to lack of paper. Due to foreign FOREX Indian Premiere League was stopped telecasting and SLT PEO TV has temporarily stopped telecasting foreign channels. The central bank tightened monetary policies and increased taxes.

Table 2.4.1: Impact of the financial crisis in each sector

Sectors	Effects on Sectors
Health Sector	<ul style="list-style-type: none"> • Lack of life-saving medicine • Major surgeries postponed • Hospitals were shut down due to a lack of power
Education Sector	<ul style="list-style-type: none"> • Exam postponed because of lack of paper • Schools, Universities were closed due to power cut • Teaching is fully dependent on an online platform • Canteen in educational institution unable to run
Transportation Sector	<ul style="list-style-type: none"> • Public transportation limited due to a lack of fuel • Public transportation charges increase
Energy Sector	<ul style="list-style-type: none"> • Lack of fuel • High price of fuel • Long queue in front of the fuel station
Entertainment Sector	<ul style="list-style-type: none"> • Foreign channels temporarily stopped telecasting • IPL was stopped telecasting • Network issue

A total of LKR 588 billion of domestic currency was printed by Sri Lanka in the first quarter of 2022 (including the selling of reserves to pay off loans), after the printing of LKR 1225.20 billion and LKR 505.90 billion of currency notes in 2021 and 2020, respectively. There was, however, a very difficult time keeping inflation under control and stabilizing exchange rates over the years because of the constant printing of currencies. (Bhowmick, 2022). Sustainable solution focuses on long-term benefits but here, government decided to print more money to avoid the problems temporarily rather than taking steps to solve it permanently. From December 2021, there was an increase in inflation, which resulted in a drastic decrease in the monetary value of the Sri Lankan Rupee. This reduced the purchasing power of the Lankan currency. The above graph shows the inflation of Sri Lankan Rupees from December 2021.

3. RESEARCH METHODOLOGY

The research process is divided into the following stages: literature review, preliminary survey, data collection, analysis, and conclusions and discussions. Data collection commenced after a preliminary survey is conducted. Data was gathered by a survey of 400 Sri Lankan residents based on a questionnaire. The respondents were asked to rate the relative effects of the variables that contributed to the Sri Lankan economic crisis by filling in a questionnaire survey. Two rounds of Delphi

technique were used for the data collection process. Literature review used to identify the factors affecting the financial crisis.

Delphi method is used by academics from a wide variety of fields. It is a widely recognized and highly popular method of gathering information from subject matter experts. This method is established as a mechanism for group dialogue that leads to an agreement on a significant topic by participating in the group dialogue (Hsu & Sandford, 2007). The Delphi procedure is one of the most suitable methods for reaching consensus through a series of questionnaires to collect information from a panel of carefully selected experts (Delkey & Helmer, 1963). Figure 3.1 indicated the hypothesis of the factors had impact on financial crisis.

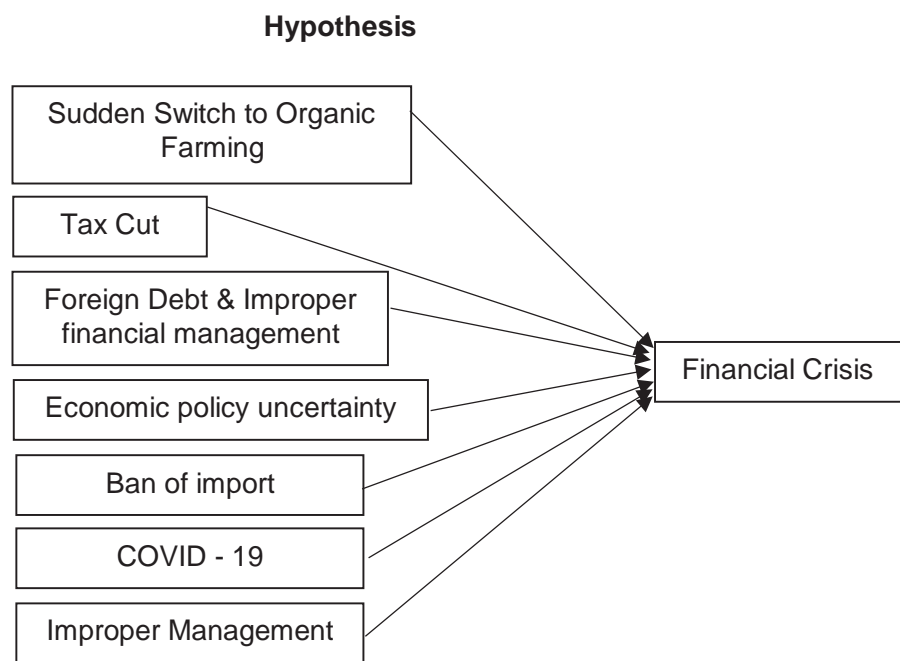


Figure 3.1: Hypothesis of critical factors impact on financial crisis

3.1 Delphi Round 1

The panel was given the preliminary questionnaire during the first round of the survey. The questionnaire was listing the contributing elements to Sri Lanka's financial crisis. As per above hypothesis, 4 factors for each seven critical factors have been selected and analyzed. The statistical analysis done using Microsoft Excel. From the analysis report most participants have selected three main factors as those had huge impact on financial crisis such as tax cut, sudden switch to organic farming and excessive foreign debt. Sub-factors under each main factors listed below in table 3.1.1.

Table 3.1.1: Classification of critical factors

Sudden switch to organic farming	<ul style="list-style-type: none"> • Fails to do feasibility study before changing to organic farming • Sudden ban on importing artificial fertilizer • Discussion wasn't taken place with agricultural and industrial experts • Lack of awareness among farmers about organic farming
Tax Cut	<ul style="list-style-type: none"> • Tax cut for basic consumer goods • Tax cut for luxury items • Fails to analyze the impact of the tax cut in upcoming years • Tax cuts are only used as an election strategy to win not to lift the country's economy
Foreign Debt & Improper financial management	<ul style="list-style-type: none"> • Improper financial management • Higher authority chairpersons have no proper knowledge of handling finance • Planned to get more loans from other countries to manage the country's situation rather than plan to lift the country's economy • Increase of expenses on Covid-19 measure as importing vaccines
Covid-19	<ul style="list-style-type: none"> • Implementation of a curfew for a long period • Business places are not allowed to open even following medical regulations • Government fails to control the price of consumer goods • Spend more money on security measures rather than spending on medical measures
Ban of import	<ul style="list-style-type: none"> • Import ban for luxury items • Import ban for basic consumer goods • Low production of convenience goods inside the country • Decrease in export because of low national production
Economic policy uncertainty	<ul style="list-style-type: none"> • Unstable economic laws and regulations • Fails to check the upcoming negative impacts when revising financial acts • Financial expert's feedback not undertaken • Dictatorship decision / centralized decision

Improper management	<ul style="list-style-type: none">• Feasibility study was not conducted on major tasks• Absence of collective decision• Lack of management skills for the higher officials• Careless thinking about future prediction when changing an economic plan
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3.2 Delphi Round 2

Obtaining response from the previous 400 members is impossible. Moreover, some of the responses obtained in round 1 were unrealistic, so those are rejected and the top 30 ranked member of the Delphi panel was given a questionnaire in the second round that contains the factors and ratings that the researchers described in the first round (Table 3.1.1), and they were invited to amend their conclusions or "to specify the reasons for remaining outside the consensus" (Pfeiffer, 1968, p. 152).

The Delphi panelists got the chance to further elaborate on the details and their assessments of the relative importance of the issues at this round. However, just a minor improvement in the level of consensus may be anticipated over the previous round (Weaver, 1971; Dalkey & Rourke, 1972; Anglin, 1991; Jacobs, 1996).

3.2 AHP Round 3

Analytical Hierarchy Process (AHP)

Based on mathematics and psychology, the Analytic Hierarchy Process (AHP) is a structured method for classifying and analyzing difficult decisions. This can carry this out pairwise or using a matrix comparison (Pair-wise Comparison).

Only the chosen members were taken into consideration in this survey due to the potential for second feedback and to maintain the accuracy of the results. Here, only the top five crucial factors which led to financial crisis, chosen from the second Delphi questionnaire, were used to compare each factor's likelihood to the other four.

4. RESULTS & DISCUSSION

Results obtained from AHP analysis showed in Table 4.1. Based on AHP template created by Goepel & Klaus (2013) factors have ranked according to the participant's responses.

Table 4.1: Major Impacted factors on financial crisis

Criterion		Comment	Weights	Rank
1	Crit-1	Fails to do feasibility study before changing to organic farming	26.5%	2
2	Crit-2	Tax cut for luxury items	12.9%	4
3	Crit-3	Fails to analyze the impact of the tax cut in upcoming years	15.0%	3
4	Crit-4	Tax cuts are only used as an election strategy to win not to lift the country's economy	9.8%	5
5	Crit-5	Improper financial management	35.8%	1

Results obtained from this study shows how the financial crisis and the government policies triggered the twin deficit clearly. According to the findings, improper financial management has a significant impact on the financial crisis, as indicated by the 35.8% of respondents. "Fails to do a feasibility study prior to switching to organic farming" is the second-most-affected factor, receiving support from 26.5% of respondents. When intending to change any policy, especially the economic policy, which has a significant impact on a country's growth, proper management and methodology are essential. Due to poor financial planning for the future and an election promise, the economic policies were changed. Before changing or implementing a new economic policy, a clear feasibility analysis should be conducted. A country's decision to adopt an organic farming strategy will lead to a beneficial conclusion, but a rapid change is not the best approach. A systematic and disciplined approach might be a sustainable approach. When deciding to change or modify an economic policy, a panel of experts with deep expertise in the area must be consulted.

The sustainable approach to follow to overcome the changing complication of nation clearly mentioned in Table 4.2

Table 4.2: Steps to follow to overcome changing complication

Factors	Sustainable Approach
Improper financial management	<ul style="list-style-type: none"> • Appointing well educated and knowledgeable person for management • Conducting feasibility study before implementing major change • Consider sustainability when planning and implementing major changes • Debt restructuring
Fails to do feasibility study before changing to organic farming	<ul style="list-style-type: none"> • Discuss with experts who have knowledge in relevant area • Preplan risk and repairing solutions to mitigate upcoming risk • Release import ban on artificial fertilizer

	<ul style="list-style-type: none">• Provide awareness among people• Growing vegetables in home garden
Fails to analyze the impact of the tax cut in upcoming years	<ul style="list-style-type: none">• Perform further analysis when changing economic policy• Revise tax cut law in order to increase tax income
Tax cut for luxury items	<ul style="list-style-type: none">• Reverse tax cut for luxury items• Increase tax for ultra-luxury items• Reduce purchase of luxury items• Restrict import of luxury items
Tax cuts are only used as an election strategy to win not to lift the country's economy	<ul style="list-style-type: none">• Appointing future minded and experienced person to power• Increase production of domestic products• Implementing tax cut for basic consumer goods• Reconsider tax cuts

5. CONCLUSION

As a result of the study's review of literature on economic policy uncertainty, the financial crisis' impact on economic policy, and the ways to overcome the changing complexity, this study examines the literature on economic policy uncertainty. The focus here is primarily on the steps that countries that have faced financial crises have taken. The researcher was able to come up with a sustainable approach that can be implemented to overcome the current economic situation and to boost the GDP of Sri Lanka from there. As an economic policy was implemented without researching its future impact, mismanagement is one of the main reasons for the financial crisis. In history, it has been said that "prevention is better than cure," however Sri Lanka has been far from this paradigm. It is the government and politicians' fault when discussing mismanagement. There is no time for blaming anyone and nothing will change. As a result, we must take steps to revert the nation to its previous state.

It is the responsibility of everyone living in Sri Lanka to work together to improve the nation and take steps to reduce the worsening situation, even though the government should take the major steps to fix the situation. Growth of a country doesn't matter, sustainable growth matters.

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An Application of Bloom's Taxonomy and Learning Skills Profile to Assess the Skills Development Expectations of State University MBA Students

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1. Introduction

An MBA programme should fulfil the needs of employers and students and hence, the MBA curriculum needs to meet both industry and student expectations by delivering the skills sets needed in the workplace. However, most of the researchers have been focusing on the employer's expectations from an MBA graduate, and the focus on MBA students' expectations or the graduate perceptions from an MBA programme in terms of developing skills has not been given much attention (Christou, 2000). This, in fact, stands as a gap in this area of study, and therefore, could be addressed with possible suggestions of a prevailing problem where the students' expectations should be considered.

2. Methodology

The population of this research study consisted of students who were following MBA programs in state universities of Sri Lanka.

Table 1: Population

University	Administrative Province
University A	Western Province
University B	Central Province
University C	Sabaragamuwa Province
University D	North Central

Cluster Sampling was adopted in this study in order to select the universities. In stage one, nine state universities that offer MBA programmes were selected out of the fifteen state universities of Sri Lanka. Subsequently, four MBA offering universities were selected randomly. All the students in the current two batches (1st year and 2nd year) who were following the MBA program in each university were selected as the sample. Due to time constraints and the students were on end-semester vacation, batch no.2 of the University D was not at reach for data collection.

Table 2: Break-down of the Sample

University/ Batch no.	University A		University B		University C		University D	
	Total students in the batch	valid responses	Total students in the batch	valid responses	Total students in the batch	valid responses	Total students in the batch	valid responses
Batch 1	42	40	34	34	56	47	35	28
Batch 2	37	32	27	24	53	48	-	-
Sample								253

The questionnaire included questions with Likert-scale ranging from 1 to 5. After the formulation of the preliminary questionnaire, to test the reliability, accuracy and validity of the developed statements/questions, it was subjected to a pre-test prior to data gathering with a sample of 32 MBA students.

3.Results and Discussion

3.1 Expectation of Developing Behavioral Skills of the Males and Females

A two-sample t-test was applied in order to identify whether there's a significant difference between males and females in their expectation of developing Behavioral Skills. For analysing purposes, p value is determined at a significance level of 0.05.

Table 6: Statistical findings of the Sub-skills under Behavioral Skills

Sub Skill	p value	Validity
Goal-setting Skills	.03	Accepted
Action skills	.06	Not Accepted
Initiative Skills	.26	Not Accepted

Based on the results, there is a statistically significant difference between Males and Females when it comes to their expectation of developing the sub skill goal-setting skills, under behavioral skills.

3.2 Expectation of Developing Interpersonal Skills of the Married and Unmarried Students

Table 7: Statistical finding of the Sub-skills under Interpersonal Skills

Sub Skill	p value	Validity
Help Skills	.01	Accepted
Leadership skills	.04	Accepted
Relationship Skills	.26	Not Accepted

Findings show a statistically significant difference between married and unmarried students in their expectations of developing help skills and leadership skills.

3.3 Expectation of Developing Skills based on the Academic Year of Study

A Two-sample t test was conducted (significance level at 0.05) to analyze whether there's a statistically significant difference between the students studying in the two academic years of study, in their expectation of developing skills. Only the key skills which depicted a statistically significant are presented.

Table 8: Statistical finding based on the Academic Year of study

Key Skill	Sub Skill	p value	Validity
Interpersonal Skills (LSP)	Help Skills	.00	Accepted
	Leadership skills	.01	Accepted
	Relationship Skills	.14	Not Accepted
Behavioral Skills (LSP)	Goal-setting Skills	.01	Accepted
	Action skills	.00	Accepted
	Initiative Skills	.18	Not Accepted
Information Gathering Skills (LSP)	Sense-making skills	.05	Accepted
	Information gathering skills	.00	Accepted
	Information analysis Skills	.52	Not Accepted
Analytical Skills (LSP)	Theoretical Skills	.22	Not Accepted
	Quantitative Skills	.12	Not Accepted
	Technology Skills	.00	Accepted
Analyzing Skills (Bloom's Taxonomy)	Analyzing Skills	.04	Accepted

Findings show a statistically significant difference between the students studying in the two academic years of study in their expectations of developing help skills, leadership skills, Goal-setting skills, action skills, sense-making skills, information-gathering skills technology skills and analyzing skills.

One-way ANOVA was conducted in relation to each independent variable for which the hypotheses have been developed based on the age, level of management, years of experience and basic degree. In brief, this explains the mean comparison and identifies significant differences in between the groups analyzed. P value or the level of significance was considered at 0.05.

3.4 Expectation of developing Information Gathering Skills based on the Level of Management students work for:

Table 9: Statistical finding of the Sub-skills under Interpersonal Skills

Sub Skill	p value	Validity
Sense-making skills	.88	Not Accepted
Information gathering skills	.13	Not Accepted
Information analysis skills	.00	Accepted

Findings show a statistically significant difference between the students working for the three levels of management, in their expectations of developing information analysis skills. In order to identify between which groups (levels of management) the significant difference exist, a further analysis was done through a post-hoc test, where in this study, Tukey HSD was used.

Table 10: Further Analysis through Tukey HSD

Multiple Comparisons		
Information analysis skills Tukey HSD		
(I) Level of Mgt	(J) Level of Mgt	p value
Operational Level	Middle Level	.941
	Top Level	.004
Middle Level	Operational Level	.941
	Top Level	.003
Top Level	Operational Level	.004
	Middle Level	.003
*. The mean difference is significant at the 0.05 level.		

Findings show a significant difference between Top level and Operational level where the p value is 0.004. Further, a significance difference exists between Top level and Middle level management in their expectation of developing information

analysis skills with a p value of 0.003. Expectation of developing information analysis skills is somewhat similar among the students working for the operational level and middle level of management.

Following Matrix illustrates the identified significant differences based on the demographic factors and the types of skills under Bloom's Taxonomy and Learning Skills Profile. For an example, there is a significant difference between males and females in their expectaion of developing goal-setting skills. Only one type of skill have been identified from Bloom's Taxonomy which is *Analyzing* and in which a significant difference was identified based on the academic year of study. Expected skills to be developed fluctuates while students continue their learning through the academic years.

Table 11: Significant differences under each skill based on demographic factors

Skill / Independent Variable	Interpersonal Skills			Information Gathering Skills			Behavioral Skills			Analytical Skills		
	Help	Leadership	Relationship	Sense-making	Info. Gathering	Info. Analysis & Analyzing	Goal-Setting	Action	Initiative	Theoretical	Quantitative	Technology
Gender							✓					
Marital Status	✓	✓										
Level of Management						✓						
Academic Year of Study	✓	✓		✓	✓	✓	✓	✓				✓

4. Conclusions and Recommendations

Based on Gender, the expectation of developing goal-setting skills changes. Based on marital status, the expectation of developing help skills and leadership skills changes. Furthermore, when it comes to the academic year of study, a statistically significant difference between the students in the two academic years of study was identified in their expectation of developing help, leadership, goal-setting, action, sense-making, information gathering, technology, and analyzing skills. Finally, it was also observed that a statistically significant difference exists between the levels of management that the students work for, in their expectation of developing information analysis skills. Students tend to show more interest in developing skills through practical learning approaches which includes team building, communication, practical application of theories, problem solving skills and practice of using new technological tools.

It is preferred that workshops focusing Personality Development, Career Guidance, Risk-taking and Management Decision Making and Technological know-how should be conducted as core modules in the MBA programme. Further, field/industry visits could be included in order to gain more knowledge and exposure on the theoretical approaches that has been applied in the organizational context. Executing this study focusing other students following MSc programmes and comparing the same with that of the MBA students' expectations could be considered. Furthermore,

employers' expectation from an MBA graduate can also be focused apart from students' expectation and both could be compared.

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Employee turnover: a quantitative study to find out how health and organisational level factors affect employee turnover in Serendib apparel factory

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Abstract

The study is done to find how health and organizational factors affect employee turnover in Serendib Apparel factory. There are three main objectives, and the first objective is to find out how Health factors affect employee turnover in Serendib Apparel factory. The second objective is to find out how Organizational level factors affect employee turnover in Serendib Apparel factory. and the third and final objective is to give recommendations to minimize employee turnover.

This study discusses how Health and Organizational level factors affect employee turnover. The findings of this Research will provide readers with an understanding of how the above variables influence workers, ultimately leading them to quit their essential jobs in apparel factories. Furthermore, this study will aid Serendib Apparel factory and the apparel industry to get an idea about the problems that the employee of the company and industry is facing due to health and organizational-level factors. The given assumptions will be helpful to minimize the issues the employees are facing, or even it might help to eliminate the problems as well.

Author keywords

Employee Turnover, Apparel Factory, Health Factors, Organizational Level Factors

Introduction

Clothing manufacturing in Sri Lanka started in the early 1960s, during the period tailors and seamstresses were producing clothes for the nation's consumers. However, in the 1970s, the government began to export ready-made clothes, which quickly spread across the country. During the 1980s, the export of ready-made clothes grew quickly, and by 1992, the apparel sector had become the country's "largest foreign swap earner." (Rajapaksha 2015).

Serendib Apparel factory which is situated in Kandy Central province was started in the late 1990s as a small apparel manufacturing factory in Kandy city. The owners of the Serendib Apparel factory started with 11 female machine workers sewing and manufacturing undergarments and socks. After few years of successful business, the owners shifted into a new location with a spacious work area. Now there are more than 150 employees are working for the factory. Patagonia, Gap, and River Island are some of their past and present customers.

Aim of the research

To find out the Health and Organizational level factors affecting employee turnover in Serendib apparel factory.

Methodology

The researcher selected the Saunders onion paradigm to conduct the study. It is made up of five stages, with the research flow beginning at the outermost layer and progressing to the innermost layers in a step-by-step procedure. As the research method out of Qualitative and Quantitative Methods, the researcher selected the Quantitative method. When gathering data via questionnaires, surveys, and statistical analysis, the quantitative method is used.

The relevant data was collected through a questionnaire consisting of 19 questions and the questionnaire was presented in the form of a Likert scale. Probability random sampling was used in the study to select the samples. Under random probability sampling there are 4 primary sampling methods out of them the researcher selected simple random sampling. The population that the researcher decided to study was apparel factory workers from the Serendib apparel factory and the samples were taken from the factory. The sample of the study is 30 Apparel factory workers from the Serendib apparel factory.

Findings

According to the results of the descriptive statistics, the mean values for the variables are around 4.26 (Sexual harassment), 4.911(Pay), 4.255(Working environment), 4.433(Physical hazards), 4.56(Ergonomic hazards), 4.56(chemical hazards) and 1.33 (employee turnover). The standard deviation explains the variability of the data of variables. According to the results, the Working environment has the highest standard deviation. Therefore, the answerers for the quality of the working environment were a variety from one answerer to another.

According to the correlation test results, sexual harassment, payment and ergonomic hazards are positively correlated with labour turnover. This indicated that the employees of this sector more tend to be left from their jobs due to high levels of sexual harassment, payment, and ergonomic hazards.

According to the regression analysis results, chemical hazards are not significantly affecting labor turnover. other factors significantly affect for labour turnover of this specific sector. However, only these variables are positively related to labour turnover, sexual harassment, payment, and ergonomic hazards. According to the results, sexual harassments are the most contributing factor for labour turnover in this sector. The VIF values are less than 10. Therefore, the predicted results from the regression were more accurate with related to multicollinearity.

Conclusion

Employee turnover refers to the departure of skilled individuals from an organisation. Employee turnover might include resignations, terminations, retirement, and even death. Employee turnover in a business is influenced by several factors. "They include ten

determinants such as pay, integration, centralisation, instrumental communication, formal communication, utilisation, upward mobility, and distributive justice, length of service, age, education, occupation, marital status, and sex,” according to previous studies.

For this study, the researchers used six variables to identify which factors are the most significant effect on the labour turnover related to the Serendib apparel factory. According to the results of the descriptive statistics, the mean values for the variables are around 4.26 (Sexual harassment), 4.911(Pay), 4.255(Working environment), 4.433(Physical hazards), 4.56(Ergonomic hazards), 4.56(chemical hazards) and 1.33 (employee turnover). According to the results, the Working environment has the highest standard deviation. According to the correlation test results, sexual harassment, payment and ergonomic hazards positively correlate with labour turnover. This indicated that the employees of this sector tend to be left from their jobs due to high levels of sexual harassment, payment, and ergonomic hazards.

According to the regression analysis results, only these variables are positively related to labour turnover, sexual harassment, payment, and ergonomic hazards. According to the normality test results, all the variables are normally distributed. Therefore, the predicted results from the regression and correlation test were more accurate with related to the normality test. As together, sexual harassment is the most significantly affect factor for the labour turnover in Serendib apparel factory. Other than that, inefficient and improper payment methods and Ergonomic hazards also affect labour turnover.

Recommendations

Sexual Harassment

- Encourage employees to report any type of harassment so the management can take necessary actions against them.
- Conduct training programs and seminars to educate employees on sexual harassment.
- Define the consequences that people with such behaviour may face if the harassing behaviour is discovered.

Pay

- Give the employees adequate wages for their hard work. Sri Lanka's garment workers receive less money for their work than other countries and this is why many factory workers leave their jobs. It is therefore very important to give workers a decent amount of money to make them happy.
- Give the employees seasonal bonuses and rewards for their hard work and achievements inside the factory this will motivate the employee to stay with the factory.

Ergonomic Hazards

- Employees' workstations should be designed ergonomically, which will allow them to work peacefully for extended periods while also increasing productivity.
- Allow for appropriate intervals, since proper recovery time may help to minimise tiredness.

- Focus on providing height-adjustable chairs and tables for neutral positions, which employees of all sizes and forms can use.
- Provide tools that suit the hand, are free of sharp edges, and avoid uncomfortable wrist and hand postures

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TESTING THE VALIDITY OF PURCHASING POWER PARITY OF SRI LANKA.

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Abstract

This paper expounding purchasing power parity in the context of Sri Lanka, as a long run unit elasticity of exchange rate. The purchasing power parity theory of exchange rates has the same status in the history of economic thoughts and economic policy as the quantity theory of money. This study investigates the strong and the weak relationship between macroeconomic variables and the purchasing power parity of the nation. Moreover; purchase power parity is compared with the relative price level of identical product available in the country. However; it is inappropriate to compare the price levels based on the price index since there are changes in the consumption behavior and tastes. This study includes 20 years of macroeconomic variables annual data from 1997 to 2016 data will be collected through the secondary sources from the world Bank open sources. these data been analyzed to check the validity of the data for selected period reliability test will be carried out, also further ARDL Test, ARDL bound test, OLS test are used to validate the hypothesis and test the relationship between purchasing power parity and exchange rate. This study reveals that real exchange rate is not constant in of Sri Lanka, and this illustrates Sri Lanka has weak relationship between the purchasing power parity and exchange rate, inflation, interest rate, money supply, gross domestic product, foreign direct investment. This study helps to enhance the knowledge about how purchasing power parity affecting the growth of the economies. Also try to solve the myth of purchasing power parity does not exist in developing countries.

Key words: exchange rate, inflation, foreign direct investment, money supply, purchasing power Parity.

01. Introduction

The foundation of many theoretical models of international finance is purchasing power parity. It is essential that the cost of a specific good, stated in a single currency, be the same across all nations (Wickremasinghe, 2005). Purchasing power parity is a key concept in international economics and a model for determining

exchange rates. The quantity theory of money and the purchasing power parity theory of exchange rates both hold significant positions in the history of economic thought and economic policy.

Simply put, one unit in the home nation must have a value equal to one unit in the other country. A looser interpretation of this idea contends that changes in the exchange rate are proportional to differences in inflation experienced by businesses engaged in international trade (Muchiri, 2017).

The Purchasing Power Parity can be calculated using the formula given below;

$$S = P1/P2$$

Where,

S = Exchange rate of currency 1 to currency 2

P1 = Costs of goods X in currency 1

P2 = Costs of goods X in currency 2

Several studies have been conducted to examine the reliability of the purchasing power parity, particularly for developed nations as a whole. In industrial economics, the long-run equilibrium condition of purchasing power parity is legitimate. In situations of long-term balance, it is believable. It is accepted as the analytical foundation for setting the exchange rate and a tool for comparison between countries, and it is seen as an extension of the one price law (Muhammad, et al., 2014). The benchmark used to confirm the quantity of money underlying a country's tiny but significant number of products is its inflation rate. The purchasing power parity will decrease when there is inflation.

Exchange rate stability may be a cause for worry when determining the volume and direction of domestic and international trade. Additionally, inflation is one of the main issues in every economy since prices keep rising and the purchasing power of the currency of the country simultaneously declines (Weliwita, 1998). to worry about unexpected changes in the exchange rate, interest rate, or another monetary policy tool intended to worry about a significant portion of policy variance. According to the purchasing power parity theory, the ratio between the prices of goods in two countries is equal to the rate of exchange between their currencies (Shalishali & , 2012).

02. Development of the hypothesis

This study wants to compute the macroeconomic determinants influence of purchasing power parity of Sri Lanka which influence the purchasing power parity.

Following are the hypothesis of this study.

H1: There is a negative relationship between EXR and PPP

H2: There is a negative relationship between INF and PPP

H3: There is a negative relationship between INT and PPP

H4: There is a positive relationship between FDI rate and PPP

H5: There is a positive relationship between MS and PPP

H6: There is a positive relationship between GDP and PPP

03. Analysis and findings.

3.1. Reliability Test

Factors	Tolerance	VIF
	SL	SL
EXR	0.387	2.587
INF	0.516	1.937
INT	0.904	1.106
FDI	0.507	1.974
MS	0.373	2.679
GDP	0.707	1.414

It may be inferred from the results of Sri Lanka's macroeconomic characteristics that there is no collinearity issue for the sample period. No VIF is higher than the benchmark value of 10 for any of the variables, and all of the variables chosen for the country have tolerance values that are higher than the benchmark value of 0.2.

3.2. Comprehensive regression analysis

Eviews software version 10 was used to create the regression analysis results. The statistical link between independent and dependent variables is ascertained using

regression analysis. The p value and t values can be used to indicate the importance of the link between the chosen variables, whereas the coefficient is used to determine if the association is positive or negative. Results of the projected regression analysis for Sri Lanka

Purchasing Power Parity (Sri Lanka)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.780217	4.078040	0.681753	0.5074
EXR	-0.043125	0.025970	-1.660555	0.1207
INF	0.079960	0.111885	0.714660	0.4875
INT	0.661742	0.388121	1.704987	0.1120
FDI	-1.515875	1.170017	-1.295600	0.2176
MS	0.043517	0.113055	0.384921	0.7065
GDP	0.080122	0.198591	0.403452	0.6932

Hypothesis One: To investigate the relationship between Purchasing Power Parity and exchange rate in Sri Lanka, the study has developed the hypothesis which is based on the empirical studies relating to the purchasing power parity of emerging economies. The estimated regression analysis results indicate the P value 0.1207 and t value -1.6606 and the coefficient is negative for Sri Lanka therefore, we accept this hypothesis.

Hypothesis Two: To investigate the relationship between Purchasing Power Parity and inflation. The estimated regression analysis results indicate the P value 0.4875 and t value 0.7147 and the coefficient is positive for Sri Lanka. Therefore, we reject the hypothesis and arrived at the conclusion that there is an insignificant positive relationship between the Purchasing Power Parity and inflation in Sri Lanka.

Hypothesis Three: To investigate the relationship between Purchasing Power Parity and interest rate. The estimated regression analysis results indicate the P value 0.1120 and t value 1.7049 and the coefficient is positive for Sri Lanka. Therefore, we reject the hypothesis and arrived at the conclusion that there is an insignificant positive relationship between the Purchasing Power Parity and interest rate in Sri Lanka.

Hypothesis Four: To investigate the relationship between Purchasing Power Parity

and foreign direct investment. Regression analysis results indicate the P value 0.2176 and t value -1.2956 and the coefficient is negative for Sri Lanka. Therefore, we reject the hypothesis and arrived at the conclusion that there is an insignificant negative relationship between the Purchasing Power Parity and foreign direct investment in Sri Lanka.

Hypothesis Five: To investigate the relationship between Purchasing Power Parity and money supply. Regression analysis results indicate the P value 0.7065 and t value 0.3849 and the coefficient is positive for Sri Lanka. Therefore, we accept the hypothesis and arrived at the conclusion that there is an insignificant positive relationship between the Purchasing Power Parity and money supply in Sri Lanka.

Hypothesis Six: To investigate the relationship between Purchasing Power Parity and gross domestic product. Regression analysis results indicate the P value 0.6932 and t value 0.4035 and the coefficient is positive for Sri Lanka. Therefore, we accept the hypothesis.

04. Conclusion

Since Prof. Cassel first proposed purchasing power parity in the 20th century, it has become one of the most perplexing financial variables. This study includes measures that help to show how Sri Lanka's buying power parity combines its strengths and weaknesses. In South Asia, Sri Lanka has limited support for purchasing power parity, according to this study's research findings. Comparatively speaking, empirical investigations of India and Pakistan have shown that they have strong relationships. This study discovered a weak and unfavorable correlation between Sri Lanka's currency rate and purchasing power parity. Gross domestic product has insignificant and positive relationship with Sri Lanka whereas Foreign direct investment, inflation and money supply have insignificant relationship with purchasing power parity. Also we can evaluate that purchasing power parity hold negatively in Sri Lanka.

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Transformation in Workplace of Hayleys Plantation Thalawakelle due to Covid-19 Pandemic

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1. Introduction

Due to Covid-19 pandemic all the organizations had to follow the rules and recommendation given by health officials like isolation and social distancing for employees at their workplaces to carry out their work (Steve Bates, 2020). Many organization bought many changes in the working style and work place as soon as possible to provide their employees a safe working environment. When the organization come up with changes at workplace their will be positive and negative results. (Brescia, 2020) Say that the work will be distributed in future. People will work across the globe so this will help in learning new things, languages, and there are many opportunities for new ideas and thoughts evolving quickly so this leads to innovation.

(Blogger, 2021) Describes that many companies had work from home facilities before pandemic but many employees preferred the physical setup to work. But due to the pandemic employees had to follow work from home policies. So, in future employees will be able to work in both ways, this will be big advantage for the employees who work from far. And also says that sudden change in work due to Covid -19 pandemic bought employees a trouble to fix a suitable workplace setup at home. There should enough space to work and a space that has no disturbance when there is a video conference and should have all the related tools and the employees should know to operate the new technology to work. So, the companies had a problem in training the employees virtually to do their work from their home because all the employees were not having the tools and was not familiar with the virtual technology.

(Arruda, 2020) Explains that E-learning will become very important to every companies and employees due to the Covid-19 pandemic. Companies should organize workshops and seminars to train employees with all the skills and handling techniques of the virtual work. Through this in future also trainings will be given by international corporates. This will build up employees professionally in their work. So, the company can face any problems and situation like Covid-19 pandemic and can move forward.

To know the changes took place in the workplace one of the largest plantation company in Sri Lanka Hayleys Plantation Talawakelle were chosen. The findings are explained and analyzed, and all proper recommendations are given. The research finding shows that Hayleys Plantation Talawakelle had done their

maximum arrangement to protect the employees and the customers from Covid -19 disease, the organization gave their best to satisfy both employees and customers by maintaining their standard and the employees are satisfied with the managements support during this pandemic situation.

2. Methodology

Research method used in the research is qualitative research. The data was collected through interviews conducted with the employees of Hayleys Plantation Talawakelle and non-probability sampling method is was used. Through the qualitative research method, the researcher can get a deeper understanding on the changes took place in the work place of Hayleys Plantation Talawakelle and the changes that benefit the employees. Case study was carried out on the organization named of Hayleys Plantation Talawakelle to find out the transformation work place due to Covid -19 pandemic. In this case study the data tools used are the interviews and observations. From Hayleys Plantation Talawakelle the researcher have selected only three employees who are confident enough to represent themselves on behave of the whole targeted population of employees for the interview. The interview was done through phone call due to safety measure. The interview was done with three employees who are working in the office of Hayleys Plantation Talawakelle.

Interview 1 name is designation clerk.

Interview 2 name is designation clerk & acting chief clerk.

Interview 3 name is designation clerk.

3. Results and discussion

The chosen samples was benefited from the rearrangement and the rearrangement is necessary for the protection and prevention from Covid -19 transmission. The Hayleys Plantation Talawakelle had utilized the office space effectively by implementing all the safety precautions. At the same time, they changed their working style with laptops from the regular writing style. This will help the organization as well as the employees to work safely and work faster. The chosen sample had shared their opinion and given suggestion to protect from the Covid -19 disease and to avoid transmission, the organization as considered the suggestion to carry out the work easily and safely and they also responded that work from home facilities was given to employees who travel 20 km every day and the organization also provided the employees laptop to do their work through online. Hayleys Plantation Thalawakelle had given traveling facilities by consider the employees safety and wellbeing even work from home facilities was also given to employees by considering traveling risks. Employees say that the organization provided facilities with transportation, work from home and medical check-up with rapid antigen test. All these facilities given was to protect themselves from the Covid-19

transmission. Hayleys Plantation Talawakelle focused on customer's satisfaction. Due to pandemic field workers and factory workers attendance was not proper so to achieve the production target the organization gave more payment for the field and factory workers who work over time. Separate cabins and distance maintaining make the employees feel lonely and they are unable to enjoy their work. This will also stress employees in work place and they can become introvert without share things and without being friendly. All the employees are satisfied with the given facilities by the management but they also request to reduce the work load and pressure from the management and they want work from home facilities from all the employees.

4. Conclusion and Recommendations

According to the research the Hayleys Plantation Talawakelle had done their maximum arrangement to protect the employees and the customers from Covid -19 disease, the organization gave their best to satisfy both employees and customers by maintaining their standard and the employees are satisfied with the managements support during this pandemic situation. The employees suggested their opinion on the facilities which should be given by the management for all the employees, they suggested for work from home facilities for all the employees and if volunteer employees who wanted to visit the office can visit and do their work and they wanted the management to reduce the workload so they could do their work without stress and with satisfaction.

The recommendation is are without considering the traveling distance all the employees should be given the facility to work from home. This will motivate them and keep themselves and their family safer. And also, after the pandemic if any employee is unable to visit the office to do their work from home can help them to finfish their work duty from home and organization is also will be benefited because the work will be done on time. And the researcher suggest to reduce the workload by hiring new employees to balance the work. This will help to organization to do the work without error and dissatisfaction and the employees will also will work with satisfaction and maximum output can be given.

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Session 07
Multidisciplinary

A relationship between factors influencing timely completion of construction project and organizational performance of housing development projects in Kandy district, Sri Lanka- A case of Denatek Builders (Pvt) Ltd and Rengvo Engineering (Pvt) Ltd

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Abstract

Time is the major parameter when measuring the success of construction projects and its delivery. The construction industry continuously struggles with the time frame to finish the project on time. The construction time overrun past the date of completion specified in the contract or beyond the date mutually agreed upon by the parties for the delivery of the project. A Contracting firm's time management is an important fragment in project success to achieve efficiency in project completion on time. But the project completion was subjected to several unpredictable factors which result due to various unseen circumstances. Denatek Builders (Pvt) Ltd and Rengvo Engineering (Pvt) Ltd are the two construction companies chosen for this research and 256 construction employees are working under them. This research investigates the relationship between factors influencing timely completion and organizational performance of housing development projects in Kandy District, Sri Lanka. The quantitative research method is followed in this research using a structured questionnaire. For the literature review, secondary data were collected from previous web pages, journal articles, reports, and other external sources.

In this research, primary data is collected from 73 target participants who are currently working on construction projects for relevant companies mentioned above based on the Krejci and Morgan Table sampling method. The target population is quantity surveyors, project managers, engineers, architects, site supervisors, and technical officers. The conceptual framework and triple constraint triangle are used as theories to find out the causes of time delays. Ineffective project planning and scheduling,

utilization of resources, construction technology, and variations in project contracts were found as dependent variables from previous researches. According to the empirical overview in the literature review, the main dependent variables identified are skilled labour availability, design and documentation, financial capabilities, site conditions, and communication and coordination. And the independent variable is identified as the performance of construction firms. Based on data analysis test results variables, skilled labour availability, site conditions, and communication and coordination were accepted. This is supported by the study, as their significant value was less than 0.05. The design and documentation and financial capabilities got rejected and contrasted with this study because their significant value is more than 0.05. And all the independent variables are moderately correlated with the dependent variable performance of the construction firm.

Keywords: Time Completion, Overall Performance, Time overrun, decision making, financial capabilities

1. Introduction

Due to the adaptation of the new construction nature in Sri Lanka, the construction industry has to face many difficulties and constraints. Hence, where development measures have been taken from the Sri Lankan government to overcome these constraints and difficulties. The main consequences faced by today's construction industry is challenges in procuring an adequate amount of construction materials for construction, because of the lack of resource availability. This results in the use of alternatives such as use of sustainable materials with the support of advanced technology. Thus, prevailing in the Sri Lankan construction industry to overcome the existing challenges and for the success of construction projects due to the impact of COVID-19 (Regassa, 2019).

Kandy district is surrounded by mountains and situated in the central location of Sri Lanka. Therefore, many building constructions are built on slopes and hilly areas. According to National Building Research Organization (NBRO), more than 90% of the buildings have deviated from their original approved plan. However, the building's structural stability is doubtful. Due to disasters such as earthquakes, landslides, and flash floods constructing a building is a very challenging and risky process and result in many issues. For example, difficulty in obtaining and transporting raw materials, lack of labor availability due to safety risks, price fluctuations and variations in building design (Kalani Kumarasinghe and Piyumi Fonseka, 2020).

2. Literature Review

Budgeting, monitoring and evaluation, contract variation and staff competencies are independent variables found from theoretical review to determine the factors affecting the performance of timely completion on SMEs construction projects in Kandy District, Sri Lanka (Silas *et al.*, 2017). (See Appendix A6 for critical parameters found from theoretical review for this research)

Based on various previous research conclusion and findings, project resource allocation, project planning and monitoring, construction technology and stakeholder's participation are the factors found from conclusions and findings from previous theories which determine the performance of timely completion on SMEs construction projects in Kandy District, Sri Lanka (Oiriga and Ngari, 2019). (See Appendix B6 for critical findings as well as definitions and justifications found on independent and dependent variables)

3. Findings

According to (Maqsoom *et al.*, 2019; Dixit, 2020) SLA was found as an important independent variable from the literature review. The correlation value between SLA and dependent variable PCF generated from data analysis is .440 which is moderately correlating with PCF. The significant value is .001 which is less than 0.05 and does not exceed 5% sampling error. Therefore, the test result of data analysis of this dependent variable aligning with the literature.

Based on the previous research findings from the literature review DD was found as an important independent variable (Maqsoom *et al.*, 2019). The independent variable DD has a correlation coefficient value of -.112 which is negative and weakly correlating with the independent variable PCF. Whereas, the significant value is more than 0.05 and it exceeds sampling error 5% with the value of .347. Based on these test results variable DD is contrasting with the literature.

The Independent variable FC with the dependent variable PCF had a weak correlation value of .021 and the significant value .877 is not less than 0.05 which exceeds 5% sampling error. Based on the test results generated from the data analysis variable FC is contrasting to the literature as the respondents rejected the variable for this particular research. Hence, FC was found as an important independent variable from previous research theories (Islam and Trigunarsyah, 2017).

"Site Conditions" is an independent variable identified from the literature review and empirical overview in literature review state that there is a strong relationship between SC and time delay (MUNYOKI, 2014; Maqsoom *et al.*, 2019). Thus, the correlation value .415 confirms that there is a moderate correlation with the dependent variable PCF and the significant value is .000

or 5% sampling error which is 0.05. Based on these results, SC is considered as a significant variable and supporting with the literature.

Communication and coordination was found as significant variable from the literature and empirical overview (Stonemark Construction Management, 2021). Based on test results from the data analysis independent variable CC shows moderate correlation value of .445 with PCF. The significant value is .000 and is less than 0.05 confirming that this variable is lining up with the literature, hence the result confirms the acceptability of this variable is significant for this research.

In conclusion, based on participants' responses in identifying the relationship between factors influencing timely completion of construction projects and organizational performance of housing development projects. The indicators skilled labour availability, site conditions, and communication and coordination were found as significant, and these variables line up with the literature. Hence, indicators design and documentation, and financial capabilities contrast with the literature review for this particular research study.

4. Conclusion

From the data analysis using closed ended structured questions, the correlation coefficient test to determine the relationship between independent variables and dependent variable performance of construction firms generate the following results.

The correlation coefficient between SLA and PCF is having a moderate correlation with the value of .654 which reflects that there is a significant relationship between SLA and PCF. Between DD and PCF, the correlation coefficient value is .447 which shows a moderate correlation and significant relationship. The relationship between FC and PCF was identified as significant and moderate correlation with the correlation coefficient value of .530.

The correlation coefficient value between SC and PCF is .471 which is identified as moderate correlation and the relationship is significant. The relationship between CC and PCF correlation coefficient test result value is .679 shows significant and moderate correlation.

The causes of time overrun in housing development projects are identified from the previous research findings. The main causes which were identified from the empirical overview in the literature review are skilled labour availability, design and documentation, financial capabilities, site conditions, and communication and coordination which are significant for this research study (Maqsoom *et al.*, 2019; Islam and Trigunarsyah, 2017; Alaloul *et al.*, 2017).

Based on data analysis factors influencing timely completion of construction projects and organizational performance of housing development projects of selected companies shows that the main reason identified for the variable SLA is that enough labour availability based on experience level where 37% of

participants agreed. For the variables DD and FC, the main causes identified is that clients make variations to construction design and construction material prices changes during the project time where 34% of participants responded to both the variable causes. The majority of the responses for SC is 32% for the cause due to rainy conditions sites works will be stopped. Finally, the variable CC with the majority of respondents identified as the proper method of communication channels are being used with 39% contribution.

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A Study of the adoption of lean construction methods to minimize the wastage of Construction materials in building construction projects in Colombo District.

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Abstract

Construction plays an important role in the development infrastructure of the country. Construction Material Waste is a major problem facing the construction industry. Construction activities generate more waste than other Industries. This research investigates the suitable practices and adoption of lean theory for construction waste minimization to implement in the building construction projects in the Colombo district. Colombo district is a commercial city in Sri Lanka so building construction is very common. ED&CC (Pvt) Ltd & Access Engineering PLC construction companies are popular and experienced contractors in Colombo District. They have ongoing projects including building, commercial, and civil engineering projects in the Colombo area. This study gathered information from relevant personnel at the two companies' sites in the Colombo district to assess the adoption of appropriate construction waste reduction procedures to reduce construction waste.

Theoretical models such as R3 model and Lean theory have been identified to analyze the suitable approaches to construction waste minimization. A structured or closed-ended questionnaire is the quantitative research method to use in the study. The target population for data collection is mostly site employees, such as Project managers, Site engineers, Quantity surveyors, supervisors, technical officers, storekeepers, and team leaders. This research collected data from the target population in ED&CC (Pvt) Ltd & Access Engineering PLC. The sample size identified was approximately 100. A simple random sampling method has been chosen to select the sample. However, 90 responses have been collected through an online survey due to the prevailing covid pandemic. In addition, journal extracts, previous research

findings, web articles, publications, reports, and company guidelines have been used for analysis.

Independent variables reduce waste, reuse waste, and material education and training were not supported by data analysis results and were rejected due to the significant value of not less than 0.05. other three variables were supported by the results of data analysis. Without reuse, the variable had a moderate correlation with the dependent variable construction waste with a coefficient between 0.7 and 0.4. reuse waste had no correlation with the dependent variable with a coefficient value less than 0.1. In this study, I investigated at how lean theory can be used to reduce waste in building construction, and future research on how to adopt the green building concept to reduce waste could help to solve this issue. A future study on decreasing labor and machinery waste in the construction industry, in addition to building waste, would be great.

Keywords: Reduce waste, lean, reuse waste, management controlling, material planning and estimation,

1. Introduction

Lean construction is a method of creating manufacturing systems in the construction industry to reduce time, effort, and material waste. Lean construction ensures that a project is completed swiftly at a lower cost during the construction process. Furthermore, during construction project maintenance, design, planning, and activation, lean construction aims to maximize value while decreasing costs. The usage of Lean construction improves the construction industry's productivity (eSUB Construction software, 2017).

Environmental protection and treating workers with respect ensures stronger social facilities and the employment of young people in building projects, as lean construction provides a balanced and positive environment, and the benefits can be realized by applying this to a building project. Lean construction is a method of creating manufacturing systems in building projects to reduce time, effort, and material waste. Lean construction ensures that a project is completed swiftly and at a lower cost (eSUB Construction software, 2017)

The number of residential, commercial, and mixed-use development projects done by the private sector has increased. In addition, many big infrastructure projects have been completed (Saram et al., 2020). Construction waste is divided into two categories: inert and non-inert construction waste. Three concepts are crucial in the management of construction waste. These are recycled, reuse, and reduce. Materials can be recycled and reused within the same product. Others can be reconstituted into different goods. Unfortunately, recycling that necessitates reprocessing is rarely cost-effective. Hence, the

most important method is waste minimization (B.Sasidharani , R.Jayanthi, 2015).

2. Literature review

Lean construction is a value engineering-like process. Across the construction industry, this methodology utilizes the concepts of lean manufacturing, and efficient systems linked to post-World War II. Kiichiro Toyoda, Toyota Motor Corporation's second president, perfected the lean technique. To capitalize on Toyoda's success, modern thinkers apply lean ideas to many businesses. His management philosophy "Toyota Way" was so influential in the automotive sector and the Toyota Motor Corporation still follows it. Adapting to a lean construction style can provide several advantages, including Reduced process waste, monetary loss, and increased potential for innovation are among them. Improved employee morale and increased adaptability to difficulties (BigRentz, 2021).

Construction is mostly controlled using the transformation concept, with flow and value generation concepts as the foundation of lean thinking. Delivering materials is one of the most common challenges in the construction industry. Because of delays in obtaining materials and completing required work, equipment and labor are frequently kept waiting. This issue reduces productivity and causes the project to take longer to complete (Hosseini et al., 2015). Building waste and time can be reduced by improving project management systems and expanding the usage of prefabricated pieces (Shaqour, 2021). Waste minimization involves any activity that reduces waste at its source or allows re-use or recycling. Materials waste minimization involves surveying the flow of materials in and out of the site and assessing steps to the employee to reduce the quality and range of materials discarded. The minimization of materials wastage in construction is important because wastage will have a direct impact on the cost, time, and quality of construction projects (Agyekum et al., 2013).

Materials could be carefully handled, including preventing illegal dumping and soil mixing, repurposing the material for its intended use, identifying recyclable materials, and recycling on the project site (Tafesse, 2021). While urbanization is a major concern for socio-environmental reasons, it also results in increased extraction of natural resources and the development of large amounts of construction and demolition waste. Although the use of recycled construction and demolition waste products is viable and controlled, and there are beneficial application examples, it is still unclear how to engage key players in construction projects to take advantage of this potential (Shooshtarian et al., 2020).

Lean Construction has a positive effect on organizational items by reducing waste, increasing time value, improving construction processes, increasing quality, increasing flexibility toward required change, lowering project costs, and eliminating non-value-adding activities. The first cause of waste is "rework

due to construction flaws," followed by "material transportation" (Shaqour, 2021).

Lean construction is a production-based management method that allows construction firms to increase revenues by increasing efficiency and reducing waste. These practices reduce energy consumption, improve health and safety, and eliminate waste, which contributes to long-term sustainability (Bashir et al., 2010).

To increase productivity on the construction site, a change of the materials management process is required. This is because the way building materials are handled impacts the total cost, time, quality, and productivity. So pre-planning and material procurement are equally vital in keeping the project's overall cost under control (A. A. Gulghane, P. V. Khandve, 2015).

3. Findings

The dependent variable construction waste did not correlate with the independent variable reduce waste (-0.014), and the significance value of 0.880 is more than 0.05. Reduce waste variable cannot be considered significant in affecting construction waste, according to the findings. In contrast to the literature, the results of data analysis about the reduction of waste are unexpected. Reduce waste was found to be an important independent variable from concepts (R3 concept), and empirical analysis of the literature identified a strong relationship between reduce waste and construction waste (Shaqour, 2021).

The dependent variable construction waste did not correlate with the independent variable reuse waste (-0.063), and the significance value of 0.157 is more than 0.05. The reuse waste variable cannot be considered significant in affecting construction waste, according to the findings. In contrast to the literature, the results of data analysis about the reusing of waste are unexpected. Reuse waste was found to be an important independent variable from concepts (R3 concept), and empirical analysis of the literature identified a strong relationship between reuse waste and construction waste (Agyekum et al., 2013).

The dependent variable construction waste had a weak correlation with the independent variable recycle waste (0.316), and the significance value of 0.003 is less than 0.05. This result confirms the acceptability of recycle waste as a significant variable. Therefore, this confirms that the results of the data analysis of recycle waste are in line with the literature. Recycle waste was found as an important independent variable from concept (R3 concept),

empirical overview in literature review said there was a strong relationship between recycle waste and construction waste (Tafesse, 2021).

The dependent variable construction waste had a weak correlation with the independent variable Management controlling (0.124), and the significance value of 0.03 is less than 0.05. This result confirms the acceptability of the management controlling as a significant variable. Therefore, this confirms that the results of the data analysis of management control are in line with the literature. Management controlling was found as an important independent variable from theory (Lean construction theory), empirical overview in literature review said there was a strong relationship between management controlling and construction waste (Shaqour, 2021).

The dependent variable construction waste had a weak correlation with the independent variable material education and training (0.102), and the significance value of 0.282 is more than 0.05. material education and training variables cannot be considered significant in affecting construction waste, according to the findings. In contrast to the literature, the results of data analysis about material education and training are unexpected. material education and training were found to be an important independent variable from theory (Lean construction theory), and empirical analysis of the literature identified a strong relationship between material education and training and construction waste (Ankomah et al., 2020).

4. Conclusion

The critical causes affecting material wastage in building construction project is analysed using previous research findings. Design changes during the construction phase, rework due to labour mistakes, purchase not complying with specifications, improper cutting of materials, poor site layout, etc. are found as critical causes affecting material wastage in building construction from chapter 02 (Bashir et al., 2010)

the adoption of lean construction methods is described in previous research findings. Identifying client values, defining value stream, eliminating waste, streamlining workflow, implementing pull scheduling, and achieving continuous improvement are the lean construction adoption methods from chapter 02 (BigRentz, 2021).

According to the data analysis, the key elements of the lean construction method for minimizing the material waste used in Building Construction sites are identified values from the customer's point of view and Pull planning and scheduling, with 23.33 % selecting that answer. Eliminate waste is selected by 21.11 %, continuous improvement is chosen by 16.67 %, define the value stream and the flow of work processes is chosen by 7.78%.

Lean Construction has a positive effect on organizational items by reducing waste, increasing time value, improving construction processes, increasing quality, increasing flexibility toward required change, lowering project costs,

and eliminating non-value-adding activities (Bashir et al., 2010; Shaqour, 2021).

According to data analysis, the challenge for implementing Lean Construction theory to the Building Construction sites is a lack of understanding of lean construction with 54.44 % selecting that answer. Lack of skills in the lean construction process is selected by 14.44 %, human attitudes are chosen by 12.22 %, financial boundaries are chosen by 6.67%, the poor culture among project partners is chosen by 5.56%, lack of good policies is chosen by 4.44% and the complexity of the lean construction process is selected by 2.22% participants. It is reasonable to conclude that educational hurdles constitute a danger to the long-term viability of the lean practice. So, pre-planning and material procurement is equally vital in keeping the project's overall cost under control (Bashir et al., 2010).

According to the data analysis, the most suitable recommendation to successfully adopt the lean construction methods to minimize material waste is with the use of lean methodologies, improve the work method of critical non-value-added activities with 34.44 % selecting that answer. Choosing the right lean tools to complete the three activities listed above is selected by 24.44%, implementing alternate approaches to increase the efficiency of value-added processes is chosen by 21.11 %, and eliminating non-added value activities through careful planning and the use of the just-in-time technique.

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Project time control in building construction

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Abstract The component of a project that keeps it on plan, on time, and under budget is project time control. If project time control is not implemented correctly, it attracts additional cost. In construction projects, the client will always want to finish a project quickly. The functions of project controls include project cost and schedule initiation, planning, monitoring and control, communication and closure. A construction contract can lead to legal conflicts. The main reason is the violation of the delivery time of the project, and the main goal of a construction company is to make a profit that it deems appropriate. Therefore, time control of the project is very important. Currently, the construction process is going on very fast. At the same time, there has been sustainable development. As the population increases, the use of land to accommodate people increases, so the construction industry is also increasing widely. The construction industry is one of the fastest growing industries and it contributes a lot to the country's economy. The Survey of Construction Project Time Management shows that most projects are cost and time overruns. The project can be very complex and full of challenges. Many unforeseen problems overrun project cost and time. Therefore, many technologies and methods should be adopted for successful monitoring and control to make the project successful. A project manager must successfully deal with this while controlling time and cost during the construction phase. To establish a basis for calculating a schedule using time estimates for the project's activities, it is necessary to select an estimated start time and a required completion time for the entire project. These times define the time in which the project must be completed. The time required for project completion is usually part of the project objective and specified in the contract. After receiving the estimated duration for each activity of the project and the overall time frame in which the project should be completed, the client can determine whether the activities can be performed by the required completion time.

Keywords: Project time control, additional cost, construction contract, sustainable development, time frame

1. Introduction

Construction has evolved into an ever complexed web of interactions between

ever faster processes, choices, and actions. However, there is a movement toward sustainable development at the same time. A construction project, like any other project, has various development phases that vary from one another in terms of the time and money required to complete it. The examination of cost allocation in respect to time is a critical concern when it comes to construction projects. It partially relates to the examination of the consistency of the relationship between these two variables over the course of several project phases, or, to put it another way, the examination of the viability of using the s-curve approach with respect to certain tasks and issues.

The component of a project that keeps it on course, on schedule, and within budget is called project time control. With careful consideration of every step in the process, project time control starts early on with planning and concludes late on with post-implementation assessment. Every project should be evaluated to determine the level of control that is necessary; too much control requires too much time, and too little control poses a significant danger. The cost to the business in terms of mistakes, corrections, and additional audit fees should be made clear if project time control is not executed correctly.

Costs, risk, reliability, communication, time, development, procurement, and human resources all require control systems. The importance of the projects to the financial statements, the dependence of stakeholders on controls, and the number of controls all need to be taken into account by the auditors. The development procedure and its implementation should be examined by auditors. If necessary or required, an evaluation of the development process and the end product's quality may also be conducted.

2. Project time control

Monitoring the state of project activities, such as updating project progress and managing changes to the timetable baseline to meet the plan, is known as project time control. This approach is advantageous because it gives the tools for identifying deviations from the real plan and for taking corrective and preventive action to lower risk. The length of time it takes to complete a project is frequently of utmost importance to the parties involved. Project delays, however, are widespread worldwide, particularly in developing and disadvantaged nations.

3. Project time control process

Three key factors play a role in the project time control process: input, tools and methodologies, and output. Plans for project management, a project schedule, information on work performance, a project calendar, and assets related to the organizational process make up the input. Performance reviews, project management software, resource optimization techniques, modeling techniques, leads and lags, schedule compression, and the use of scheduling

tools are some of the tools and techniques used to control project time. The output that is anticipated from these processes includes work performance data, schedule forecasts, change requests, project management plan updates, project document updates, and updates to organizational process assets.

4. Conclusion

According to the studies, project managers are crucial when it comes to organizing building projects. The majority of respondents had firsthand knowledge of how a sequence was designed following a conversation and written method statement, the activity durations were computed in full or in part, and the price was allocated in separate documents. With date and contingent restrictions were employed. According to these results, the majority of respondents understand the value of progress reports by maintaining paper records that are promptly entered into databases for future use.

Additionally, the vast majority of respondents were aware that labor allocation records were preserved when work was done. This demonstrates that they are aware of the occurrences relating to compensation or delays that are being recorded. When it comes to connecting the resource used to the work done and in which location, the majority of respondents reported that tasks were classified as being completed on schedule for both labor and plant and equipment records.

Last but not least, the majority of respondents utilize earned value the least as a gauge of design stage advancement. They chose to update the schedules on a monthly basis and to report on the project's overall status. They preferred to update or monitor schedules as a straight, date-related status line with the work that has already been completed to the left of the line, the work that still has to be completed to the right of it, and the timetable re-sequences. This would demonstrate how the estimated progress that has been made thus far has affected the timeframe of the remaining planned activities. To deal with the out of order works, most of them have prioritized unplanned logic.

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Sustainability aspects of fly ash as a cement substitute in Sri Lanka at difficult times.

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Abstract

The architects, engineers, and owners of newly planned buildings are primarily concerned with the function of sustainability in the construction industry. When creating a building, the design and the materials chosen are the two key factors. With the client's instructions, architects create an environmentally friendly building design and submit it. Engineers, on the other hand, must select and build the designed building using environmentally friendly and sustainable materials. They must also make the building durable to extend its lifespan. Sustainability will play a significant role as the building industry moves into the future. Being sustainable benefits not only ourselves but also the environment and the generations who will use this planet after us. Being sustainable entails not just planting trees after structures are completed, but also adopting environmentally friendly and sustainable building materials and construction techniques. When compared to other products, sustainable materials offer a wide range of benefits, including cost and resource efficiency, waste reduction, and increased construction lifespan. The fundamental benefit of adopting sustainable materials is that they are eco-friendly and enable future generations to cohabit on this planet same as we were. Cement is a key component of building construction as a building material. Around the world, cement is a common binding substance used in the construction industry. Cement has downsides while being a good binding substance. The byproducts of burning pulverized coal, which is used to generate electricity, can therefore be used as a substitute for cement. Fly ash does, however, have drawbacks for the environment, although the benefits outweigh those drawbacks. Fly ash, a byproduct of burning coal, is also produced without the use of additional large machinery or a significant amount of land, however, the production of cement requires large machinery and mining. Fly ash is used in concrete to increase workability, strengthen hardened concrete, and increase durability. In comparison to other construction-related binding materials, it is also less expensive to create. The use of fly ash as a cement substitute provides benefits for the environment as well as from a commercial or industrial standpoint. In several parts of the world, research and the use of fly ash in building were first introduced in the early 1990s. After being established as an achieving or facilitating the achievement, fly ash began to be utilized more frequently in the late 1970s.

Fly ash replaces cement, which saves energy use, greenhouse gas emissions, and the amount of industrial waste that must be disposed of in landfills. Additionally, it makes concrete more resilient, extending the lifespan of concrete-built structures and roadways. It also improves the preservation of other raw materials and natural resources. Fly ash is utilized to make PCC more affordable and more effective. Fly ash often replaces 15% to 30% of the Portland cement, with even higher percentages being employed for mass concrete constructions. In place of the removed cement, an equivalent or larger weight of fly ash is used. Fly ash and Portland cement are commonly substituted at a ratio of 1:1 to 1.5:1.

Keywords: Sustainability, Fly Ash, Cement, Environmental advantage, Coal

1. Introduction.

Sustainable green materials have attracted worldwide interest in the construction and building material areas in recent decades due to their ability to reduce limestone exploitation for the cement industry. The fast expansion of residential and industrial construction has also stimulated large cement manufacturing, which is one of the drivers of carbon dioxide emissions. It has been calculated that the cement sector contributes up to 7% of world carbon dioxide emissions.

Because fly ash contributes to the total cementitious material available in a mix, the PCC's minimum cement factor (portland cement) can be efficiently reduced for FAC. The ACI recognizes this contribution and suggests that for FAC, a water/(cement + pozzolan) ratio be used instead of the traditional water/cement ratio used in PCC.

FA can be used in the concrete industry in two ways. First, it can be used as a partial replacement for cement due to its pozzolanic reactivity. The second is for entire cement replacement via a geopolymerization technique. The FA characteristics of cementitious materials were primarily influenced by the following factors: the type and mineralogical composition of coal, the degree of coal pulverization, combustion conditions, additives used to assist combustion or post-combustion processes, and the FA collected, handled, and stored methods. FA is divided into two groups that pertain to the total element of Si, Fe, and Al.

2. Results and Discussion.

Table 1 shows the chemical composition of both FA as determined by XRF powder analysis. In FA classes C and F, the total element content of Si, Fe, and Al was 61.71% and 91.35%, respectively. It can be seen that the Si and Al content of class F fly ash is higher than that of class C fly ash, implying that

class F fly ash contains more amorphous alumino-silicate than class C. This amorphous content combines with the calcium hydroxide (Ca(OH)₂) generated by cement hydration processes to form calcium-silicate-hydrates (C-S-H) gel and calcium-aluminate-hydrates (C-A-H) gel. In the geopolymerization process, it reacts with the alkaline solution to form aluminosilicate structural linkages (Si-O-Al-O-Si).

Table 1: Chemical composition of class C and class F fly ash.

Chemical composition of FA	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	CaO	K ₂ O	Na ₂ O _{eq}	SO ₃	MgO	LOI
Class C	20.7	32.0	9.01	27.1	2.51	1.00	1.61	2.05	2.97
Class F	55.23	10.17	25.95	1.32	1.59	1.59	0.18	0.31	5.25

The FTIR analysis has six band ranges, as is well known. The band area detail of 4000-3500 cm⁻¹ indicates the loss of Ca(OH)₂, 3500-1600 cm⁻¹ indicates the stretching of the (-OH) bond and bending of the (H-O-H) vibrations, 1600-1000 cm⁻¹ indicates the gains of the Si-O-Si bond typical of quartz, 1000-800 cm⁻¹ indicates the loss of the CaCO₃ gel, 800-500 cm⁻¹ indicates the symmetric stretching of the Si-O-Si and Al-O-Si bonds, and the last band is less than 500 cm⁻¹ indicates the bending of the Si-O-Si and O-Si-O bonds .

Table 2: Peak number of class C and class F FABand range (cm⁻¹) indication

		Class C	Class F
4000-3500	Loss of Ca(OH) ₂	0	0
3500-1600	Stretching (-OH), bending (H-O-H)	1	1
1600-1000	Gains Si-O-Si bands typical of quartz	1	1
1000-800	Loss of gel CaCO ₃	0	0
800-500	Symmetric stretching of Si-O-Si and Al-O-Si	1	3
< 500	Bending vibrations of Si-O-Si and O-Si-O bonds	1	1
Total band points		4	6

Fly ash particles react with free lime in the cement matrix to produce more cementitious material, increasing long-term strength. The non-combustible mineral part of coal is made up of fly ash. Coal is first ground to the consistency of powder before being used in the power plant .When carbon is blown into a power plant's boiler, it is burned off, leaving molten particles full of calcium, alumina, and silica.

Before they can escape from the power plant exhaust, these particles harden into small, glassy spheres, giving the product its name, fly ash.

The residue that is extracted from the fuel gases of thermal power plants by the mechanical dust collector or electrostatic precipitator is called fly ash or pulverized fuel.

The type of fuel used, the load on the boiler, and the kind of separator all affect the fly ash's composition. Fly ash includes silicon, aluminum, and calcium oxides, similar to Portland cement, but far less calcium oxide.

When compared to equivalent plain cement concrete, fly ash concrete has the following advantages:

- Greater workability
- Improved sulphate resistance, a lower heat of hydration, and superior freezing and thawing resistance.
- Reduced alkali-aggregate interactions; decreased water and air permeability; decreased leaching of lime released during cement hydration
- Increased resilience to forceful water attack

You may have noted that the fly ash concrete has a higher total cementitious material content but a lower OPC content, a lower fine aggregate content but a purposefully higher coarse aggregate content, less water, and less density due to the lower density of fly ash compared to cement.

Fly ash generally enhances new concrete by lowering the amount of water needed for mixing and enhancing paste flow characteristics. Improved workability, a decrease in water need, a reduction in the heat of hydration, and more are all advantages.

The use of fly ash will not slow down in the construction industry in the nearby future due to its advantages.

Conclusion.

According to the aforementioned descriptions, the chemical composition of Si and Al in Class F fly ash was higher than in Class C fly ash, which is supported by the FTIR spectra analysis results. The chemical composition influences the formation of the (C-S-H) and (C-A-H) gels in pozzolanic reactivity, as well as the chemical bond gel in geopolymer reactivity. The unreacted fly ash particles, on the other hand, were used as filler in the cementitious process.

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GREEN TECHNOLOGY APPLICATION IN THE CONSTRUCTION INDUSTRY

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01. Introduction

Green technology is a developing and fashionable option in the modern building sector. Green technology has received a lot of attention since the early 1990s, and there has been a significant movement in modern construction toward an efficient building design execution driven by eco-friendly activities that make sustainable technology feasible. Sustainable technology, sometimes referred to as "green" technology, is one that has a "green" focused aimed towards sustainability and is very relevant to building in the present period. Green technologies are eco-friendly inventions that frequently include efficient energy, recycling, health safety issues, and resources that are renewable, according to the US Daily Newsletter on Green Technology (2016 edition). First and probably most important, securing natural resources, eliminating the negative effects of construction activities on environmental safety by using recyclable or recyclable materials, and changing the production pattern to minimize waste and emissions are the highest priorities in the construction of environmentally friendly buildings. Second, finding an alternative to harmful behaviors that harm the ecosystem and make it difficult for humans to survive.

02. Challenges to use of green technology

Since it covers the majority of the green expenses that may be mentioned in many traditional technology advances, it can be concluded that green technology is more expensive than any other technology that might serve as an alternative. Even though green technology is very new and recent, due to its dynamic development and implementation expenses, it may end up being even more expensive than older technology. Green technology adoption and use are delayed by a variety of different barriers, which may be either straightforward a lack of a proper regulatory framework—or technological, economic, political, cultural, and legal in character. More specifically, from the perspective of a company, these difficulties to the adoption of green technology include input, performance effect uncertainty, a lack of funding, and a lack of experienced staff. But getting beyond these barriers is a challenge.

03. Discussion and results

For the study's sustainable principles to be developed, green technology is both highly valued and essential. Furthermore, the benefits of using "green technology" in construction projects may be substantial and widespread, providing notable benefits for both new and existing buildings. Making a building "green" involves several steps that engineers and building owners perform. The amount of trash that is reduced as a result of using green construction techniques may be its most important benefit. Traditional technology, like petrol generators, can have a wide-ranging, disastrous impact on the environment, making it essential for businesses to choose to use green technologies. When compared to older technologies, green technology helps reduce industrial carbon footprint output by minimizing waste formation, preserving water use, and using less energy. Utilizing green solutions will be essential and acceptable since the building industry of the twenty-first century is moving toward sustainable development, which is definitely moving toward the reduction of negative effect.

04. Methodology

Given the major influence that building projects have on the built environment, green technology has become a vital component of sustainable construction projects. In order to expose the drifts of green technology applications from the first six, this paper uses an organized review of a variety of literature with sources from renowned conference papers, journal articles, and government reports. This review is done using sustainable design principles and a solid understanding of the technology life cycle. Identifying the advantages and difficulties of using green technology in construction projects is equally important.

05. Conclusion

The use of green technology in current construction projects enables rising market prices and increased demand for their services. Reduced ongoing operating costs, improved occupancy rates, and rising property prices benefit even the majority of infrastructure owners. Most of these eco-friendly technologies are implemented in buildings to combine the numerous regulatory systems that are added to them.

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GREEN TECHNOLOGY APPLICATION IN CONSTRUCTION.

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Abstract

When contemplating the significant influence produced on the building design, green technology has become a vital aspect of sustainable construction projects. Its ideals are powerful and all-encompassing, contributing significant gains when employed in both new and existing structures. Green building technology has risen as one of the most popular construction concepts. Green technology applications in construction provide much farther extensive advantages, providing huge benefits when employed in both existing and new structures. Green technology makes properties increasingly energy-efficient and ecological, resulting in a lower carbon footprint and less environmental effect. Green construction technology provides significant benefits to builders, property owners, and renters alike. Green technology advantages are mostly realized through improved energy efficiency. Green building construction is used in all stages of the development of new buildings. Every component of the building, including its siting, design, building supplies, and the systems utilized to manage and maintain operations, is chosen to be as environmentally friendly and power as possible. Typically, 30-40% of a commercial facility is empty at any given time. To monitor the track of the status of building sectors, green building technology employs motion sensors, RFID scanners, card access readers, and other sensors. Green technology automatically turns off lights and changes HVAC, conditioning, heating, and airflow options when an area of a structure becomes empty. Building owners can save up to 30% on their energy bills by decreasing unnecessary energy use in this manner.

Keywords: Green technology, Solar power, Insulation, Cool roofs, Technologies

1. Introduction

Green building technology has risen as one of the most popular construction concepts. Green technology applications in construction provide much farther extensive advantages, providing huge benefits when employed in both existing and new structures. Green technology makes properties increasingly

energy-efficient and ecological, resulting in a lower carbon footprint and less environmental effect. Green construction technology provides significant benefits to builders, property owners, and renters alike. Green technology advantages are mostly realized through improved energy efficiency. Green building construction is used in all stages of the development of new buildings. Every component of the building, including its siting, design, building supplies, and the systems utilized to manage and maintain operations, is chosen to be as environmentally friendly and power as possible. Typically, 30-40% of a commercial facility is empty at any given time. To monitor the track of the status of building sectors, green building technology employs motion sensors, RFID scanners, card access readers, and other sensors. Green technology automatically turns off lights and changes HVAC, conditioning, heating, and airflow options when an area of a structure becomes empty. Building owners can save up to 30% on their energy bills by decreasing unnecessary energy use in this manner. The top sustainable construction technologies currently used in green construction are listed below.

2. Findings

Solar power

Solar energy is increasingly being used as a sustainable construction method. It is used in two ways in green construction. The first is active solar power, and the second is passively solar power. The use of functioning photovoltaic energy that absorb the sun's light to provide heating and energy is known as active solar power. It minimizes the requirement for electricity or natural gas. The initial setup costs are higher, but it saves money on electricity bills and helps to reduce emissions of greenhouse gases from nonrenewable energies like fossil fuels.

Green insulation

Whenever it comes to construction and house building, one of the most pressing problems is insulation. Most people, however, are unaware that insulators are merely wall screens that do not need to be fashioned of expensive and well finished materials.

Green insulation provides a solution by reusing old and then used materials like fabric and papers. In other words, the walls are lined with recyclable material.

Cool roofs

Cool roofs are innovative green innovations that aim to reflect heat and light away from the building. It helps to keep homes and structures at normal room temperatures by reducing heat uptake and thermal emittance.

Cool roofs lessen the need for air conditioning, resulting in lower energy consumption and, as a result, lower overall greenhouse gas emissions generated by power plants.

Water efficiency technologies

Water efficient technologies are used, and they are all part of environmentally friendly construction technologies. The technologies essentially include the re-use and deployment of efficient water delivery systems. Dual piping, greywater re-use, water recycling, and water-saving fixtures are some examples. These methods ensure that water is properly managed, recycled, and utilized for non-portable functions such as car washing and toilet flushing. Dual piping, for example, reduces sewage traffic while increasing the possibility of reusing water on-site. Rainwater harvesting, on the other hand, supplies water for several uses and may even be saved for future use. Water economy sustainable construction solutions, in general, reduce water usage expenses and aid in conserving water. To tackle water problems, the technologies aim to reduce water waste by 15% in urban areas.

Sustainable indoor environment technologies

Structure occupants' safety and health are critical and must be ensured during in the building of any building or house. As a result, green construction must include sustainable indoor technologies. Green safety criteria must be met by the materials employed, which include hazardous-free components, non-toxic substances, non - combustible emissions, and water resistance.

Wood, cork, and bamboo, for example, are organically sourced and contain no harmful, inflammatory, or carcinogenic ingredients. The use of low Volatile organic materials improves Indoor air quality and lowers exposure to potentially harmful substances such as vinyl, hydrocarbon, and lead.

3. Conclusion

Thoughtfully designed and built structures offer a legacy to subsequent generations to enjoy. We must recognize that everything we construct today must last and improve the lives of the people who follow after us.

From each and every indication, the viewpoint of this study reveals the possibility of better energy efficiency through removal of needless energy usage and savings of up to 30% on energy expenses, making green technology critical. Great construction and design should not come at the expense of the environment, but instead work in harmony with it and have the least possible impact.

Finally, in the twenty-first century, the majority of emphasis is focused on sustainable growth, and it is agreed that green technology adoption in building projects is critical for any building design in any country to fulfill its sustainable goals.

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Construction Clients in Selecting Appropriate Procurement Route

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Abstract

Making decisions about purchases is an important factor in project success. Although numerous stage-based, objective models have been put out to direct clients' procurement decisions, little attention has been paid to the clients' subjective preferences in the construction industry. This study creates a decision-making framework that can assist construction customers in making educated procurement decisions by recognising the importance of clients' experiences in justifying procurement routes. Relevant procurement choices were evaluated using a mixed-method approach that included semi-structured interviews and multi-objective optimization based on client specifications and project deliverables.

Using a template that enables customers to prioritise procurement techniques for various project types, the lived experiences of construction clients and the importance they attach to pre-defined selection rating criteria were later examined. The resulting framework provides a comprehensive, useful, and collaborative selection process for construction procurement that encourages the timely completion of projects by minimising cost overruns and delays brought on by ill-informed client judgments.

Keywords: construction, decision-making construction, clients, construction procurement

1. Introduction

Construction procurement decision-making is complex. It is impacted by various elements including project idiosyncrasies, procurement options, and customer specifications. According to, clients' decisions regarding the best procurement path continue to be an important but challenging barrier to overall project success. Although there are ongoing discussions over the underperformance of construction projects, earlier research has shown that the root of the problem can be found in the decision-making process that

occurs during project development. As a result, academics have underlined the importance of effective procurement channels in the building sector.

Client attributes have an impact on procurement decisions in addition to the objective procurement drivers of cost, quality, and time, according to Ref. The authors of further suggested that the creativity of construction clients (CCs) in the procurement process is frequently motivated by subjective thoughts, insider information, or prior exposure to projects that are similar. Therefore, it has been suggested that a subjective approach that considers the unique characteristics of each project be used to evaluate procurement routes rather than basing them solely on objective models. In order to achieve overall project success, it is recommended that efforts be made to establish decision-making tools that might match a variety of project performance indicators to project specifics and client requirements.

Although many construction industry experts believe that a project's overall success is determined by the agreement of all significant stakeholders, others think that project success is much more complicated and that the client's satisfaction with the final product is perhaps the most important determinant of whether a project can be considered successful or not. Although many academics have attempted to streamline the construction procurement process, there is still a lack of understanding regarding the function and influence of CCs' subjective characteristics in choosing the best procurement paths for various project types. In order to help CCs make educated decisions about procurement while aligning their perceptions and experiences with the objective reality of the procurement selection process, the major goal of this article is to investigate the impact of CC's subjective experience in procurement selection.

Two phases of this study's execution were used. In-depth qualitative interviews were conducted as part of the first stage with the goal of determining how peculiar beliefs, experiences, and perceptions of the procurement selection process affected CCs. The CCs were then given the assignment of prioritising several project factors that guide their procurement choices for various project types. A framework that might improve the procurement selection process based on careful analysis of client characteristics, aims, and project idiosyncrasies was developed as a result of the combined approach.

2. Procurement and Construction Clients

2.1. Construction Clients

Clients in the construction sector determine the organisational and management structure of project delivery, in contrast to other sectors. While choosing procurement routes in the building business is still unclear, there

are common techniques and methods of executing projects in sectors like manufacturing and the car. According to, the construction industry's procurement procedure is client-centered. The provision, upkeep, and disposal of construction projects are the responsibility of the construction contractors (CCs), and their actions or inactions affect the final result of the project. Furthermore, CCs evaluate construction procurement from a variety of angles. CCs' considerations now encompass elements including project variance, risk perception, and end-user satisfaction in addition to the fundamental project criteria of cost, quality, and time.

According to, CCs are typically split into two types: public and private clients. However, it is also recognised that within these two broad categories, there are subcategories based on clients' experiences and whether they are primary or secondary constructors. The classification of CCs as experts, inexperts, etc. has also been evaluated in the publications "Constructing the Team" and "Rethinking Construction." According to, CCs can play a variety of unique roles in the procurement process. The client may play an assertive role in driving innovation, the client may play a cooperative role in driving innovation with the construction team, or the construction team may play a passive role in driving innovation.

CCs are confronted with some project uncertainties as they evaluate the viability of a project during the procurement process. As a result, in addition to considering the project's goals and the client's attitude toward risk, other elements like the client's resources, unusual project characteristics, flexibility, and ethical concerns have constantly influenced clients' inventiveness in the procurement process. The preferred procurement option is frequently chosen based on the criteria that are most important to the client, even if these characteristics have various effects on projects depending on their size and complexity. Therefore, academics have underlined the need for alignment between customers' objectives, the characteristics of available procurement alternatives, and the anticipated project outcome.

According to, choosing a procurement strategy should be a totally rational process when the aims of the clients are well specified. CCs ought to be able to select project delivery options with ease in order to meet their project goals. This is unachievable, though, given the intricacy of modern building and the reality of clients' subjective characteristics. The desire for modern building varies with clients' levels of skill and has widened the gap between knowledgeable and uninformed clients. In today's construction sector, only clients who are knowledgeable about the most recent innovations and best practises are pertinent. This explains why different clients' points of view when analysing procurement possibilities can differ.

While an experienced client understands the value of collaboration and sustainability in the project's final success, an inexperienced client might not

place as much emphasis on these aspects when choosing a project delivery method. Regardless of the classification, CCs do not fully examine the procurement options at their disposal. Instead, they frequently look to the history, feedback from other stakeholders, and the influence of outside forces like the legal system and public opinion. Unfortunately, this method does not fully account for the uniqueness of specific projects, and it may cause clients to make decisions without sufficient information [18]. This could ultimately lead to subpar construction, cost overruns, or a delay in project completion. To avoid the effects of inefficient choices and how they would affect the project's outcome,

2.2. Construction Procurement

CCs view procurement as a series of calculated risks that need to be assessed in order to produce a project that is secure, economical, and appropriate. This viewpoint has had a considerable impact on the development of construction procurement, leading to a variety of possibilities that are mostly driven by client requirements and project requirements. The definition of procurement has remained dynamic and robust as an essential component of the project delivery process, however, and is now more broadly defined as "the acquisition of new buildings, or space within buildings, either by directly buying, renting, or leasing from the open market or by designing and building the facility."

Scholars agree that choosing an appropriate procurement route is a key factor in determining the success of a project as construction procurement continues to develop.

The "collection of rationalistic decisions within a controlled environment, seeking to provide generic, prescriptive criteria for clients and advisers to follow to select the 'optimal' procurement route for their project" is an example of an acceptable procurement selection technique. This procedure can be summed up by calling it a framework for acquiring or securing construction. Although the results of earlier construction project decisions may be very instructive in defending CC's choice regarding related projects, it asserts that the client has a number of procurement options.

There are a number of options for each procurement choice, and each one can be improved to suit the needs of the client and the particulars of the project. The following section discusses a few of these procurement methods and their variations as they relate to clients in the construction sector. categorised the four main categories of building procurement choices as follows: There are four types of procurement systems:

- (1) Separated or traditional systems,
- (2) Design and construct systems,

- (3) Management-oriented systems,
- (4) Partnering/collaborative systems.

1. Separated or Traditional Procurement Systems

Over the years, the development of project delivery channels has gone through many stages. Before the Second World War, many projects were funded using "conventional" methods, which have been in use for more than 150 years. The conventional procurement route is described as having design as a separate function from construction. It is known as the oldest kind of documented procurement alternative. The design is finished before choosing a contractor to construct the works when traditional procurement is used, which is thought to be the least risky strategy for the client because there is an inherent level of certainty about the project's quality and construction time if it is properly implemented.

This allows for a somewhat reliable estimate of the whole project costs to be made prior to the start of construction, assuming no changes are made. There are many accounts of post-contract adjustments and delays, which frequently lead to increased project costs and schedule overruns. While many construction projects have been successfully delivered across the globe using traditional procurement, there are many stories of these issues.

2. Design and Build Method

The end of World War II marked the beginning of a period of steady economic expansion and advancement of human capital. The implementation of an integrated procurement strategy, which combines the design and construction activities involved in project delivery, was necessary to meet the societal demand at the time for rapid delivery of public buildings. This procurement approach is termed "design and build".

Defines design and build as a strategy where one contractor takes on the risk and responsibility for project design and building, typically in exchange for a fixed fee. Construction frequently starts before the comprehensive design is finished, and the contractor completes the design as the project moves forward, giving it the reputation of being a fast-track way.

From the definition, it can be inferred that this approach shortens project duration, ensures cost predictability, and promotes integrated contractor involvement in project design and planning. Design responsibility is transferred from direct client control to firms whose primary operations are profit-focused when there is a transition to design and build. In a design-and-build contract, the customer transfers to an independent contractor the legal responsibility for both the design and the construction [35]. This one contractor may be a single integrated company with an internal design and construction delivery team or it may be a group of several design and construction companies assembled for a specific bid. Other integrated types

of procurement emerged as a result of the desire to improve the design and build procurement approach.

3. Management-Oriented Method

To fill the gap between conventional procurement and design and build, the idea of management-oriented procurement was developed. In the 1970s, this technique originated in the United Kingdom. By using this procurement strategy, the CCs hand over control of project design and construction to a specialist who serves as the client's management consultant. Management-driven procurement improves project quality and allows for design modifications. It guarantees that the designated managing consultants are in charge of the construction duties without their actually carrying out any of the work at the client's expense. This indicates that the consultants take control of the building process and guarantee project value for money.

Management contracting and construction management are two variations of management-based procurement, both of which have the designation of a managing party as their primary attribute. In construction management, the client employs a construction manager (CM) to supervise the design and construction operations and to use their knowledge and experience to complete the project for a predetermined fee. The primary responsibility of the CM is to monitor adherence to project specifications in the absence of any formal contractual obligations to the design team or contractors. The customer and the trade contractors continue to be the only parties to the contract. By virtue of their established contractual relationship with the package contractors, the consultant under a management contract, however, assumes a portion of the building risk. The involvement of the professional consultant in the project planning and design is a significant advantage of management-oriented procurement. Although early consultant engagement lowers the risk of project overrun while tolerating subsequent design decisions as construction advances, the uncertainty over project cost at the initial stage of the procurement is a significant downside of this strategy. In the early 1990s, the adoption of more integrated procurement techniques, sometimes known as partnering, began to take off.

Partnering/Collaborative Method

Between contractual parties, partnership in construction procurement fosters teamwork, trust, long-term commitment, open culture, mutual objectives, customer focus, and innovation. Partnering suggests that effective project outcomes are better achieved through the collective effort of all stakeholders involved in project delivery, aside from driving innovation through mutually agreed-upon objectives, developing strategies for conflict resolution, committing to continuous improvement, measuring performance, and sharing gains. The use of PPP (Public-Private Partnership) and PFI (Private Finance Initiative) procurement options, thus, offers the foundation necessary for partnership.

The main goal of PPP/PFI procurement is to provide a framework for collaboration between the public and private sectors in order to manage project risks and conflicts and achieve the best possible project outcomes. A strong legal framework, adequate stakeholder engagement, appropriate risk assessment and allocation, transparency, and the availability of funding are believed to be the most important factors for successful PPP/PFI projects. This is true even though PPP/PFI procurement offers a wide range of benefits through innovative and collaborative practises among stakeholders in the delivery of public projects.

Conclusions

The process of choosing construction procurement channels is not simple, according to academics. Instead, it varies depending on the nature of the client, the complexity of the project, and the availability of the necessary data to achieve the project's goals. The decision-making framework created in this study can assist CCs in making informed judgments because it recognises that CCs' capacity to make wise investment decisions is a crucial element that influences project success. In order to review the many classifications of CCs, the selection of procurement alternatives, and some of the options open to CCs, this paper looked at the literature.

It supports preexisting claims that there may be more than one procurement approach that will satisfy particular customer criteria.

The complexity of contemporary construction projects and the dynamic nature of client objectives have made it difficult for scholars to make any real progress in simplifying the decision-making process for CCs. This study emphasises that clients' aims are not static and that the reality of the current environment necessitates a flexible approach to CCs' decision-making, in contrast to prior scholarly contributions that are purely predicated on clients' objectivity. This study utilised CCs' experiences in choosing procurement routes through the value they attach to various project aspects by using a mixed-method approach that included qualitative interviews and the MOO technique.

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Consumer choice of hair shampoo products in Sri Lanka

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1. Introduction

This study aims to investigate the consumer behavior of different consumer segments of the hair shampoo products in Sri Lanka and examine the factors affecting the consumer behavior among hair shampoo users in Sri Lanka. Consumer behavior of with respect of six shampoo brands namely; Dove, Tresemme, Ayush, Sunsilk, Lifebuoy and Clear were analyzed in this study. Consumer behavior reflects from the quantity usage of the product and the brand choice considered as dependent variable in the study. Segmental factors are nature of living area, age, gender, educational level, marital status, nature of the household, household income considered as independent variables of the consumer behavioral factors and factors influencing the consumer behavior.

Consumer behavior is a subject which evolves around marketing discipline, modern definition of consumer behavior defines according to the requirements in the marketing field and focuses the examination and application of consumer behavior principles to the development and implementation of marketing strategies (Schiffman & Kanuk, 2008). The term Consumer Behavior is defined as the behavior that consumers display in searching for, purchasing, using, evaluating, and disposing of products and services that they expect will satisfy their needs. Consumer behavior focuses on how individuals make decisions to spend their available resources of time, money and effort on consumption related items. That includes what they buy, why they buy it, when they buy it, where they buy it, how often they buy it, how often they use it, how they evaluate it after the purchase, the impact of such evaluations on future purchases, and how they dispose of it. In this study we consider consumer behavior as change in the quantity usage and brand choice. Quantity change and brand choice are dependent variables which are considered as reflecting the consumer

behavior where as other factors that affect on customers to change the quantity usage and brand choice are called independent variables.

2. Methodology

This research was undertaken as a quantitative study using primary data. An online questionnaire was used to select a convenient sample. A total response of 115 shampoo users were sampled through an email survey. Descriptive statistics were used to analyze the categorical variables and segmental variables of the population. In order to examine the association of the variables cross-tabulations, Pearson Chi-Square test, Nonparametric K Related sample test and Nonparametric Two Related sample test were used. This research is in the nature of exploratory research since, this is to figure out existing associations between variables and shortlisting significant variables affecting dependent variables. Questionnaire has been emailed to the sample size of 200 based on conveniently selected email addresses and received 115 responses along with shampoo users and non-users. In order to achieve first objective of the research, both shampoo users and non-users have been considered (115 respondents) but for the rest of the objectives, only shampoo users were considered (100 respondents).

3. Results and Discussion

The findings indicate that using shampoo by an individual is a function of household income and not significantly associated with other segmental factors of consumers' considered in the study such as; nature of the living area, age, gender, educational level and marital status. Further, the findings revel there is no significant preference or ranking among six shampoo brands and there is no significant change in the preferred shampoo brand and its package size, purchasing frequency and number of packs purchased at a single transaction.

4. Conclusion

The findings indicate that using shampoo or not using shampoo by an individual is a function of Household income and not significantly associated with other segmental factors of people considered in the study such as; nature of the living area, age, gender, educational level, marital status and nature of the household. According to the findings, there is no significant preference or ranking among six shampoo brands. Further, there is no

significant change in the preferred shampoo brand, its package size, purchasing frequency and Number of packs purchased at a single transaction during the pre - Covid and post-Covid time periods.

According to the findings, 67.4% of the respondents do not change the consumption or shampoo brand with respect to a 10% increase in the price of the currently used shampoo (Px) whereas 20.9% will change the brand to a much cheaper lower brand whilst 8.1% and 2.3% will reduce the consumption by less than 10% and more than 10% respectively. Further, only "nature of the Household" is associated with the change of the quantity usage and brand switching with respect to a 10% increase in the price of the currently used shampoo.

In response to an increase in the Household income by 10%, almost 81.7 % of the respondents will change the present consumption level, 13.4% will switch over to a comparatively higher brand, 2.4% will reduce the consumption less than 10% whilst the remaining 2.4% will increase the consumption less than 10%. Further, it was observed that the change in the consumer behavior in terms of changing the quantity usage and switching to another brand with respect to the 10% increase in the household income is significantly associated with categorical variables such as; Nature of living area, Nature of the household and Household income.

Other factors affecting the shampoo brand choice and quantity usage of a consumer were identified (on level of importance as) Good Experience, Health concern, Availability, Price of the product, Expert recommendation, Brand name (Brand Equity), Discounts offered, Attractive packaging and Advertising.

Further, Nature of the Living Area" influences the other factors such as Good Experience and Brand Name. Age influences Good Experience, Health Concern, Expert Recommendation, Price of the Product and Advertising. Also it was noted that the Gender is associated with Discounts whilst Marital status affects the Advertising. Nature of the Household affects Good Experience and Brand Name. Finally, it was noted that Household Income affects Good Experience.

Results of the study will be useful to corporate managers to understand the consumer behavior and their preferences to develop their product for the sustain of the business. The study was confined to the Western Province and limited to the brands manufactured by Unilever Sri Lanka.

5. Recommendations

Researcher recommend conducting further study in this area to confirm the facts and eliminate the weakness in this study by applying appropriate random sampling technique and conduct the survey with an adequate sample covering more segmental or categorical variables representing the sample in a fair manner and covering other shampoo brands in Sri Lanka to avoid brand biasness.

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Impact of Covid-19 on the Financial Market and other Economic Variables in Sri Lanka

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1. Introduction

Financial markets are not independent of a country's economic performance. Despite the economic slowdown caused by the Covid-19 pandemic the stock markets have been performing exceptionally well including in Sri Lanka. The purpose of this study was to find out if Covid-19 has had any impact on the performance of the Sri Lankan stock market which is measured by the All Share Price Index (ASPI) as well as investigating whether there is a difference in the behavior of four macroeconomic variables namely, interest rates, money supply, domestic credit and inflation based on Pre-Covid and Post-Covid conditions. The choosing of the four variables were based on certain economic rationale and theory.

Performance of the stock markets are measured by Indexes. The Colombo Stock exchange has two main indexes to measure its performance which are All Share Price Index (ASPI) and S&P Sri Lanka 20 Index. Since ASPI is covering all shares listed in the Colombo Stock Exchange (CSE), it has been considered for this study as a measure of performance of the CSE.

According to Keynes' Liquidity Preference Theory, people demand money for three motives (Tily, 2011), of these the speculative motive refers to an investor's reluctance to tie up investment capital for fear of missing out on a better opportunity in the future. Keynes's analysis captures uncertainty and expectation in the demand for money and its relationship with interest rates (Tily, 2011). Accordingly, the rate of interest was the cause, not the passive consequence, of the level of economic activity (Tily, 2011). And in the case of this study, we are looking at the interest rate as one of the causes for the ASPI movement. For our study we take two of the variables to represent

interest rate, they are the Average Weighted Lending Rate and the Average Weighted Deposit Rate. The Average Weighted Lending Rate (AWLR) is calculated by the CBSL monthly based on interest rates of all outstanding loans and advances extended by commercial banks to the private sector (Central Bank of Sri Lanka, 2021). The Average Weighted Deposit Rate (AWDR) is calculated by the CBSL monthly based on the weighted average rates of all interest-bearing deposits of commercial banks (Central Bank of Sri Lanka, 2021).

Secondly, the money supply measured by monetary aggregates are defined in accordance with their respective level of liquidity. The CBSL has been influencing the monetary aggregates by way of changes to the statutory reserve ratio which in turn affects the money supply of the country (Central Bank of Sri Lanka, 2021). For this study we have taken broad money (M2b) as the primary indicator of money supply in comparison to the other indicators of narrow money and base money. Reserve money is a component of broad money (M2b), and it is directly impacted by the Statutory Reserve Requirement (SRR) set by the Central bank. And CBSL uses the SRR as one of the main policy instruments to influence the money supply of the country. SRR is the proportion of rupee deposit liabilities that commercial banks are required to maintain as a deposit with the Central Bank (Central Bank of Sri Lanka, 2021). When the SRR is high the Commercial banks are required to keep more money with the Central bank which limits their ability to give out loans to customers (and vice versa). When commercial banks see a reduction in the SRR requirement as in the case last year due to covid 19, they had the ability to lend to more customers with the additional cash reserves that was held with CBSL.

Thirdly, in Sri Lanka we can divide the total domestic credit reported by CBSL into three categories, namely Credit to Government, Credit to Public Corporations and Credit to the Private Sector. In this study we will only consider the variable credit to the private sector when looking at ASPI performance as the other two variables relate to lending to the state.

Finally, Literature on inflation as a variable shows significant variations in its impact in response to money supply/money expansion. Moser (1995) in his study of The Main Determinants of Inflation in Nigeria found that monetary expansion driven by expansionary fiscal policies, to a large degree became one of the main determinants of Inflation in Nigeria (Moser, 1995). On the

other hand, Ediriweera and Deshika (2021) in their study on Factors Influencing Inflationary Condition in Sri Lanka observed that The trend analysis of inflation shows a high variation of price level within the Sri Lankan economy while foreign exchange rate, gross domestic production, and money supply show a smooth trend with least shocks indicating money supply has little to do with inflation (Ediriweera & Deshika, 2021). In Sri Lanka, inflation is measured by two indices, namely Colombo Consumer Price Index (CCPI) and National Consumer Price Index (NCPI). To find out if inflation has any impact on the ASPI, we look at the CCPI headline value index and not the percentage change as ASPI is also an index.

2. Methodology

This research was undertaken as a quantitative study using secondary data. A sample of 76 records covering the time period from 2015 Jan to June 2021 was extracted from Bloomberg terminal and CBSL reports. The data set was then analysed using Microsoft excel to arrive at time series graphs to show the performance of each variable in the last five years. Prior to carrying out an analysis for the comparison of each independent variable against dependent, the individual variables which are of different scales (LKR, percentages, index) were converted to a standardized measure of an index by the use of a base year and month (January 2015) so that a comparison of them could be possible. The data set was further divided into pre and Post-Covid categories based on the date of 1st January 2020. We have chosen this date as December 31st 2019 was the date that the Chinese authorities informed their World Health Organisation China office of a new type of pneumonia cases in Wuhan City, Hubei province the epicentre of the Covid 19 outbreak (Ravelo & Jerving, 2021) which later turned out to be the start of the Pandemic. Further, the data was converted into SPSS and coded into a dummy variable which represents pre and Post-Covid period in order to examine whether there is a significant difference between the means of each variable based on Pre-Covid and Post-Covid period.

3. Results and Discussion

The research findings indicate that ASPI performance under a time-series graph and an independent-sample t-test shows a difference between the Pre and Post-Covid periods. The economic variables of money supply measured by M2b, private sector credit growth and inflation measured by CCPI show an upward trend but no visible difference in their behavioral pattern under

time-series graphs. All three variables measured by an independent sample t-test show a difference in Pre and Post-Covid period. Interest rates under the time-series graph show that the average weighted lending and deposit rates move simultaneously with a net interest margin of about 4-6%. In the post-Covid period, it is observed that the rate of change in both the lending and deposit rates reflect each other. Further, an independent sample t-test indicates that the means of both the lending and deposit rates in the Pre and Post-Covid period are not significantly different.

4. Conclusion

In conclusion we can state that ASPI data in the Pre and Post Covid periods show a visible and statistically significant difference in their behavior. The economic variables of money supply measured by M2b, private sector credit growth and Colombo Consumer Price Index show an upward trend of growth but showed no visible difference in their behavior pattern under time series graphs, however it was proved that there is a significant difference in their behavior under an independent sample t-test at 5% significant level. The economic variable interest rate measured by both the average weighted lending and deposit rates moving in simultaneously in either a positive or negative manner with a net interest margin of about 4-6% between each other. In the post Covid period it is also observed that the rate of change in both the lending and deposit rates mirror each other. But an independent sample t-test indicate that the means of both the lending and deposit rates in the Pre and Post Covid periods are not significantly different at 5% significant level. Further, we can also state that the volatility has been reduced significantly in all variables except ASPI and Average Weighted Lending Rate during Post-Covid era, this may be due to less number of data available compare to the Pre-Covid era data in all variables.

5. Recommendations

The researchers recommend that additional statistical analysis be carried out to examine the correlation between all variables and the strength of the correlation. Further, we recommend regression analysis to examine the influence of independent variables on the dependent variable ASPI performance and to build a model to forecast ASPI performance.

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Ensuring a right to safe and healthy environment in Sri Lanka; A comparative Analysis based on the landmark judgments made by European Courts of Human Rights

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Abstract

In 1978 Sri Lankan Constitution fundamental rights has been guaranteed in Chapter 111 from Article 10 to 14. There for government has duty to protect, develop and promote the human rights of the citizen of Sri Lanka .In the Article 17 it has mentioned that “Every person shall be entitled to apply to the supreme court, as provided by the Article 126 ,in respect of the infringement or imminent infringement ,by executive or Administrative action of a fundamental rights to which such person is entitled under the provisions of this chapter. Most importantly these rights have been restricted by the article 15 due to some reasons namely Interest of national security, The Constitution of Sri Lanka does not expressly recognize the right to a safe and healthy environment as a constitutionally protected fundamental right, nor does it expressly recognize the right to life as a fundamental right. Supreme Court has held that some fundamental rights in the Constitution implicitly recognize the right to life, But it is not progressive as the judgments made by European Court of Human Rights. Furthermore, the Constitution imposes a fundamental duty on every person in Sri Lanka to protect nature and conserve its riches which is also an unenforceable duty Due to these circumstances, a question has arisen whether the Sri Lankan government has made successful attempts to address and endorse of the right to a safe and healthy environment. Though, the Parliament has enacted many laws to ensure that the environment is protected, thereby attempting to create a healthy environment. Sri Lankan law and the Supreme Court has made minimum of judgments in flavor of right to a safe and healthy environment .This issue has created many problems to the environmental rights especially the right to a safe and healthy environment and it is found that lack of specific provisions to formulate policies to encourage the prudent use and conservation, and management of the country’s natural resources, land resources, water, aquatic resources, wildlife, forests and soil. Although the Constitution does not contain any specific fundamental right pertaining to the enjoyment of a healthy environment, the Supreme Court has entertained, afforded relief and settled few fundamental rights applications relating to environmental issues, on the basis of the equal protection provisions contained in Article 12(1) of the Constitution. But the issue is, this would be enough to overcome the issues relating to a right to a safe and healthy environment in Sri Lanka. Even though, the Sri Lankan Supreme Court entertained, afforded relief and settled many Fundamental Rights

Applications relating to environmental issues, inadequate enforcement of laws, corruption and population growth have created a number of environmental challenges for the country. Lack of Supreme Court judgments in relation to right to safe and healthy environment has led to harm to rights relating to a safe and healthy environment, this should be addressed and Sri Lankan law must be up to the levels of European Law. Many States now incorporate a right to a healthy environment in their constitutions. Many questions about the relationship of human rights and the environment remain unresolved in Sri Lanka, however, and require further examination. In Sri Lanka it shows that lack of positive intervention on environmental rights. This characteristic of the right to environment may root some difficulties in its full recognition and enforcement as there is no identified, definite principle or procedure to carry out this process. Therefore, an aggregate approach to the subject through a modern method based on the legal system would ease such issues in the process of executing environmental rights. A human rights approach to environmental protection is not proposed to the exclusion of other approaches or species with and environmentalism. Rather, it is proposed as a tool to execute other approaches as well as mechanisms on environmental protection. Therefore, necessity has arisen to strongly recommend that human right to a safe and healthy environment be incorporated into Fundamental Rights Chapter of the Constitution to be proposed.

Keywords - Human Rights, Right to a safe and Healthy Environment, Fundamental Rights

1. Introduction

In 2008 the United Nations Human Rights Council adopted Resolution 7/23 on Human Rights and Climate Change which, for the first time in a United Nations (UN) resolution, stated explicitly that climate change “poses an immediate and far-reaching threat to people and communities around the world and has implications for the full enjoyment of human rights”. A subsequent study published by the Office of the High Commissioner for Human Rights (OHCHR) in January 2009 asserts that global warming “will potentially have implications for the full range of human rights”. The failure to adequately mitigate the causes of climate change means that adaptation to climate change is now a significant and costly problem requiring international support consistent with the provisions of the Climate Convention. A continued failure to reduce greenhouse gas emissions will result in climate impacts that surpass our capacity to adapt and which amount to loss and damage, thereby aggravating the injustice experienced by those least responsible for the causes of climate change. The solution is to make a rapid transformation of our economic systems away from a dependence on carbon while protecting the right to development of the poorest and most vulnerable people and Countries. The right to safe and healthy environment will be the

heart of this study aiming at contributing to the development of human rights by addressing relative new issues. More ever, this will not providing and historical overview of the subject matter, but somewhat explaining how major events and trends have led to the present situation regarding environmental human rights. Further, this study aims to debates on environmental human rights and specially on the right to a safe and healthy environment is highly interesting for the general progress of human rights. Therefore, this study will aim to contribute to development by discussing its probability and relevance in European, and Sri Lankan context. Though this study is touching upon sustainable development, it is not presented an in-depth discussion of the sustainable development and rather focus on human rights related field. Specially, the human rights on environmental aspect are debated on the 1972 Stockholm Declaration and the 1992 Rio Declaration, which are the landmark of the environmental human rights specially the third generation rights. They have opened the new juncture for environmental human rights. The Rio Declaration was initiated the institutionalization of the concept of sustainable development towards to the world and also the progressive development is discussed for the first time the interconnection between human and environmental apprehension at the global level . Therefore, this thesis will aim on the progress of environmental human rights for the period of 1968 onwards. Despite every interesting contribution to the topic from other regional legal systems such as African Court of Human and People's Rights, this research aims on the State of Council of Europe, and Sri Lanka context. Other systems will only be used for the discussion on the overview of the findings of the research. This approach seemed reasonable for many reasons .For the first, the European Human Right System is currently the most highly developed regional system which protecting and promoting human rights all the way through legal means. Further, in order make balance of the review Inter American Systems legal activities which is not developed as European System, is illustrated and in order to test the local contribution to global concern rights such as a right to safe environment, Sri Lankan case laws and how its implementation on human rights development in the era of climate change will be analyzed. Further, this study focuses on whether right to a Safe and Healthy Environment had been addressed by the Supreme Court of Sri Lanka.

2. Methodology

The qualitative method is used for this research in order to collect information, especially secondary data will be used (internet and exiting writers Books (case studies) may be referred. The researcher shall be relayed on Primary data as well as secondary sources of data .The primary data being the 1978 Constitution of Sri Lanka, Constitution of India, Additionally, the researcher has referred International Conventions, Bills of Human Rights and International Principles and guidelines (Human Rights)

,books, magazines articles of various authors that are available in libraries, leading journals, and newspapers, blogs and on the Internet.

3. Result and discussion

At The present Fundamental Violations are directed only against the State .When considering violation in relation to Right to safe and healthy environment may be occurred from the private actors adversely than it occurs from State actors, therefore FR violations should also are directed against the private actors and that liability for infringements should be extended not only to state sector but also to private actors. It is required to broadly define in the Fundamental Chapter in the Sri Lankan Constitution “Fundamental Right to cover up right to safe and healthy environment or Right to clean environment.

Constitution of Sri Lanka does not define what would amount to torture or cruel, inhuman and degrading treatment, and it has also been left to the Court to interpret the provision. Sri Lankan Constitution does not clearly provide a safeguard for the right to a safe and healthy environment as it is protected in the European context.

Although the equality provision of the Constitution has been used expansively to encompass issues of environment and development, it is doubtful whether the boundaries could be hard-pressed much further to deal with these more specific rights. The contracted scope of the current provisions on fundamental rights, including the absence of a right to life provision, would be an obstruction in doing so. In Sri Lanka the most recent attempt at constitutional reforms did not include these categories of rights except in very limited terms. Obligations of the State in relation to environmental protection especially the right to safe and healthy environment and ensuring an adequate standard of living for its citizens in all its aspects have again been relegated to a chapter on Principles of State Policy and Fundamental Duties, which do not provide rise to legal rights and are not enforceable in a court. These provisions are very old, and a new draft must necessarily reflect new perspectives on economic and social rights, including environment (Right to a safe and healthy environment) and sustainable development.

4. Conclusion and Recommendations

This study addressed issues relating to right to a safe and healthy environment in Sri Lanka and proved that the Sri Lankan Supreme Court has not properly addressed the right to safe and healthy environment. So that It is proposed to amend the existing Fundamental Rights Chapter of the Sri Lankan Constitution adding a fresh Article namely “**Right to a safe and healthy environment**” having considered most of the available related articles of the Conventions and some Principles which have addressed the

issues relating to right to a safe and healthy environment. The reason for considering most of the available articles of conventions and principle is to building a much useful article to the Constitution of Sri Lanka is that, Sri Lanka has signed and ratified some of the conventions I have addressed above. Some principles had been addressed and used to make judgments in Supreme Court, for instance, the *Bulankulame v. Secretary Ministry of Industrial Development* [2000] 3 Sri .L.R . The petition was filed by a group of person's occupant in Eppawela, North Central Province, challenging the government's decision to enter into an Agreement with Freeport Macmoran to mine a greater part of the rock phosphate in the area. All the petitioners argued that such mining affected their rights, their environment and the national interest. The respondents argued that the petitioners had no standing to bring such an action. Rejecting the objection, the court held that the petitioners had sufficient standing in a matter such as this as it affected their lives. In the judgment it is mentioned that "Access to information on environment issues is of paramount importance. The provision of public access to environmental information has, for instance, been a declared aim of the European Commission's environmental policy for a number of years. Principle 10 of the Rio Declaration calls for better citizen participation in environmental decision-making and rights of access to environmental information, for they can help to ensure greater compliance by States of international environmental standards through the accountability of their governments". Further, Sri Lankan government has primary obligation to respect, protect and promote the right to a safe and healthy environment of people living in the Country. Therefore, seeking the implementation of the right to safe and healthy environment at the domestic level is particularly important in order to make use of the proposed article.

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The causes of vaginismus and its management practices among middle-aged married women

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Abstract

Vaginismus is the body's natural reaction to fear of any kind of vaginal penetration. This problem may result in a woman's having difficulties getting pregnant and her accompanying sadness, which causes most couples to fight and bicker. These problems are leading to suicide among women and a desire to live alone. The aim of this research was to investigate the causes of vaginismus and suitable management methods to minimize vaginismus among middle-aged married women. Secondary data sources published between 2011 and 2021 were used. The mind map and the Saunders Investigation Design were applied to guide this study. The thematic analysis approach was used to examine ten research studies as part of the methodological option's qualitative study design. The main causes identified for vaginismus were fear, depression, insufficient or incorrect sexual knowledge, beliefs or negative attitudes, sexual trauma, sexual abuse, and organic diseases such as sexually transmitted diseases, endometriosis, hymeneal abnormalities, vaginal atrophy, postmenopausal estrogen deficiency, pudendal neuralgia, vaginal infections, and cancer. The management and treatment methods were couple counseling, dilator therapy, cognitive behavioral therapy, muscle and mind relaxation exercises, finger approach, following spouses' confident finger approach, attempting intercourse after 100 percent assurance, and health practitioner's assistance. The most effective methods were following a confident partner's finger approach, attempting sexual activity after being 100 percent confident, and receiving a piece of professional medical advice. In Sri Lanka, sex therapy is the most widely used treatment for vaginismus, and sexual phobia is its primary cause. Developing strategies to deal with women with vaginismus and conducting awareness programs for struggling couples to solve this matter have to be the top priority of relevant authorities.

Keywords: vaginismus, married women, middle-age

1. Introduction

Vaginismus is a type of genital problem caused by an improper tightening of the vaginal region muscle. It can lead to discomfort, vaginal relations troubles,

or even full sexual dysfunction, as well as the unwillingness to have a gynecological examination (Lahaie, Boyer & Amsel, 2010). Vaginismus may be brought on by an infection, a lack of understanding of vaginal anatomy, anxiety from pain, and extreme genital dryness. It can result from family issues, stress, and the inability to produce children. Due to the reluctance to discuss this subject openly, most couples are unable to identify the causes of vaginismus and give up seeking medical counsel or a cure. This study primarily examines the reasons, varieties, and therapies for vaginismus in married women in their middle years. Medical authorities must devise effective measures to address this problem and provide relevant embarrassing couples with the knowledge to overcome vaginismus, such as by organizing clinics, advising them to seek medical assistance, and suggesting stress-reduction techniques. Since this is such a private and sensitive subject, the research is reasonable. The public is ignorant of a critical issue that has resulted from most suffering women to do not healing, and they encounter several difficulties in life as well as psychological issues such as suicidal thoughts.

Zarski, Berking, and Ebert (2018) discussed that 60% of women said that the sickness had impaired their ability to enjoy life, indicating that it had a negative influence on their health and quality of life. It has also been linked to hopelessness and anxiety.

According to Saadat (2014), It is estimated that 1 to 17 percent of people worldwide experience vaginismus each year. Vaginismus is a common genital disorder that affects 1-7% of females worldwide. In healthcare settings across the world, it might range from 5% to 17%. In a 1990 study of Iranian women who frequent reproductive clinics, it was found that 8% of the population had vaginismus, 12% of women had it at least 50% of the time, and 4% of women had it constantly. A recent study of 22 Iranian women with vaginismus found that 73 percent of them have basic vaginismus.

2. Methodology

This research investigated the causes of vaginismus in married women and suitable management practices to implement by the Medical Officer of Health (MOH) to minimize vaginismus among married women. Moreover, this study analyzed the knowledge of the symptoms, types of treatments, and optimal therapies for overcoming vaginismus, as well as issues in their family lives and appropriate suggestions for married women.

The literary worked research methodology to gather the necessary journals and books, library publications, and databases to search prior literature, and the use of the Saunders research onion model to define the research design in six layers, including research philosophy, approach, method, strategy, time-

horizon, and data collection and analysis technique are all covered in the methodology of this research.

This study was created to achieve the research objectives as steps of literature assessing topic options, looking for citations in the literature, and the process of gathering, understanding, and analyzing literature. writing a review, references from previous research, and reporting magazines and newspapers. To examine the research objectives, published papers between 2011 and 2021 on the topics of “bio-psychosocial factors of vaginismus”, “vaginismus treatment”, and “effective management of vaginismus” were compiled as qualitative data.

A reviewed literature was important for growing a research plan, recognizing what has already been identified about a specific topic, identifying any knowledge gaps, and determining how the study could contribute to further awareness. It aids in the identification of gaps in the study, the introduction of a theoretical framework, the development of a conceptual framework, and the discussion of the results of a study. It aided in the development of a study topic (identifying what is already known and gaps in knowledge), the evaluation of findings (assisting in the identification of other study results that match up or appear to confirm the findings that differ, permitting the research to be placed in the field), and the acquisition of study results to conduct studies.

3. Results and Discussion

Fear, preconceived notions, a pessimistic outlook, bodily ailment, and sexual trauma are the causes of vaginismus. These factors make vaginismus worse in terms of severity. Some people have tighter muscles, more arguments with their spouses, and occasionally neglect their partners to avoid having sex.

Dilator therapy, sexual psychotherapy, and cognitive-behavioral therapy are all forms of treatment for vaginismus. In Sri Lanka, sex therapy is the most widely used form of treatment and sexual phobia is the primary root. Developing a program to combat vaginismus in women should be a top priority for the relevant authorities.

Women were more likely than males to believe that the vaginal opening was too small for entry (44% vs. 17% for women), that it was filthy (44%), and that childbirth (33%) was something to be feared (Gunasinghe, Gunaratna, and Silva, 2004). Fear and belief are the most typical contributors to vaginismus in Sri Lanka. Most women who accept marriage proposals are reluctant to have sex. Women are therefore unfamiliar with or distant from their relationships. She lacks feelings and is reluctant to mate because of this. She was in agonizing pain as a result of the decreased lubrication because she plans to have sex at any time. Some individuals believe that having faith will hurt like

having a sexual encounter; it will tear and bleed. Additionally, Sri Lanka has a higher prevalence of such characteristics.

Sexual abuse is the least significant factor contributing to vaginismus in Sri Lanka. Most parents worry about their kids, and many of them are quite close to their kids. Most children report abuse to their parents when they see it. He or she then makes the trip to the hospital for counseling and other procedures. Researchers claim that not every child resides with their parents. Many of them, though, are with their parents. In a typical circumstance, there is no way to sexually assault someone.

Couple therapy is also the most effective in Sri Lanka and it can help to identify the troubles having with a partner. If a person has erectile dysfunction and only the wife gets treatment, the vaginismus condition will never go away. In Sri Lankan society, most husbands do not want to allow their women to receive treatments alone, hence most wives accompany their husbands everywhere, especially to the doctor.

The least essential treatment is Fenton's repair, which accounts for 18.5 percent of the total in Sri Lanka (Gunasinghe, Gunaratna, and Silva, 2004). Among the three themes identified by the researcher, dilator treatment is the least important. Women in Sri Lanka who suffer from vaginismus fear entering the dilator and even the finger without training. They will require more time to heal from their fear after counseling or sex therapy.

4. Conclusion

Vaginismus is caused by fear, beliefs/negative attitude, organic disease, and sexual trauma. Treatments for vaginismus include dilator therapy, sexual psychotherapy, and cognitive-behavioral therapy. Sex therapy is the most common treatment and fear of the most effective cause in Sri Lanka.

Pacik & Gletta discussed that vaginismus is a prominent cause of unhappy marriages, resulting in marital problems, sorrow, loneliness, and the inability to endure gynecological examinations. Divorce is a common occurrence in vaginismus.

Gunasinghe, Gunaratna, and Silva (2004) introduced non-consummation induced by mild to severe vulvar spasms that can be treated with sex therapy. There is a need to educate medical practitioners, particularly gynecologists and primary care doctors, about the importance of sex therapy for treating vaginismus (Gunasinghe, Gunaratna, and Silva, 2004).

5. Recommendations

It is required to determine the sources of the vaginismus caused by fear or any other relevant factors by a health practitioner or MOH to encourage women and their partners to attend treatment or counseling sessions. It is important to aware people to get proper treatment methods by informing this type of issue to health professionals. MOH has a responsibility to conduct programs on couple counseling and therapies such as muscle and mind relaxation exercises and educate on finger approach and following a confident partner's finger approach. It is recommended to conduct more research studies related to vaginismus and related field which will affect the health of the community.

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Investigating the impact of hands-on activities of science subject on the performance of 07th grade students.

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Abstract:

This paper examines the impact of hands-on activities of science subject on the performance of 07-th grade students. Hands-on experiences have been defined as the instructional methods and activities that involve direct experiences which provide students with concrete learning opportunities as well as actively manipulating objects to understand their nature such as laboratory activities, simulations, experiments, and demonstrations. I have identified the problems faced by the students in science subject content during their reaching learning process using the following data collection methods observation method, documentation review, and semi-structured interview method. I wanted to investigate “how hands-on activities affect students’ science performances with interesting practical-based science education”. The specific objective of this research study is to promote practical-based science education and the general objectives are improving the engagement for the science period, create a positive network between teachers and students and develop performance regarding the science-based formative and summative assessments. In this research study, my students had an opportunity to manipulate hands-on activities to engage with the science subject content. Pre-state and post-state examinations and students’ work samples were used to record changes in the impact of hands-on activities in science education. At the end of the three cycling processes of this investigation, the mean score of the research study was changed from 1 to 8.94. Based on the discussion of the results and findings of the research in the implementation process, I conclude that practical-based science education can improve the students’ performances and make the classroom atmosphere more alive. Finally, from this study, it has been shown that it is possible to explore alternatives as this has enhanced the performance of students in the said task and exposed them to real materials used in learning scientific concepts. This has given birth to a new dimension to teaching less and learning more.

Keywords – Hands-on activities, teaching-learning process, performances of students, practical-based science education

1. Introduction:

Science is one of the most important subjects in the school curriculum due to its relevance to students' lives and also due to its ability of universally applicable problem-solving and critical thinking skills. These are lifelong skills that allow students to generate ideas, weigh decisions intelligently and even understand the evidence behind public policymaking. Teaching technological literacy, critical thinking, and problem-solving through science education gives students the skills and knowledge they need to succeed in school and beyond.

Contrary to what most people believe, hands-on learning is not a fad. In fact, it has been going on for quite some time now. In the simplest sense, hands-on learning is learning by doing things using motor and cognitive skills. It involves teaching the students how to observe everything around them, plan a process to test their hypothesis, put the process into motion, and drive it to successful completion. In the end, they should be able to explain the results they have obtained from the process.

According to the research topic, "Investigating the impact of hands-on activities of science subject on the performance of 07th-grade students" students in most schools usually showed little lower marks for the science subject. I want to study what are the reasons that affect those students on behalf of their science subject performance. As mentioned, the problem of engaging students in science has always been challenging and pressing. Even though engagement does not necessarily entail, or result in, understanding, especially when it comes to the case of learning science, engaging students in science is a prerequisite for understanding.

The general objective of this research is;

- To promote practical-based science education.

Specific objectives are;

1. To improve the engagement for the science period.
2. To create a positive network between teachers and students.
3. To enhance scientific literacy knowledge among students.
4. To develop performance regarding the science-based formative and summative assessments.

2. Methodology results:

In order to promote practical-based science education among 07th-grade students in respective schools, I implemented the classroom action research by using hands-on activities. Before going to the real research, I conducted pre-research to identify the students' problems during the teaching-learning process. The pre-research included interviewing the science teacher, and students, observing the teaching-learning process, documentation review,

and conducting a pre-state examination of the students. The observation aimed to gather information about the whole activities during the teaching-learning process by implementing the various hands-on activities.

Based on the pre-research findings, I started the research at school. The research was conducted in three cycles and the first cycle consists of three meetings and the other two cycles consist of two meetings. I conducted the pre-state and post-state evaluations from each cycle to identify the improvement of the students' practical-based science education. I have used quantitative and qualitative methods to analyse data in my action research. In this research study, I have used, **graphs, pareto charts, and pie charts** to visualize data as graphical representation methods and the mean of the pre-state and the post-state examination was calculated to represent the quantitative method.

After analysing the result from several sources of the data, such as the elicitation method, short note, written question, poster presentation, reflective form, group work, and the model papers, and also at the beginning and end, the score of pre-state and post-state examination papers, I obtained some findings which answered the research questions. At the beginning of the phases, they learned without any practical-based activities, but at the end, they got a fully practical-based science education. The mean score is increased from **1** in the pre-state examination under cycle one, to **8.94** in the post-state examination under cycle three.

3. Discussion and conclusion:

The findings of the research study have shown under the implementation process and as can be seen in the tables under each cycle, that hands-on activity could promote the students' science performances and the atmosphere of the teaching-learning process became more alive.

Besides, the atmosphere during the implementation of hands-on work also improved. The improvement could be seen in their active participation in answering questions (they looked more curious), asking the teacher if they got difficulties, paying attention to the teacher's explanation, and increasing their motivation to learn.

The process of teaching and learning became more communicative and learning anxiety was reduced. The students were not ashamed of asking the question from teacher and answering the teacher's questions. They also were active in discussing the experiment with their friends.

Based on the discussion of the results and findings of the research in the implementation process, I conclude that practical-based science education

can improve the students' performances and make the classroom atmosphere more alive.

Finally, from this study, it has been shown that it is possible to explore alternatives as this has enhanced the performance of students in the said task and exposed them to real materials used in learning scientific concepts. This has given birth to a new dimension to teaching less and learning more.

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Environment Management and Sustainable Development: A Case from a Manufacturing Sector Organization in Sri Lanka

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1. Introduction

Climate change and the global warming is a contemporary issue in the 21st century due to escalating greenhouse gasses emission and negative human interference. Co2 emissions from human activities, deforestation and use of fossil fuel which are threat to sustainable environment are some aspects. The continued CO2 emission leads to have disastrous effects on the global climate system. Thus, eliminating CO2 emissions, minimizing harmful environment activities, reducing negative man-made activities towards environment, enhancing environmental quality become the utmost priority to counteract climate change and global warming. Therefore, promoting environmental protection strategies is one of the important aspects to achieve sustainable development goals which emphasise on balanced economic, environmental and social development, was recognised in early 2000. Later in 2015, the UN officially accepted it, introducing sustainable development goals (SDGs), which have to achieve by its member states by 2030. Therefore, sustainable development strategies play a key role in the business agenda of both public and private entities of UN member states worldwide. This study aims to examine the corporate contribution towards sustainable development (SD) through environmental management of Sri Lanka in the context referring to the environmental management practices of a large-scale manufacturing company (referred to as INSEE) as a case study

2. Methodology

Primary data was collected mainly through in-depth interviews, observations, and field visits. In total, nine interviews were conducted with key organisational members who are in the top position in the decision-making hierarchy of the company and whose work is much sensitive to create environmental issues. They are Plant Manager, Environment and CSR Manager, Process Performance Engineer, Health and Safety and Admin Manager in Puttlam plant, site manager of mining site at Arruakkalu, site

manager eco- cycle plant at Katunayaka, Logistic operations manager at Peliyagoda warehouse, Company Communications and Reputation Manager and System Compliance Manager in Colombo office. Furthermore, the validity and reliability of data collected through interviews were confirmed during the field visit at Puttlam plant. We were able to observe the real operation process and its environmental impact. Further, the secondary data collected after reviewing the company website, handbooks, and other internal reports available at the plant site and the head office, and sustainability reports of the company and similar companies in the South Asian region were also used to confirm the findings. Thematic analysis based on Triple Bottom Line (TBL) was used for data analysis

3. Results

3.1. Sustainability Concern of INSEE

The cement manufacturing process generally creates many environmental and social issues. By understanding such problems, INSEE has formulated its processes under four main green concepts of sustainable operations; high quality products with low carbon footprint, sustainable construction with low social cost and process, production with green mark certification to minimise environmental and social issues while contributing to SD (INSEE sustainability report 2018). Company vision about SD is evident from the plant manager's view;

“Our effort is to minimise negative impact of our activities on the environment, facilitates to underprivileged people in our operation areas and contributes to economic development of the country in way of adding value to local resources; strengthen local supplies and contributing to macro level economic development”.

3.2. Environmental sustainability

According to the nature of the manufacturing process, the cement industry creates many environmental issues. But INSEE has taken significant steps to minimise its environmental problems. As per the INSEE sustainability report 2018 p.32 “we want to take definite actions to support the Paris climate agreement which aims to prevent the rise of global warming”. So, the company has incorporated its environmental management practices into business strategy, whereas environmental issues have been integrated into the decision-making process.

3.2.1. CO₂ Emission Control

Since INSEE has an utmost concern about how to reduce global warming, it has taken several steps such as upgrading combustion equipment, reducing

limestone contents, using substitute material and introducing sophisticated monitoring systems, etc. over the last few years (INSEE Sustainability Report, 2018).

3.2.2. Sustainable Power Consumption

The Cement industry is a high energy-intensive industry. Mainly coal is used at the Puttalam plant kiln which requires more than 1450°C to produce clinker, while electricity is used mainly for grinding and mixing process. In 2018, 125,434,477 KWh of electricity was consumed by the Puttalam plant and Ruhuna cement plants. So, the company has initiated several steps to reduce power and energy consumption and CO₂ emission.

3.2.3. Sustainable Water Consumption

As INSEE has remained conscious of water efficiency in the areas of its plant operations, the company's water resource management efforts mainly focus on the careful use of water resources, develop infrastructure for rainwater harvesting and investing in the effluent treatment plant (INSEE Sustainability report, 2018).

3.2.4. Circular Economy- Waste Management

Considering that INSEE is in the cement manufacturing industry, it does not generate any waste. But it provides the best solution to waste generated by most of the other industries in the country by collecting their waste and using them to generate power requirement of Kiln. INSEE is the only waste management service provider in Sri Lanka licensed by CEA for the handling and transport of hazardous waste.

3.2.5. Air Pollution Control

In general, the cement manufacturing process primarily generates dust emissions which may create many environmental problems such as air pollution and water pollution. So, INSEE has taken proactive approaches to ensure its processes operate with low dust emissions.

3.2.6. Environmental Conservation

INSEE is committed to environmental conservation in all aspect of its operations. Its main environmental conservation initiatives are bio-diversity

conservation, animal rescue program, coral reef restoration and restoration of a degraded fern land.

4. Discussion

4.1. Contribution for Environmental Sustainability (EnS)

According to the TPL concept EnS refers to the corporate contribution to enhance human wellbeing by protecting natural resources like minerals, air, water, land and entire ecological system (Klarin, 2018). Further, reducing the use of non-renewable resources (Dhahri & Omri, 2020), reducing CO₂ emissions and environmental pollution (Song et al., 2019), green production process to reduce ecological scarcity (Ucala & Xydis, 2020) are the other mechanisms to improve EnS which focuses on how business can operate while protecting physical environment and maintaining an ecological balance.

As study found INSEE maintain leadership status of environment management and it has ensured 100% compliance in all relevant environmental areas and the company has properly structured environmental management systems in every aspect of its operations while effectively contributing to control global warming through reducing CO₂ emission, providing sustainable solution for non-renewable energy consumption, water consumption, waste management, air pollution and maintaining bio-diversity.

4.1.1. CO₂ Emission Control

Reducing CO₂ emissions and environmental pollution in every aspect is important to achieve EnS (Song et al., 2019). The cement manufacturing industry is among the most energy-intensive industrial sectors and one of the largest contributors to CO₂ emissions and air pollution (Morrow et al., 2014). The global cement industry has released 5.1 billion tons of CO₂ into the atmosphere in 2018 (Arel, 2016), and it has a significant adverse impact on socio-economic development in the locality (Ince, 2019). As this study revealed, INSEE has a clear concern about reducing CO₂ emission in their production process. They were able to reduce 78-80% of clinker content, which mainly generates CO₂ using substitute material of fly ash, which does not generate additional CO₂ at their process. Currently, they operate with 573 kg CO₂/ ton of cement, which is the lowest level at the industry of the southern region. It implies that INSEE has made a momentous contribution to controlling global warming through reducing CO₂ emission of its operations.

4.1.2. Sustainable Power Consumption

The use of renewable energy may aid economic growth and reduce CO₂ emissions (Mahmood et al., 2019). Meanwhile, Dhahri and Omri (2020) have stated that replacing non-renewable energy resources with renewable sources is an effective way to achieve EnS. A study found that INSEE has been able to reduce coal consumption by 34% using alternative fuels such as biomass, garment waste, and seed materials. The company's target was to increase the proportion of alternative fuel mix up to 50% by 2022. So, it will help to reduce non-renewable energy consumption immensely. Table.3 shows the contribution for EnS through sustainable power consumption.

4.1.3. Sustainable Water Consumption

Scarcity of water will be a prominent environmental problem in the future. One of the key elements of SD is water security (United Nations, 2015). The relevance of water security coped with the global water crisis and urged water security as an overarching global goal (Zhu & Chang, 2020). As the environmental and CSR manager said INSEE has clear consciousness of water- efficiency, which is also evident from the sustainability report as they do water recycling, reuse water, and rainwater harvesting. According to the Sustainability report, 2018 and section 4.2.2.4 of the study explain that company effort to improve water- efficiency and sustainable water consumption policy.

4.1.4. Circular Economy- Waste management

A huge amount of solid waste collection and its treatment is a real environmental burden in every country (Seara-Paz et al., 2016). Since, at present, the cement industry worldwide uses municipal solid waste (MSW) as its energy generating source and substitute raw materials, it will provide the best solution to mitigate the solid waste burden (Carvalho et al., 2017). Findings of the study show that INSEE collects about 250 mt of MSW and industrial waste per day at their eco-cycle waste pre-processing facility unit and shredding facility unit at Puttalam cement plant. Furthermore, the study says INSEE, a socially responsible corporate citizen, plays a vital role in disposing of non-recyclable and non-degradable solid waste through its operating system providing sustainable solutions to the waste problem in Sri Lanka

4.1.5. Air Pollution Control

One of the crucial inherent environmental pollution factors with respect to the cement industry is air pollution through generated dust at the plant sites and neighbouring areas. According to Li, Zhang, Du, and Chen (2020), the

cement manufacturing industry is the second largest emitter of air pollution while Zhang et al. (2016) said the cement industry generates 5–7% of anthropogenic CO₂ worldwide with very high air pollutant emissions. So, with understanding, this situation INSEE has installed dust filters that absorb dust through bags and use other methods like dry fogging system, road watering, covering, and closed yards to reduce the dust. Consequently, its plant site's dust emission level at present is 1mg per cubic meter, which is much better than its standard of 293mg per cubic meter. It indicates that INSEE has made significant efforts to reduce air pollution to maintain a healthy environment at the workplace and surrounding areas.

4.1.6. Biodiversity and Environmental Conservation

Biodiversity and sustainable development are interrelated (Xu et al., 2020). So in 1992, more than 150 countries signed the Convention on Biological Diversity (CBD) as a common goal of conservation and sustainable use of biodiversity (Wang et al., 2020). Therefore, business needs to perform their operations preventing damage for biodiversity. But integrated cement manufacturing process heavily damage to biodiversity as it does mining to supply limestone requirement. However, the findings of the study reveal that INSEE takes substantial efforts such as environmental impact assessment and biodiversity mapping, including existing flora and fauna stock and special biological values before starting mining. Then after mining, the company rehabilitates all mining lands with the same soil layers, restores plants, bushes and flora, and maintains the ecological system and aquatic habits such as artificial wetlands and salt marshes, etc., while rescued and relocated animals reside at the quarry expansion areas.

When compared with the contribution for environmental sustainability of similar companies in the Southern region, mainly Lafargeholcim and Ambujha cement (INSEE sustainability reports, 2018), they also have taken the same kind of initiatives in different levels. This study found that INSEE is a responsible corporate citizen in Sri Lanka. It has taken generous voluntary initiatives as it contributes to preserving the environmental sustainability of the country, and outcomes of those initiatives are in line with the environmental sustainability pillar of the TBL.

5. Conclusions

The study has mainly aligned with three key pillars of TBL identified by Elkington, 1990 (Hammer & Pivo, 2017), principles of stakeholder theory as presented by Freeman (1984) (cited in Colvin & WittJustine, 2020), and UN SDGs. The study applied a qualitative methodology based on a leading cement manufacturing organisation in Sri Lanka (INSEE) as a case. The study aims to understand the main initiatives of INSEE for the SD of the country, to examine how these initiatives contribute to achieving micro and

macro level SD, and to examine its achievement of SDGs. INSEE mainly depends on the natural resources of limestone, which is extracted from the local area in which it operates. According to the nature of the operation process, it creates several environmental issues due to high CO₂ emissions, high power and water consumption, air pollution through dust, and damage to biodiversity, etc. However,, INSEE, a responsible corporate entity that has operated over many years in the country, has properly understood such adverse impacts and has formulated its strategies to overcome those issues.

Although INSEE operations heavily create many environmental issues, the company is able to control such impacts by implementing a strong environmental management system. Currently, company tremendously contributes to reduce global warming and climate change by reducing CO₂ emissions of 573 kg CO₂/ ton of cement which is the lowest level at the industry of the southern region in way of reducing coal consumption by 34%, reducing clinker mix in the product up to 78%-80% and using substitute material. Further, INSEE follows sustainable power consumption policy and sustainable water consumption policy through recycling and rain-water harvesting. Plant site dust emission level of INSEE is 1mg per cubic meter while it's standard is at 293mg per cubic meter. Moreover, the company has initiated environmental conservation projects such as bio-diversity conservation, animal rescue program in quarry sites, coral reef restoration, and restoration of degraded fern land in upcountry.

In conclusion, the findings of the study reveal that INSEE has significantly contributed to the sustainable development of the country in every aspect as an ethical corporate citizen while its activities have been directed and moving towards the achievement of SDGs by 2030.

6. Implications of the Study

Stakeholder theory has emphasised that when corporate entities operate in society as part of the wider social system, all possible stakeholders' expectations will be addressed reasonably. Consequently, corporate entities will be able to achieve micro level (organisational - economic) and macro level (social) development, which is broadly discussed as a corporate contribution for SD under TBL concept. So, this study aims to analyse how INSEE has been contributed to SD while satisfying stakeholders' expectations. Findings are in line with the stakeholder theory and TBL since INSEE has implemented several economic and social projects in order to satisfy all possible stakeholders' expectations while significantly contributing to SD of the country. Moreover, the findings of the study provide valuable insights to managers of INSEE to assess their own contribution for the SD and formulate new strategies to further improve the performance of the areas which have not been achieved so far. Similarly, findings of the study could be useful to managers of the other corporate entities since INSEE

plays a role model for the industry while significantly contributing to the SD of the country.

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Microfinance credits in Sri Lanka and its impact on livelihood development

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1. Introduction

Even in the 21st century poverty is one of the most server and contemporary problem in globally even in the developed high income countries. Thus policy makers and economists are still struggling to formulate appropriate strategies to ensure better and quality living standard of everyone. World Bank (2020) has revealed that 9.2 % of the world population (about 689 million people) in the world is struggled with extreme poverty in term of income less than \$1.90 per day. It implies those people don't have proper financial income to survive and accomplish even their basic needs and wants. As early researches reveled micro finance credit facilities largely contribute to reduced poverty level in world wide. So, most of the developing countries is currently adopting this strategy as a solution for poverty alleviation. In Sri Lankan context, micro finance facilities have extended to many SME sectors with the intention of improvement of such sectors while enhancing income of entrepreneurs and employees and get rid of poverty level exists in SME sector. This study is carried out to examine the impact of microfinance credits on livelihood development in Sri Lanka.

2. Methodology

As this study accommodates mixed methodology data is collected through both primary and secondary sources. Mainly interviews method is used to collect primary data whereas secondary data is collected reweaving prior research related to the microfinance discipline and browsing reliable web sites. Additionally published annual performance reports of the Ministry of Finance and Central Bank were also used. Although initially plan to conduct interviews with three managers banks of NSB, RDB and Sanasa in Gampaha branches and Director of Industries Department (Western Province).

3. Discussion

3.1. Micro Finance Industry in Sri Lanka at present

Sri Lanka and rest of the countries in the world, especially developing countries are recognized and highly accepted the role of microfinance and microfinance credit facilities in order to uplift living states of poor people and SME's performance. Microfinance system of Sri Lanka comes from last 4-5decadeds. In those periods Sri Lanka had a microfinance system called 'Cheetu' which is an informal approach. However it was an effective microfinance option in order to formulation of capitals, savings and enhance poor peoples' wealth and income (CBSL report, 2019). Since 1980s microfinance sector in Sri Lanka has been developed significantly and nowadays many financial entities have varieties of microfinance schemes to provide credit facilities for SMEs, small famers and low people. Most of the leading microfinance credits fronted by the government and private entities such as licensed finance companies, licensed banks, credit co-opertive societies and thrifts, co-operative rural banks, Divinaguwa banks and community based organizations NGOs and INGOs providing different kind of microcredit schemes like Ran Aswenu, Isura, Bhagya, Samurdhi banking scheme, enterprise Sri Lanka, Govijana banking credit scheme, credit scheme for women and business owners etc. These different microcredit sachems and entities have different approaches and models. For instance, Samurdhi microfinance facilities are operated as individual microfinance unites while Isura and Bhagya implement under intermediaries approach with the participation of development banks and commercial banks while SANASA is operated as village banking.

Even though there are many micro finance products are available in Sri Lanka some people like less educated background peoples, small scale business holders, famers and small groups are experienced many challenges and difficulties when access to formal finance entities. So still many of them are approach informal and unregulated micro financing sources (Chandrasiri & Bamunuarachchi, 2016).

In Sri Lanka, unregulated microcredit finance companies are illegal as they charge high rate of interest rates and transaction costs, unethical and distress recovery methods as well as due to low level of corporate governance. In some cases activities of unregulated companies may not be a solution to poverty alleviation and it may adversely affect poverty and cerate "credit trap" and distress situation. Moreover, unethical behavior of unregulated microfinance entities affects to loss of credibility of regulator sector, and ultimately adversely affect to economic development of the country. Therefore, the Microfinance Act, No. 6 of 2016 was enacted with effect from 15th July 2016. This Act provides licensing, regulations and supervisions of companies carrying on microfinance business and the Monetary Board the CBSL has empowered to regulate business activities all

licensed micro finance companies (LMFCs) in the county. Further this Act provides for the registration of Microfinance Non-Governmental organizations (MNGOs) registered under the Voluntary Social Services Organizations (Registration and Supervision) Act, No. 31 of 1980 as well.

3.2. Contribution of microfinance sector towards economic development

Micro financing is the most popular financing model in rural areas. Therefore, microfinance sector in Sri Lanka plays a vital aligning with economic growth, employability, inflation and economic-social welfare and shows an incredible growth during the last few years. So, it is an effective tool for reduction of poverty in low income families in rural areas as it's contribute to the growth of rural sector. Meanwhile, economic expertise said that in developing countries like Sri Lanka micro financing is an effective approach to eliminate poverty while toughen up social well-being. Therefore different government came to the power in time to time they implement different types micro financing programs focusing rural development. 2018 government introduced two main new programs namely, Gamperaliya and Enterprise Sri Lanka intention of achieving economic growth and to increase per capita income to 5000 USD while generating one million of new job opportunities, increase GDP more than 5 percent and increase exports strengthening micro enterprises, SME sectors, young enterprises and self-employment (MOF, 2018).

In 2018, there were approximately 230,000 entrepreneurs and SMEs in Sri Lankan employing 2.8% of total workforce. So, government intension was to generate 100,000 new entrepreneurs and expand existing entrepreneurs business. Therefore government has introduced 22 new microfinance sachems such as 17 subsidiary loans, 3 donor finance loans and 2 non-financial loans facilitating low income people with the intension of reducing poverty through self-employment in SMEs like fisheries, potteries, handicrafts, traditional masks, agriculture, floriculture, wood based products and tourism. Summary of micro financing programs carried out by major microfinance institutions in 2017 and 2018 shows in table 01.

Table 01: Summary of Micro financing programs Loan Portfolio in 2017 and 2018 (Rs. Million)

Microfinance Institute	Total Loan Portfolio in 2017	Total Loan Portfolio in 2018
Department of Divineguma	54,547	68,206
Department of Co-operative Development	75,281	72,788
Department of Agrarian Development	1,452	2,122

Regional Development Bank	128,343	135,442
Lankaputhra Development Bank	3,965	3,690
Total	263,588	282,248

Source: Department of Development Finance performance report 2017-2018

The total value of works completed under Gamperaliya program as at 31st December 2018 is summarized in table 02.

Table 02: Progress of the Gampareliya Program - 2018

Province	Total value of completed works (Rs. Million)	No. of projects fully completed
Northern	715.65	973
Southern	474.32	900
Eastern	1,135.01	985
Western	498.93	819
Uva	691.06	906
Central	514.34	931
North Western	615.08	1,241
North Central	88.30	111
Sabaragamuwa	336.88	371
Total	5,069.57	7,237

Sources: Gampareliya Secretariat

In addition that during the year 2018, loan amount to Rs 76 billion disbursed to the microfinance sector through the SANASA Bank (Rs. 47 billion), HNB and BOC (Rs. 13 billion and Rs. 6 billion respectively) while Commercial Bank and Seylan Bank also significantly contributed to microfinance portfolios providing various microfinance programs.

Additionally, under the Enterprise Sri Lanka program numbers of microfinance loan schemes have been introduced to enhance SMEs and poor peoples in order to reduce poverty and uplift their lives. They are;

- Ran Aswenna – benefited to small scale farmers and business, commercial farmers, floriculture famers and entrepreneurs in fishery industry
- Govi Navoda – SME famers
- Diri Saviya –self-employees and entrepreneurs in animal husbandry and poultry sector
- Jaya Isuru – SMEs such as handicrafts, pottery, wood crafts, fisheries, livestock, agriculture, timber based business, masks, clothing, ornamental fisheries, horticulture, printing, light engineering etc.
- Green loan – fertilizer producers and small scale hotels
- Rakawarana – small scale child care and elder care owners
- SMELoC (SME line of credit projects) – SME entrepreneurs

- NCGI loans – SME entrepreneurs
- SME companies – youths, famers, self-employees, women and who are investing to establish SMEs

(MOF Report, 2018)

Moreover, government and private banks have been implemented more than 60 loan schemes to for the benefits of poor peoples, SMEs and famers etc. in order to fulfill SMEs needs as well as to enhance income, wealth and business of them as summarized in table 03.

Table 03: Loan facilities to SME by government and private banks from 2018-2010

Bank name	2018/19		2019/20	
	No of beneficiaries	Total amount (Mn)	No of beneficiaries	Total amount (Mn)
BOC	498	2254.70	596	275.2
People's bank	206	1436.72	284	2014.8
RDB	880	2186.15	1185	2763.8
DFCC bank	214	2894.93	244	3370.6
Sampath bank	127	2190.49	158	2725.4
HNB	221	2907.73	257	3382.0
Commercial bank	153	2261.73	186	2779.9
NDB	341	4005.54	386	4413.6
Seylan bank	73	1134.18	93	1636.7
NTB	84	1497.33	102	1810.6
Total	2797	22,769.50	3491	27,682.4

Source: MOF Reports, 2018/19 and 2019/20

In 2019 due to negative growth rate and complicated tax system SMEs were experienced to serious issues. So, supporting to SMEs and poor people CBSL and MOF has implemented different financial assistance programs, SME loans, refinance scheme such as Saubhagya like Enterprise Sri Lanka. However, according to the MOF and CBSL 2019 reports, Enterprise Sri Lanka was not a successful microfinance project. But in end of 2019, government has provided Rs.88, 270.5 Mn loan to SMEs through this project.

3.3. Poverty level of Sri Lanka

As a country Sri Lanka has able to reduce its poverty level significantly through implementation of effective poverty alleviation programs. But according to SDGs alleviation of poverty is still remaining. According to the available statistics population percentage below national poverty is declined

from 15.2% (2006/07) to 4.1% in 2016 (Figure 01). Gender and age wise poverty pattern is presented in figure 02. Furthermore poverty among children is comparatively high to adults. Since the Sri Lanka is a well concern about citizens' social well-being; social protection is the major key of diminishing poverty in the country. Approximately, about 34% of Sri Lankan get benefits and rewards from social programs, insurances and microfinance credit schemes. According to the World Bank Global Finance (2015) has showed that 82.7% of adults have access towards financial entities which means Sri Lanka is stated in high level of financial entities access when compare to other South region countries. When considering area wise Colombo poverty percentage is 0.9% while Killinochchi has 18.2% (IPS, 2016).

According to the SD report (2020) poverty reduction is a contemporary issue in Sri Lanka. However Sri Lanka has showed significant development towards reducing poverty. People who are survival with less than \$1.90 per day have declined to 0.27% in 2020 from 2% in 2010. SDGs target is to reduce it up to 0 values in 2030. Due to social support such as financial supports, microfinance credits and considering social well fare of citizens Sri Lanka could able to reduce to 0.27% while other South region countries are at high level of percentages. However people who are earned lower than \$3.20 per day scale has reduced from 7.96% in 2020 to 20% in 2010. But has to be reduced to value of 0 in the long term (Cuaresma et al., 2019).

Figure 01 shows the poverty headcount index with regarding to national poverty line of Sri Lanka.

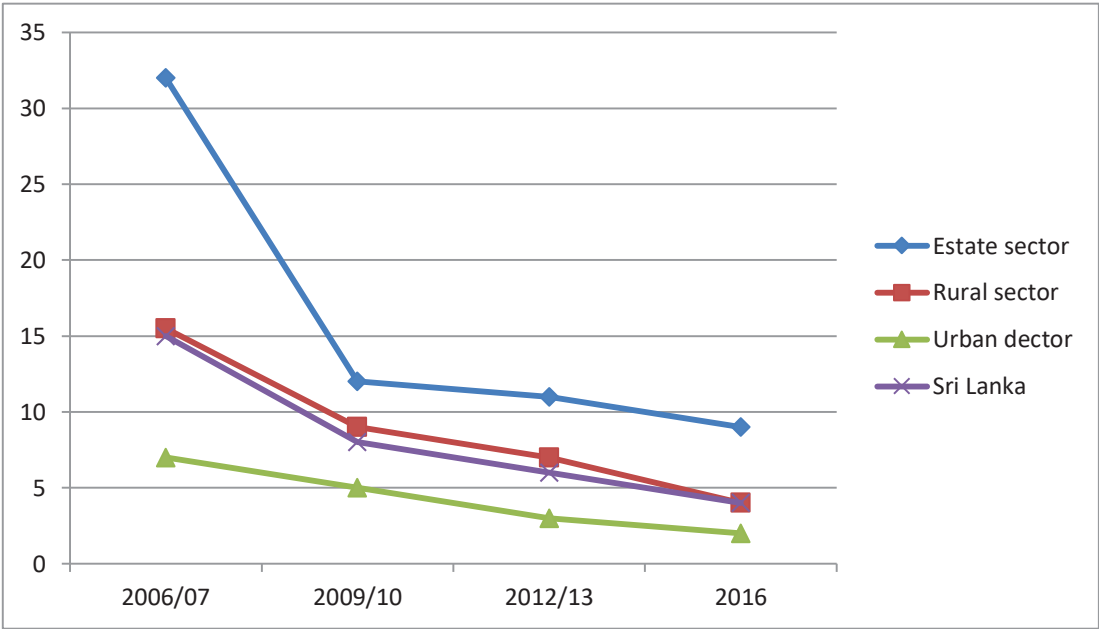


Figure 01: Poverty headcount index

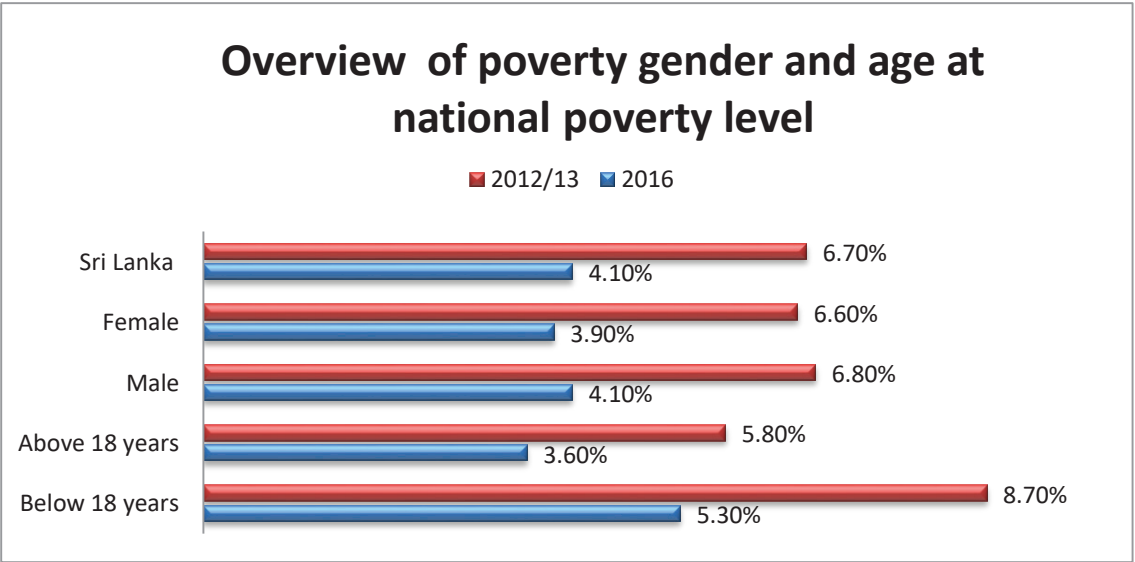


Figure 02: Overview of poverty gender and age at national poverty level

3.4. Achieving Sustainable development goals (SDGs) through microfinance credit facilities

As a UN member country Sri Lanka opted to achieve SDGs by 2030 including eradicate poverty, good health, equality, quality education etc. UN SDGs is directly facilitated to enhance social, economic and environment aspects in the country (Maps approach, 2018). Sri Lanka has currently achieved up to certain extent some SDGs such as quality education, health and eradicates poverty.

Since micro finance credit facilities may help to develop SME and micro sector industries which promote entrepreneurship and provides more employment opportunities compare to large scale industries and self-employment opportunities it may benefitted to vast group of low income people even in rural areas increasing of their income. Consequently, it may help reduce poverty level of the country and achieve zero hungry goals through empowerment of the people and reduce income inequality. Furthermore, increase income level of poor people enhances their living and social statues while it leads to improve quality of life and education as well. In that scene micro finance credit facilities ultimately affects to reduce poverty and achieve sustainable development goals as shown in figure 03.

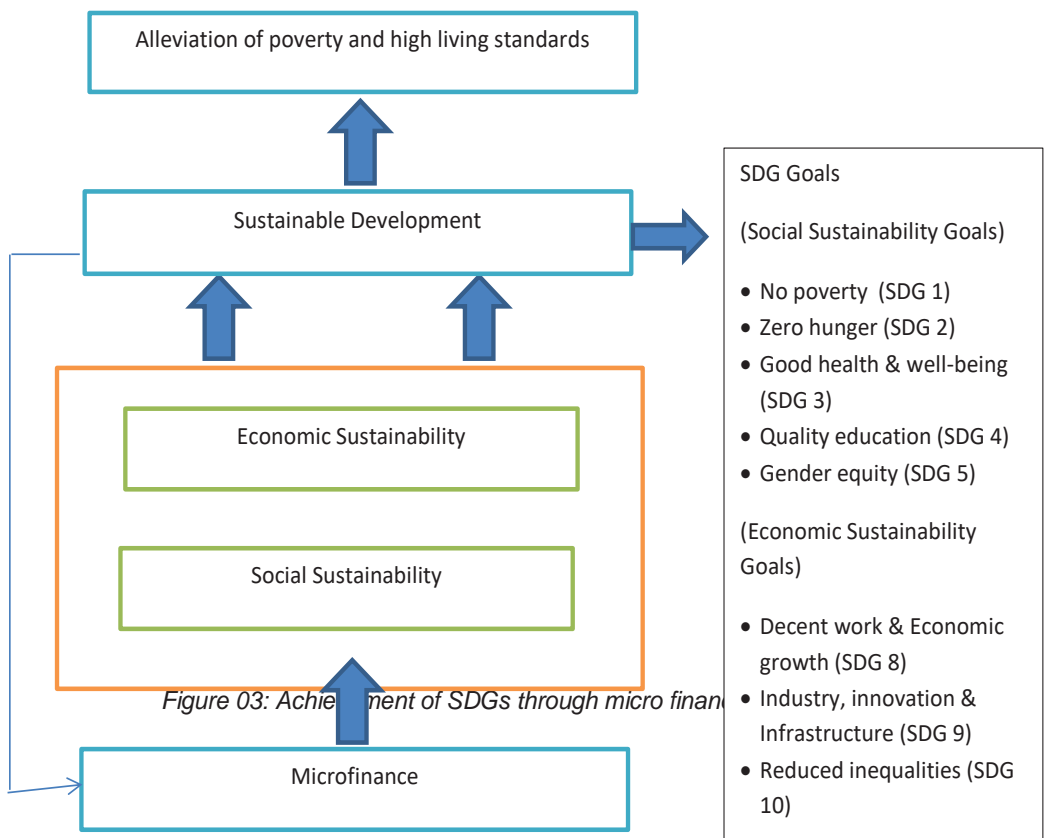


Figure 03: Achievement of SDGs through micro finance

4. Results

Data collected through primary and secondary sources reveals that micro finance schemes benefited to SME sector in worldwide in border range especially as a tool to reduce poverty through empowerment of small scale entrepreneurs and enhancing income level of them.

When it examines the impact of micro finance credit facilities to reduce poverty in the pottery industry of Sri Lanka can be discussed as follows.

1. Household income

Through microfinance credit facilities, entrepreneurs in traditional pottery industry can develop their industry and with quality improvement they will be able to capture approach modern market even export market. On the other hand with the technological adoption they will be able to operate with high efficiency at low cost. Due to low interest rate of micro finance loan profit margin of the business will be further increased. Consequently house holder i.e. pottery makers income could be gone up. In parallel to that consumption range of them and households savings will be increased while it will help to diminish vulnerabilities come across of income deficiencies in the future. Increase of income leads to enhance education quality among children in their families.

Circulate more money to fulfill requirements are so on. Expansion of money inflow of householders is the desirable outcome. Enhancing inflow money of household would be marginal benefits than previous status. Therefore, improvement of household inflow money circulation is the major aspect in order to eradicate poverty and lightning up poor people's lives are the dominant intension of microfinance credit schemes.

2. Household's expenditures

Expenditure in household is most sensitive aspect as poor people are struggling in order to fulfill their daily requirements. As results of the increase of income from their industry with the support of microfinance facilities, households are in a position spend more for their daily needs than previous. So they can increase consumption expenditure and pattern and expenditure on other activities. Finally, high income could facilities for high standard of living. Thus microfinance credit would lead to strengthen the expenditures of households in pottery industry.

3. Household assets

When people having excess or high stable income flows they encourage accumulate household assets. Since microcredit would help to increase their cash inflows they may purchase movable and immovable properties to maintain social statues. As respondents said many people in their village have constructed new houses while some others have purchased three wheelers which they did not possess previously. Some other pottery makers have purchased vehicles like tractors or small lorries to facilities to their industry.

4. Household vulnerabilities

Low income people have suffered from uncertainty and risks from society, uncertainty of future, children's risk even from natural weather conditions. So basically microfinance would help to improve infrastructure while saving money to re-use in future betterments of them. As a result of the increase cash inflow due to development of their industry with the support of micro finance pottery marks' level of savings will also be increased. So it would be opportunity to mitigate future vulnerabilities which they faced.

5. Women empowerment

One of the aims of the microfinance credit schemes is empowerment of woman community extending its facilities. Researchers found that women's repayment is much better than men's thus microfinance entities encourage women to borrow money and improve women's well-being on behalf of their husbands if she is married. Furthermore, it believes that there's high positive improvement of social welfare from women. Similarity through the micro finance facilities extended to the pottery industry would positively affect to empowerment of woman this industry.

6. Gaining new employment opportunities and training

Apart from the financial facilities provide through micro finance scheme it organizes training programs for the identified beneficiaries. Likewise, Production and Training Centre of Clay Articles situated in Bandarawatte, Biyagama provides adequate training for the pottery makers in the Gampaha district. So they would be able to improve their technical knowledge to operate modern equipment use in the industry and marketing training to identify new market trends and marketing strategies. So ultimately microfinance credit facilitates may leads to enhance quality life and diminishing poverty of its beneficiaries.

5. Conclusions

Study reveals that microfinance credit facilities would positively affect to uplift the livelihood of the people who living in rural areas of the country wider aspect. Mainly such facilities would help to increase their income, accumulate wealth, and enhance the level of savings and expenditure capacity while improving lifestyle and well-being. Further, study reveals that microfinance credits would help to protect their business and develop its products up to export quality while uplifting their income, living and social status. Besides, it enhances women involvement in different industries by empowering them. Ultimately results of all these outcomes of microfinance facilities will be linked with the achievement of Sustainable Development Goals. Ultimately micro finance credit facilities will be helped to reduce poverty level of the people in the industry and certain SDGs with in the stipulated period of 2030.

So, the findings of this study can be used as guidelines for policymakers and corporate managers. Further, researchers and academics can use the findings of the study to understand the extent and different efforts taken by Sri Lankan government to uplift people's livelihood. Since this study is mainly based on secondary data and few interviews data, it is need to conduct a comprehensive study covering a large sample from small and medium entrepreneurs in different parts of the country and policymakers in different government and private entities, banks and other micro financing institutes and NGOs involved in the industry to understand the real impact of microfinance credit facilities as a mechanism to develop livelihood.

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Implementing Sustainable Construction Techniques In Concrete Roads To Improve The Business Performance Of Sri Lankan Turbulating Market

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Abstract

Currently, as Sri Lanka is gradually moving into the upper-middle-income category. The rate of growth in the country's transport demand is outpacing its GDP growth. Most are provided by the Road Department. The aim of the research is to the implement sustainable construction techniques in concrete roads and improve the business performance of Sri Lankan turbulation market the objectives are 1) Identifying the major issues affecting the failure of concrete road construction. 2) Critically review the top five factors through secondary research studies and expert ideas. 3) Appraising innovative and sustainable techniques for the improvement of concrete roads in Sri Lanka. This study uses a literature review method, with a detailed review of both academic and practical articles, and prospective applications in the implementation of sustainable construction techniques in concrete roads to improve commercial performance. A key word is used to narrow the focus of the investigation in the initial part. Google Scholar and Scopus searches were performed and we summarize and elaborate the results we obtained from the case studies. According to previous studies, demand for transportation carried approximately 95% of passenger traffic and 97% of freight in 2012; the rail network carries only 5% passenger traffic and 2% freight; water systems carry only 1% of all inland cargo. In addition to that, Sri Lanka has a road network of 116,000 kilometers with the current density of 1.7 km roads per square kilometer landmass. It is a huge scale compared to its regional counterparts of Sri Lanka. -However, Sri Lanka's local authorities are responsible for the administration of 56% of the road network. Nine provincial councils are responsible for the administration and management of provincial roads. Thus, provincial councils and local authorities govern the majority Road network. In Sri Lanka, it normally costs about 22.3 million to build 1 kilometer of concrete road. The lifespan of concrete road is 25 to 35 years. But many concrete roads last only 3 to 6 years due to corruption and lack of proper maintenance. As a result, Sri Lanka faces a massive economic downturn with the construction of new roads in a short period of time. The main objective of this study is to increase the lifespan of concrete roads with the implementation of sustainable

techniques, eliminate corruption in the sector, remove the cost of road rehabilitation and to control the amount of money spent on road development by half to build up the country's economy.

Keywords: Sustainable construction techniques; Business performance in Sri Lanka; Construction techniques in a tabulating market; Transportation techniques in Sri Lanka; Sustainable Road construction.

1. Introduction

Currently, as Sri Lanka is gradually moving into the upper middle-income category, the rate of growth. The country's transport demand is outpacing its GDP growth. Most are provided by the Roads Department This demand carried approximately 95% passenger traffic and 97% freight in 2012. Degradation As a result of the rail sector, the rail network carries only 5% passenger traffic and 2% freight. Water systems carry only 1% of all inland cargo. This is largely due to the importance of the road sector significant share of national resources allocated to road network in past decades. Sri Lanka has a road network of 116,000 kilometers. of Sri Lanka The road network is classified into national, provincial, divisional council, local authority roads and constructed roads. 12,380 km of national roads Administered by the Central Government through the Road Development Authority (RDA) Company. Nine provincial councils are responsible for administration and management Provincial roads. Thus, provincial councils and local authorities govern the majority Road network. This part of the network is mainly located in regional areas and provides access. In Sri Lanka, it normally costs about 22.3 million to build 1 kilometer of concrete road. The lifespan of this concrete road is 25 to 35 years. But many concrete roads last only 3 to 6 years. A major reason for this is the problem of corruption and lack of proper maintenance. As a result, Sri Lanka is faced with a massive economic downturn with the construction of new roads in a short period of time.

The main objective of this is to increase the lifespan of the concrete road by more than 30 years by implementing such techniques, eliminate the corruption in this sector and create a new project, eliminate the cost of road rehabilitation and thereby reduce the amount spent on road development by half and build the country's economy.

2. Literature Review

2.1 Dominance of foreign companies

Historically, Sri Lanka has developed craft-based construction technology that has evolved from over 2000 years of experience. This level of technology was sufficient to meet construction needs even in the post-independence period. However, large-scale rapid development projects such as large-scale road reconstruction works; Demanded a high level of technical input. Local industry is not fully prepared to meet this increased

technological demand; Some large-scale construction projects were undertaken by foreign contractors due to lack of technological development, knowledge and transfer.

Example: CML-MTD Construction Limited.
China State Construction Engineering Corporation Ltd.

table 2.2.1: proof for taken road projects foreign company

Source: ©2022 | Integrated Road Investment Program (iRoad)

name of the Contractor	Package No.	Contract Amount (LKR)	Contract Amount (USD)	Road Length (Km)	Agreement signed Date
CML-MTD Construction Limited	MO-04	2,274,491,009.64	12,706,653.69	65.78	8/5/2018
CML-MTD Construction Limited	BA-03	2,458,963,395.33	13,737,225.67	83.53	14-05-2018
China State Construction Engineering Corporation Ltd	JF-03	3,350,157,507.60	18,715,963.73	71.81	28-09-2019
China State Construction Engineering Corporation Ltd	VA-04	3,733,169,368.08	20,855,694.79	100.31	8/11/2019

2.2 Using improper mixing ratio for concrete roads

In normal conditions, Contractors do the manual mixing as per their wish and decreasing the height of the concrete road for their profit and economic benefits. This is one of the worst cases for implementing the sustainable concrete roads which can stand for more than 30 years. As a result, the road is disrupted and the road is broken in a short period of time and then rebuilt again in a short period of time, thus Sri Lanka faces huge losses and economic collapse in the country.



2.3 Competitiveness in government tenders

In Sri Lanka, normally government distribute their road projects for different construction company by calling tenders. As a result, low cost estimated companies will get the tender in low bidding and they will do the projects. Even though, contractors got the project in low bidding they expect profit from the project total amount. Do, they will use low quality materials and it will lead the concrete roads in unsustainable way.



2.4 Involvement of unskilled workers.

The construction sector suffers from a lack of adequate professionals, low skill levels of fresh graduates and a skilled labor force. High demand for professionals in many countries and low salary scales in the local industry may reduce the number of professionals retained in the local construction industry. This problem is not limited to the local industry but is a common reality in many developing countries. Also, less than 4% of the workforce in Sri Lanka is formally trained and carries certifications indicating their skills. Low skilled workers may be due to many reasons such as lack of training opportunities provided by companies and lack of comprehensive training courses, skill development short courses and individuals not interested in attending such courses, lack of knowledge about new technologies. As a result, they are unaware of the impact of quality degradation due to lack of knowledge about it and do not know how to incorporate new technologies. As a result, they may not be able to build quality roads.



As a result, the country's economy goes to other countries and Sri Lanka easily adapts to the economic downturn.

At the first International Conference on Sustainable Construction in Tampa in 1994, Charles Kibert put forth the initial concept of sustainable construction as “sustainable construction is the creation and responsible management of a healthy built environment based on resource efficient and ecological principles” (Kibert cited in Murray and Cotgrave, 2007, p.13). Later, Plessis provided a clear description of sustainable construction in the Agenda 21 discussion document for sustainable construction in developing countries in 2002. He did so by eloquently articulating the sustainability picture as; “sustainable construction is a holistic process aiming to restore and maintain harmony between the

natural and built environments, and create settlements that affirm human dignity and encourage economic equity” (Plessis, 2002, p.8). As a result, this definition of sustainability introduces the concept of environmental restoration, going beyond the preceding definitions' implied emphasis on minimizing negative effects.

Most research on the sustainable development of construction projects tended to concentrate more on the environmental considerations as compared to social and economic considerations. Generally speaking, the environmental component of Priority has been placed on sustainability, which is typically considered before the economic and social factors in building initiatives [2, 3]. This is due to the need for businesses to adhere to environmental rules. comply with legal requirements [1]. Considering, for instance, state and federal regulations on wetlands preservation the highway agency will have to create a highway with the aim of preventing historical site deterioration. minimizing the effects of the environment on such wetlands. This may incur additional expenses (taxes) and result in causing disruption to the areas where the motorway will be redirected.

3. Methodology

Using a literature review methodology, we looked at both academic and practical articles and prospective applications are comprehensively reviewed in implementing sustainable construction techniques in concrete roads to improve the business performance. A keyword was used in the initial part of the investigation to narrow its focus. Google Scholar and Scopus searches were done.

Besides, publicly available applied publications such as technical white papers, and other commercial web pages were reviewed to identify implementing sustainable construction techniques in concrete roads to improve the business performance.

So, we have mainly focused on the case studies for this and we are summarizing and elaborating the results what we have got from the case studies

4. Results & Discussion

Currently Sri Lanka is developing country which is not stabilized in economical way. From the research approach we have found that implementing sustainable construction techniques in concrete roads is crucial one to improve the business performance of Sri Lankan tabulating market. So, we have identified some factors which are need to be change and which need to be improved for the sustainable construction techniques.

4.1 Provide ready mix concrete for concrete roads

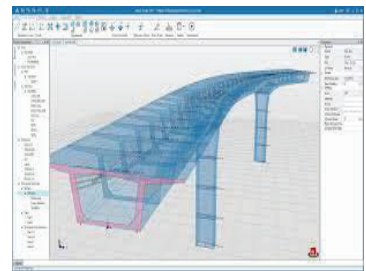
The main reason many roads fail in a short period of time is the poor quality of the concrete mix. By setting up ready mix concrete base in many areas and using only ready-mix concrete mixture for local roads by approving it through the government authorities, corruption can be eradicated on a massive scale and roads can be created which can last longer than 30 years in a sustainable manner.



The use of instant mix in concrete road works may also be preferred through contracts in this regard. But in this case the relevant mixing agents must obey the mixing ratio.

Using BIM-Building Information modelling in the concrete road project.

Current era is knowledge explosive area which is fulfilled by modern technologies and concepts. So, we can use modern concept like BIM in our construction work. Building information modeling (BIM) is a comprehensive method for producing and managing data for constructed assets. A digital representation of an asset across its lifecycle, from planning and design to building and operations, is produced using BIM, which is based on an intelligent model and supported by a cloud platform.



The benefits of BIM include greater accuracy in reducing errors during construction, reducing manpower requirements, and reducing wastage of money. Misreading of design documents is a well-known problem occurring on site and is a solution to many such problems and contributes massively to sustainable construction.

Using AI based system structural design for road projects

Reinforcement is the very important part in making the sustainable concrete roads. Because they are giving more strength for the concrete mixture and it helps to increase the sustainability of the road. So, the proper quality materials are needed to make the sustainable roads and, at the same time the reinforcement materials should be designed in a way which can



sustain more force on them and giving more strength to the concrete mixtures.

Further Steel's tensile strengths are depending on the diameter of the steel rod. So, for the sustainable works we have to choose proper diameter rods.

Also, we can design an AI based system to design very precise and strength design by inputting soil type, material type what we use and other environmental factors to improve our sustainability of the road.

Assign the contractors as Maintenance to the Concrete Road works.

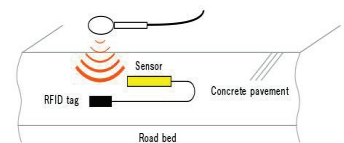
In Sri Lanka normally most of the constructors are doing the contract and their job is done after completing their project. Once the project is completed maintenance are done by RDA and Municipal authorities. Hence, even though the contractor made poor quality and unsustainable roads, unwanted maintenance cost need to be bear by Clients. This is one of the lacking systems that we have.



If we make the contractors as a maintenance officer then we can guarantee their works since the contractors not likely to bear the unwanted exceed money for maintenance.

Assign RFID and GPS system to assess the road projects

Numerous structures in civil engineering are composed of reinforced concrete. The majority of this material's degrading processes, like corrosion, are linked to a higher amount of material moisture. As a result, it is thought that a key technique for assessing the structural health of reinforced concrete is moisture monitoring. In this investigation, passive RFID-based sensors are incorporated into the concrete. They are ideally suited for decades of continuous use and properly shielded from harsh environmental elements. RFID is used to power the humidity sensors and communicate data to them. The sensor housing materials are strengthened to endure concrete's highly alkaline pH values of above 12.



In order to find materials that can enable the transfer of water vapor from the porous cement matrix to the embedded humidity sensor, membrane materials are also being studied. The cement hydration is tracked for 170

days by detecting the matching relative humidity with implanted passive RFID-based sensors. Additionally, long-term moisture monitoring is carried out for over a thousand days.

Soil stabilization at low cost.

In general, rigid pavements are not the same as flexible pavements because rigid pavements act as aggregates and absorb the load of vehicles instead of transmitting it into the ground like flexible pavements. Thus, it helps to reduce the cost by using perma-zyme chemical fluid without spending massive amount of filling its base with aggregate base course (ABC) and also helps in laying a concrete road.

Perma-Zyme is a proprietary concentrated liquid multi-enzyme formulation. It changes the properties of the earth, creates better road base stabilization, perma-zyme reduces the surface tension of water and promotes rapid infiltration and dispersion of moisture. This action causes the hydrated clay particles to pressurize and fill the voids throughout the soil, thus creating a tight, dense permanent layer. Perma-Zyme is a compacted permanent foundation highly resistant to water penetration, rutting and washboarding, weathering and wear. The procedure usually takes two days, with full recovery in 72 hours.



One gallon of Perma-Zyme is 165 cubic yards of stabilizing base material and 15 gallons of Perma-Zyme is 1.61 cubic yards. , 7.62m wide, 152.4mm deep dirt road. Developed and proven. Through years of field testing, Perma-Zyme offers road builders, communities and more. Non-toxic, non-corrosive and environmentally safe.

5. Summary

The results obtained from this study clearly show that the government reached economic collapse in financial crisis due to poor quality of road reconstruction and re-construction of roads due to lack of corruption. Quality is the most important thing that management should consider in any sector because it has a great impact on the development of the country. Due to the poor quality of road reconstruction, it begins to deteriorate within a short period of time and thus the road needs to be reconstructed again. As a result, there is a lack of technology, so it is not better to give work plans to foreign companies, but to develop new technology and give work plans to domestic companies and get certification from them, and by handing over the maintenance period of the road to that company, the life span of the road can be increased.

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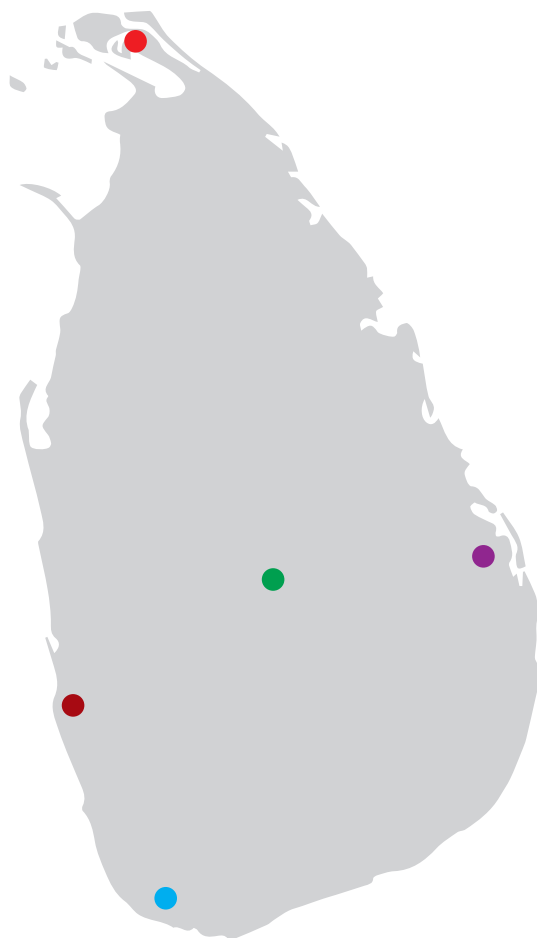
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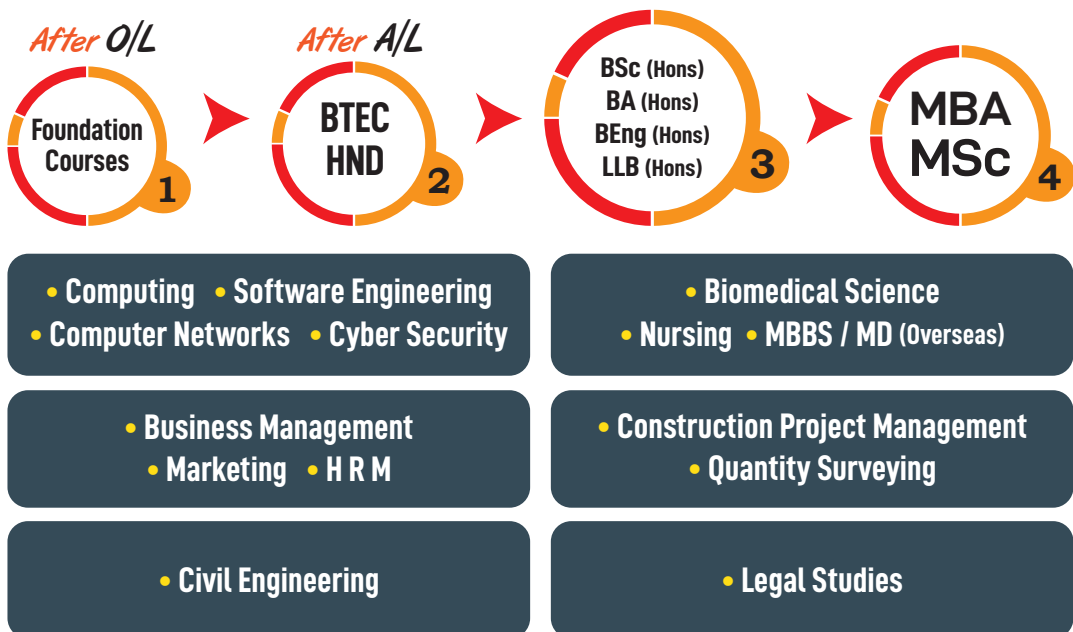
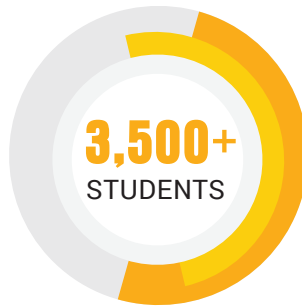
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