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# A CORPUS-BASED CRITICAL DISCOURSE ANALYSIS OF THE 2015 PRESIDENTIAL ELECTION NEWS IN SRI LANKAN ENGLISH NEWSPAPERS: *'THE SUNDAY TIMES'* AND *'THE SUNDAY OBSERVER'*

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## 1.0 Abstract

*"A Corpus-based Critical Discourse Analysis of the 2015 Presidential Election News in Sri Lankan English Newspapers: 'The Sunday Times' and 'The Sunday Observer'"* is a study which was done in order to identify the elements of stance in the news reports of Sri Lankan English newspapers about the 2015 presidential election in Sri Lanka. This was done by using corpus-based linguistics tools to analyze the data downloaded from the online editions of two Sri Lankan English newspapers. It also involves a description of the Sri Lankan political history and particularly the 2015 presidential election. The WordSmith 5 corpus linguistic tool was used to analyze the data downloaded from newspapers and British English 2006 (BE06) corpus was used as the reference corpus of the study. The analysis of data was done with an exploratory process of identifying topics and themes in the main corpus of the study, Sri Lankan Presidential Election Corpus (SLPEC) by comparing it with the reference corpus. The topics generated include the ones related to politicians, political parties, electoral process as well as security. A keyword analysis and a concordance lines analysis of a number of selected keywords of the two newspapers were done in order to search for evidence of stance. It is discussed in detail about the main finding of which is, identifying that the newspapers have presented their attitudes, ideas and feelings about the 2015 presidential election by using the linguistic mechanisms. Finally, it is discussed about the contributions and suggestions for future studies.

## 2.0 Introduction

### 2.1 Purpose of the study

This is a study which examines the newspaper reports of the 2015 Presidential Election in Sri Lanka with regards to the way that language 'is employed, often in quite subtle ways, to reveal underlying discourses of ideologies' (Baker, 13). The discourse of political news reports is particularly interesting since it can be used to illuminate the relationships and power structures that exist between the members of the society. Through this study, I focused on the attitudes of these two newspapers about the issues raised in my main corpora and I looked for evidence of stance to foreground that. The main objective of this study is to look at how language is used in news reports relating to the Sri Lankan political setting. It is particularly concerned with looking at the issues of political stance in the texts towards individuals or groups, participated in the 2015 presidential election in Sri Lanka. Corpus linguistics theory combined with critical discourse analysis methodologies is used to carry out an empirical of how the 2015 Presidential Election was reported in the Sri Lankan English newspapers in order to explore the possibility of political stance as used or implied in the texts.

### 2.2 Background: Political Situation in Sri Lanka

The background of this study is the political situation in Sri Lanka and it basically focuses on the 2015 Presidential Election of the country, which can be recognized as a watershed in Sri Lankan political history. The 2015 Presidential Election of Sri Lanka was held on the 8th January 2015 and Mr. Mahinda Rajapaksa was the president of the country at that period. Even though the normal term of office for a president in Sri Lanka is six years, according to the Sri Lankan constitution, the incumbent president Mahinda Rajapaksa called the election two years ahead of schedule. The United People's Freedom Alliance's (UPFA) candidate was the incumbent President Mahinda Rajapaksa and, Maithripala Sirisena, the former Minister of Health was chosen as the common candidate of the New Democratic Front, a coalition led by The United National Party (UNP). Rajapaksa was able to receive only 47.58% of all votes and Sirisena won the election by receiving 51.28% of all votes. The 2015 Presidential Election of Sri Lanka was a very controversial event because of a number of reasons. The incumbent President Rajapaksa secured a second term in office, in the presidential election, which was held in January 2010. The eighteenth amendment to the constitution was passed in September 2010 by the parliament, during the reign of Rajapaksa's government. By removing the two term limit on presidents, it opened the gates for Rajapaksa to run for a third term. Therefore, after passing the eighteenth amendment to the constitution, Rajapaksa called the election two years ahead of the schedule and the common opposition candidate Sirisena was declared the winner by defeating Rajapaksa. My study was done about such a political background and on the basis of that situation, it revealed some interesting issues about stance towards individuals and groups in the Sri Lankan political arena.

## 3.0 Research Problem

**How did the Newspapers use linguistic mechanisms in reporting the 2015 Presidential Election in Sri Lanka to convey their personal feelings, attitudes and assessments?**

Linguistic mechanisms are used by the writers for various purposes. This study focuses on how the newspaper reporters used linguistic mechanisms in reporting the 2015 presidential election in Sri Lanka to convey their personal feelings, attitudes and assessments. In this study, corpus linguistic methodology is used to carry out an empirical study about how the 2015 Presidential Election was reported by the Sri Lankan English newspapers press. This study reveals some information about how the Sri Lankan press uses language to ideologically position the readers to appeal to the newspapers' points of view. Accordingly, this is a study which attempts to find out how the newspapers use linguistic mechanisms in reporting the 2015 presidential election in Sri Lanka to convey their personal feelings, attitudes and assessments, by using the corpus linguistic methodology.

### 3.1 Research Questions

01) What are the major themes and topics of interest represented in Sri Lankan English newspapers during the 2015 Presidential Election?
02) How useful is the Keyword Analysis and concordance line analysis in identifying differences in two newspaper's point of view about the 2015 presidential election of Sri Lanka?

## 4.0 Methodology and Exploratory Analysis

### 4.1 Methodology

#### 4.1.1 Data source

Data for the study were collected from the online editions of two major Sri Lankan English newspapers, *The Sunday Times* and *The Sunday Observer*. Both newspapers are published on Sundays, and newspapers two weeks before the election and two weeks after the election were chosen

for collecting data. The data collection exercise was carried out by extracting all newspaper reports that discuss the 2015 Presidential Election from the 28th December 2014 to the 18th January 2015.

#### 4.1.2 Creating the Sri Lankan Presidential Election Corpus (SLPEC)

I used the term Sri Lankan Presidential Election Corpus (SLPEC) to refer to the main corpora of the analysis. It was created by using 87 news reports from *The Sunday Times* and *The Sunday Observer* newspapers. News reports from the 28th December 2014 to the 18th January 2015 were used to create SLPEC. From Sunday Times, I selected 29 news reports published before the election and 21 news reports published after the election and from Sunday observer, I used 21 news reports published before the election and 16 news reports published after the election.

#### 4.1.3 Corpus tools

A number of corpus tools can be used to automatically create the keyword lists, the frequency lists and the concordance lines. Out of them, I selected WordSmith 5 tools to create the keyword lists and concordance lines in my study. Keywords involve comparing a wordlist made from a corpus one is interested and another wordlist from a reference corpus. The reference corpus word list is assumed to be a large corpus which will help WordSmith to work out what is unusual about the words in the chosen text. Therefore, I created the word lists through WordSmith 5 software and it is also used to compare the word list of the corpus with the word list of the larger reference corpus, a process which helps to identify the key words which are statistically high or low in frequency. I used the one million word BE06 corpus compiled by Paul Baker as my reference corpus.

#### 4.1.4 Selecting items for analysis

I got a list of keywords that contains the corpora and keywords with high keyness value are analyzed. The keywords are categorized into groups in terms of themes before analyzing them. This keywords analysis is followed by a concordance analysis of some of the keywords in order to identify elements of stance through the context of use.

#### 4.1.5 Analysis of the data

The main analysis started with identifying the keywords in the main corpus, after comparing it with the reference corpus, BE06 corpus. It is followed by the concordance analysis of some of the keywords in order to identify elements of stance through the context of use. In order to clarify and elaborate on the quantitative findings also, the analysis of data is used.

### 4.2 Exploratory Analysis

#### 4.2.1 Creating the keyword list

A Keyword list is created by using WordSmith 5 corpus tool in order to find out the themes and topics which were of interest in the newspaper press during the period of the 2015 presidential election. Keywords 'are words that occur in a corpus or text more often than we would expect them to occur, when compared against a (usually larger) reference corpus, which acts as a standard reference for normal frequencies of words.' (Baker, 2012: 107) Baker further observes that keywords uncover the "aboutness" of a particular corpus, which means, what about the particular corpus is. Through this study, this aboutness was realized when the Sri Lankan Presidential Election Corpus was compared with the BE06 in order to generate the topics. I downloaded the BE06 Corpus of Paul Baker at first. It was retrieved from Paul Baker's page at http://www.ling.lancs.ac.uk/profiles/48/ as a zipped file. Then the corpus was extracted from the folder and saved as text files. Then the SLPEC was loaded into WordSmith 5, and the word list was created at first. The word list which was created by the WordSmith 5 displays all of the words in SLPEC and it includes their frequencies too. The same thing was done with the text files of the BE06 corpus also. By loading BE06 corpus to WordSmith 5, a

word list was created. Then those two word lists were compared with each other by using the Keyword function section of the WordSmith 5 tool which then created the keyword list of 150 words. Due to time and space constraints, the top 50 words of the keyword list were selected for the exploratory analysis. Below is the table presenting the top 50 keyword list:

| N | *Keyword* | Freq. | % | RC. Freq. | RC. % | Keyness |
|---|---|---|---|---|---|---|
| 1 | *President* | 819 | 0.75 | 53 | 0.02 | 1,760.43 |
| 2 | *Election* | 488 | 0.45 | 24 | | 1,087.42 |
| 3 | *Rajapaksa* | 355 | 0.33 | 0 | | 920.55 |
| 4 | *Sirisena* | 332 | 0.30 | 0 | | 860.86 |
| 5 | *Opposition* | 379 | 0.35 | 24 | | 816.22 |
| 6 | *Sri* | 304 | 0.28 | 0 | | 775.40 |
| 7 | *Country* | 477 | 0.44 | 103 | 0.04 | 760.42 |
| 8 | *Maithripala* | 287 | 0.26 | 0 | | 744.09 |
| 9 | *UNP* | 285 | 0.26 | 0 | | 738.90 |
| 10 | *Presidential* | 287 | 0.26 | 3 | | 712.61 |
| 11 | *Mahinda* | 192 | 0.18 | 0 | | 692.95 |
| 12 | *The* | 8,372 | 0.38 | 59,163 | 5.85 | 688.45 |
| 13 | *Government* | 404 | 0.37 | 474 | 0.05 | 626.86 |
| 14 | *Their* | 408 | 0.37 | 480 | 0.05 | 614.74 |
| 15 | *United* | 146 | 0.13 | 13 | | 598.34 |
| 16 | *Minister* | 273 | 0.25 | 2 | | 597.27 |
| 17 | *Lanka* | 380 | 0.23 | 0 | | 589 |
| 18 | *S* | 245 | 0.22 | 322 | 0.03 | 587.33 |
| 19 | *party* | 249 | 0.23 | 218 | 0.02 | 563.04 |
| 20 | *executive* | 236 | 0.22 | 1 | | 524.74 |
| 21 | *political* | 212 | 0.19 | 221 | 0.02 | 489.96 |
| 22 | *against* | 203 | 0.19 | 6 | | 480.98 |
| 23 | *support* | 185 | 0.17 | 20 | | 444.93 |
| 24 | *former* | 179 | 0.16 | 24 | | 435.04 |
| 25 | *candidate* | 171 | 0.15 | 46 | | 429.11 |
| 26 | *vote* | 160 | 0.16 | 19 | | 420.68 |
| 27 | *That* | 159 | 0.15 | 10,284 | 1.02 | 419.47 |
| 28 | *Campaign* | 158 | 0.15 | 50 | | 412.68 |
| 29 | *Chandrika* | 146 | 0.13 | 0 | | 411.47 |
| 30 | *National* | 145 | 0.13 | 314 | | 409.52 |
| 31 | *presidency* | 149 | 0.14 | 2 | | 407.11 |
| 32 | *Ranil* | 144 | 0.13 | 0 | | 403.98 |
| 33 | *Should* | 200 | 0.18 | 198 | 0.21 | 401.91 |
| 34 | *Q* | 232 | 0.21 | 52 | | 401.22 |
| 35 | *SLFP* | 248 | 0.15 | 0 | | 392.36 |
| 36 | *District* | 105 | 0.26 | 93 | | 381.33 |
| 37 | *development* | 85 | 0.21 | 280 | | 380.11 |
| 38 | *we* | 468 | 0.69 | 3,080 | 0.03 | 372 |
| 39 | *victory* | 69 | 0.17 | 1 | | 370.21 |
| 40 | *Community* | 62 | 0.15 | 3 | | 369.22 |
| 41 | *Powers* | 102 | 0.15 | 389 | | 363.85 |
| 42 | *Is* | 2,287 | 0.15 | 81,993 | 0.89 | 361.21 |
| 43 | *State* | 98 | 0.15 | 260 | 0.03 | 352.33 |
| 44 | *Over* | 97 | 0.14 | 180 | | 351.21 |
| 45 | *Who* | 99 | 0.14 | 2,144 | 0.21 | 350.01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 46 | *Governance* | 94 | 0.15 | 0 | | 348.62 |
| 47 | *Under* | 96 | 0.14 | 46 | | 346.78 |
| 48 | *Wikremasinghe* | 148 | 0.13 | 0 | | 344.29 |
| 49 | *JVP* | 250 | 0.16 | 0 | | 340 |
| 50 | *Leader* | 321 | 0.14 | 22 | | 331.72 |
| | | | | | | |

*Table 1: Top 50 keywords from SLPEC compared with BE06*

### 4.2 Categorization of top 50 keywords into groups

In creating keyword lists by using WordSmith 5 tool, we get a column which indicates the 'keyness' value of words. In the above keyword list, the last column indicates the 'keyness' value for each of the words separately. A higher keyness value of words of SLPEC is an indication that those words are frequently used than in the reference corpus. The top 50 keywords of SLPEC are presented in the table above. By following Paul Baker's suggestion, the keywords of the keyword list were categorized into groups based on their context of usage. In doing so, it was difficult to categorize some of the keywords due to their ambiguity. After categorizing them into categories, concordance analyses were used to clarify the context.

## 5.0 Research problem and Research questions answered

**How did the Newspapers use linguistic mechanisms in reporting the 2015 Presidential Election in Sri Lanka to convey their personal feelings, attitudes and assessments?**

In this study, corpus linguistic methodology is used to carry out an empirical study about how the 2015 presidential election was reported by the Sri Lankan English newspapers press and it reveals some important information about how the Sri Lankan news reporters use language to ideologically position the readers to appeal to the newspapers' points of view. I did a concordance lines analysis of the selected keywords and through that pointed out how the newspaper reporters have conveyed their personal feelings, attitudes and assessments by using linguistic mechanisms directly and indirectly. I was able to identify the point of views of newspaper press about political parties and groups, politicians and electoral process through the way that they used linguistic mechanisms in reporting their news reports about the 2015 presidential election of Sri Lanka.

The research questions of this study are revisited with a view to finding out how well the questions were answered as far as this study is concerned. The first question of the study is involved in the identification of the themes of the corpus.

1) **What are the major themes and topics of interest represented in Sri Lankan newspapers during the 2011 General Election?**

The major themes which are represented in the two newspapers are those related to the political groups and parties, politicians, and the electoral process and it also include security matters too. These are topics which can be recognized as topics which are directly related to the election. The themes were arrived at when SLPEC was compared with a reference corpus the BE06 Corpus. The topics which are generated by comparing two corpora together give us the necessary information about the issues raised in the news reports. These issues can be recognized as relatable issues that are expected in an election discourse normally. The keyword categorization includes major political parties like UNP, SLFP and JVP, major politicians such as Rajapaksa, Sirisena, Chandrika and Wikremesinghe, the issues concerning with the electoral matters like Candidates and Commissioner, and security words such as the LTTE. When looking at these series of topics, it can be understood that, there is a possibility that the corpus would show the differences and similarities between the two newspapers

used in making the corpus. The next question of the study is an attempt to find whether this is realizable.

2) **How useful are the keyword analysis and the concordance lines analysis in identifying differences in two newspapers' point of views about the 2015 presidential election of Sri Lanka?**

This question was answered by looking at the concordance lines of the keywords in two newspapers chosen for this study, *The Sunday Observer* and *The Sunday Times* which represent different political interests. The main corpus and the sub corpora which were derived from it are quite substantial enough to identify the bias of two newspapers. As a result of my attempt to identify whether these two newspapers are different, I found out that they are not based on the analysis of the keywords since the keywords did not reflect much difference. In analyzing the keywords, the only difference through which I came across was that some of the topics were covered by one newspaper more than the other. But when I started to use concordance lines in my analysis, I was able to find out evidence to prove that two newspapers have different attitudes about different political parties and politicians. Accordingly, I was able to find out that *The Sunday Observer* bears a positive stance towards the keywords such as Rajapaksa while it bears negative stances about the keywords such as Sirisena, UNP, SLFP and LTTE. As same as to that *The Sunday Times* negative attitudes about Rajapaksa, UNP and SLFP even though it does not reflect any positive stance towards any of the selected keywords for the analysis. Accordingly, keyword analysis and concordance lines analysis are very useful in identifying differences in two newspaper's point of view about the 2015 presidential election of Sri Lanka.

## 6.0 Main findings

The major themes and topics which are raised in the two newspapers, *The Sunday Times* and *The Sunday Observer* were identified through the keyword analysis. The keywords which came under those topics were analyzed by using concordance lines. There is no any significant difference can be seen among the two newspapers in terms of themes and topics, since both newspapers have focused on common themes, which the newspapers usually discuss during the periods of elections. These two newspapers actually present different points of view because they, in reality, represent different political points of view and I was looking for a methodology that will show the different points of view that they represent. I was able to figure out the different stances of two newspapers through the methodology which I used in this research. I was able to figure out that *The Sunday Observer* is very much supportive of the former president Mr. Mahinda Rajapaksa. The concordance lines I used for my analysis vividly illustrate that how the newspaper promotes the political career of Rajapaksa. The newspaper always portrays Rajapaksa as an idealistic politician and they portray Mr. Maithripala Sirisena as a politician who is not suitable for the presidency of Sri Lanka. *The Sunday Times* bears a negative stance towards Rajapaksa and they portray Rajapaksa as a corrupted politician. Even though they portray Rajapaksa as a corrupted politician, they do not portray Sirisena as an ideal either. Their stance towards Sirisena is ambiguous and I was unable to figure out it since the selected data did not have enough evidence to figure it out. Both the newspapers bear negative stances towards the political parties; UNP and SLFP. Accordingly, I was able to uncover some of the attitudes and ideas of the two newspapers about the 2015 presidential election by using the methodology which I used in my research.

### 6.1 Contribution of the study and suggestions for future studies

Newspapers are considered an important medium in reporting the elections in Sri Lanka. The newspaper industry in Sri Lanka is a very lively one with a wider accessibility, since most of the newspapers having online editions too. Therefore, it is very significant, because this is the first time that a corpus linguistic methodology is used to carry out an empirical about how the 2015 Presidential Election was reported by the Sri Lankan English newspapers press.

The methodology of this research can be used to do more successful studies in future on this field by improving this methodology further. In my study, there is a possibility that there are other differences that do not show up because of the way that the keywords work. The keywords of this study only focus on differences in frequency. Therefore words that are of similar frequencies would not show up in the list of keywords. Because of that, if it is used a different methodology to the methodology which is used in this study, it may give a different result. So, this is worth exploring in further research of this field. In conclusion, in order to go on further research on this field, it is necessary to look for different methodologies to analyze the data.

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# DESIGNING LIFE

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## ABSTRACT

Designing is an endless subject & endless is a small word for life. This is the whole study about design & life. First to understand design & what its role in life, secondly we have to understand how life motivates from design. When designing & life combine together, it converts into designing a life. Once the designing life is understood then it will be able to understand that the whole world is connected & nothing is separated from each other. Everything is well connected in this universe, whether it's related to living things or non-living things & visible or non-visible things. This study also consists of different types of designing life, like:- spiritual design life, philosophy design life, medical design life, engineers design life, sports design life, political design life, education design life & Art design life, etc. This study is focused on how to achieve excellence in these fields & what are the methods. To understand of excellence I have taken an example of eminent personalities from the history in their expertise field. The findings of this study can help to better understanding of designing life with various perspectives.

***Keywords:*** ***History, Inspiration, Relation, Silence, Pleasure, Excellence.***

## Introduction

Design is a strategic approach for someone to achieve a unique expectation. It defines the specifications, plans, parameters, costs, activities, processes and how and what to do within legal, political, social, environmental, safety and economic constraints in achieving that objective. Life is a process that has no end. Science is trying to explain life, but it is not theoretical or practical subject, it is beyond these methods. It is an experience, very few eminent people cross the body limits, only they have explained the life in the correct manner, but mass people have not experienced life, that's why they are unable to explain. To some extent in every society & culture the concept of life has existed, but society is unable to explain because its an individual experience. Every product has some features & life inspired from these feature, whether it related to color, shape, texture, space & forms, & the combination of these features product comes in front of us. Now the question arises why life inspired from design, it's because life is empty & to fulfil this emptiness, whatever comes in front of us we simply like it. May be it's vary person to person; it's because of the combination of design element & principle of design. Everyone knows in a theoretical manner that everything is connected with us in the universe, but when it comes to practically everyone is blank. To know the connection with everyone, one should know the process to connect with living things & nonliving things, visible & non visible thing. Let's take an example of Air, it's an invisible thing & everyone knows that we can't live without it. Everyone can feel the air, but unable to explain in the correct manner but it exists. Let's take one more example of any product which we can see it, feel it & touch it, that product also gives us a certain kind of feeling whether it is good or bad, but that product has combination of design element & principle of design, in the same manner we can feel & understand the life through some process. In the world history we can easily find few eminent saints who discover the process to understand of life, if we succeed to find the life then we will be able to connect design with life. Whatever field, we decide for our life doesn't matter, we can attain excellence in that area, but first we have to find life.

- **Research Method:**

The method of research is Conceptual*:* Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

- **Objective of the studies are:**

- Analysis of design and eminent person's life.
- This study explains two process to achieve Excellencies of different areas.
- How to implement a process to achieve Excellency.

- **Analysis of design and eminent person's life**

Design has no boundaries, no limits it has always opportunity to explore new thing & new ideas. Everyone knows that coin has two sides, but if we observe closely, there are three sides & we can easily find out third side when a coin is positioned, for better understanding we have to give names to all three sides first one is bad, the second is good side & third is not bad neither good, it's neutral. If a designer finds out this neutral side in their life, then they will be able to explore both the design (Bad & Good) & this is moral & the ethical responsibility of designers to develop better products for society, but currently we found that designers are not only designing lifestyle products, they also design fighter planes, guns etc. which is not beneficial for the world. Designers have knowledge of elements & principle of design they know how to play with these tools. We all know that lots of people killed by AK 47 assault rifle which is designed by Mr. Mikhail Kalashnikov, we all will be agree on one point that these types of weapons are not good for the world, but still the design work is going on in these areas which is not correct. If we really want to design our world in such a manner that everything looks beautiful, then this is the designer's responsibility that they don't design such product which harms society & world.

We should also look at the automobile industry, it's good for a human being but it's not good for nature, it means product is very useful, but due to release pollution we are harming nature & ourselves, may be in the future with new technology, we can correct our mistake, but by the time we realize we may lose our environment. We have to appreciate designers & their designs which help our society, culture & world to improve our living standards. They gave us lots of things which include Garments, Footwear, Lifestyle Products, Home decor, Office decor, Medical equipments, etc. Earlier there was only customized design, but now designers are working on universal design. Universal design means survival of design for longer time in the market. May be in future designers will design universal products in such a way so that the human being & animals can use the same product. It can be done after self-realization. We can take an example from nature which is created by God. Let's take example of five elements Air, Water, Fire, Earth, & Sky which is created by God. These elements are useful for everyone & none of the living thing can live without these five elements. Hope designers will also think & work in the same manner in the future.

There are ways to know everything, but person should know the right path to achieve excellence in a particular field. I have tried to explain the lifestyle of different eminent people of different field. This study also tried to analysis different eminent persons of different fields, like: - spiritual design life, philosophy design life, medical design life, engineers design life, sports design life, political design life, education design life & Art design life.

Below physical change human body chart stage wise shows that how the body works in different stages.

| **Physical Change Human Body Chart Stage Wise** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stages & Ages | 7 | 14 | 21 | 28 | 35 | 42 | 49 |
| First Stage | Brain | Brain | Brain | Brain | Brain | Brain | Brain |
| Second Stage | | Hormone | Hormone | Hormone | Hormone | Hormone | Hormone |
| Third Stage | | | Body | Body | Body | Body | Body |
| Fourth Stage | | | | Brain ,Hormone & Body works together | Brain ,Hormone & Body works together | Brain ,Hormone & Body works together | Brain ,Hormone & Body works together |
| Fifth Stage | | | | | Intellectual | Intellectual | Intellectual |
| Sixth Stage | | | | | | understanding of himself | understanding of himself |
| Seventh Stage | | | | | | | Understanding of universe |

**First Stage: -** Everyone lives in this stage. This is the origin of the stage & till the age of 7 it developed.

**Second Stage: -** Category of these peoples is laborious; they fight for basic things like food & shelters & fights for education. These people have a tendency to do something for their lives. At the age of 14 we can easily find out the area of interest of the people.

**Third Stage: -** A third stage is near by 21 age & those who live in this stage they know what they are doing it doesn't matter whether this is wrong or right. We have selected some of the people from different field for better understanding. They all have achieved something in their areas near by 21 age.

| | Country | Name | Picture | Birth | Death | Birth place | Education | Work Area |
|---|---|---|---|---|---|---|---|---|
| **Education design life** | India | Srinivasa Ramanujan |  | 22-12-1887 | 26-04-20 | Erode | Well Educated | Education |
| Other Names: Sigmund Freud, Jean Piaget, Immanuel Kant, Nicolaus Copernicus etc. | | | | | | | | |
| **Art design life** | Italy | Leonardo da Vinci |  | 15-04-1452 | 02-05-1519 | Vinci | Well Educated | Artist |
| Other Names: Vincent van Gogh, Valentino, Karl Lagerfeld, Christian Dior etc. | | | | | | | | |
| **Sports design life** | Indian | Sachin Tendulkar |  | 24-04-73 | Alive | Mumbai | Cricket | Sport |
| Other Names: Anna Kournikova, Michael Jordan, Michael Schumacher, Pele, etc. | | | | | | | | |
| **Engineers design life** | British | Alexander Graham Bell |  | 03-03-1847 | 02-08-22 | Edinburgh | Well Educated | Invention of the telephone |
| Other Names: Henry Ford, James Watt, Nikola Tesla, William Frazier Baker, etc. | | | | | | | | |
| **Political design life** | German | Adolf Hitler |  | 20-04-1889 | 30-04-45 | Braunau am Inn | Well Educated | Political |
| Other Names: Abraham Lincoln, Benito Amilcare Andrea Mussolini, Napoleon Bonaparte, A.P.J. Abdul Kalam, etc | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Medical design life** | London | Edward Anthony Jenner |  | 17-05-1749 | 26-01-1823 | Berkeley | Well Educated | Smallpox vaccine;Vaccination |
| Other Names: Jonas Edward Salk, Louis Pasteur, Alfred Adler, etc. | | | | | | | | |

**Fourth Stage: -** Maximum people stagnant in third stage & those who enter into the fourth stage they move towards maturity, their thinking & analysis power increase & they work for society.

**Fifth Stage: -** This stage is very important for the people because till the fourth stage they struggle lot & in fifth stage they interact with lots of people & during the interaction they develop their communication skills in different ways & they know how to present their thought & views in front of the person, society & world.

**Sixth Stage: -** Those who have completed their journey till fifth stage they realize that their efforts in different fields for society are not going to help to come out of their desires & problems. There must be some other way to solve all the problems & desires, once they realize, they try to find out them self. It's a very simple way to find out themselves, but the problem is people have a habit of doing tough things. For example, if we say to a 5 year kid to learn A to Z alphabet, it would be very tough task for a 5 year kid, it means we build ourselves to do tough task & that is the main problem to do easy things & to realize ourselves, we have to learn easy ways, infect when we say easy it's also a tough but at minimum level. To realize ourselves, we have to live in present & to live in present we have to understand the concept of our body & ourselves. Both the things exist, but we are familiar only with a body not with ourselves. The concept of realizing ourselves is very simple, what we have to do is we have to sit comfortably & leave everything as it is including mind. After particular time mind will also sit & during that period there will be no time, we will live in present & we will be able to find ourselves. Those who achieve this process, they become philosopher & they will be able to explain in a correct manner that what is body & ourselves. That is the different thing that common people will not be able to understand their philosophy.

| | Country | Name | Picture | Birth | Death | Birth place | Education | Books |
|---|---|---|---|---|---|---|---|---|
| **Philosophy designing life** | Chinese | Lao Tzu or Laozi |  | 6th–5th Century BC | 5th TO 4th Century BC | Zhou Dynasty | Well Educated | Tao Te Ching |
| Other Name: Plato, G.I. Gurdjieff, Friedrich Nietzsche, etc. | | | | | | | | |

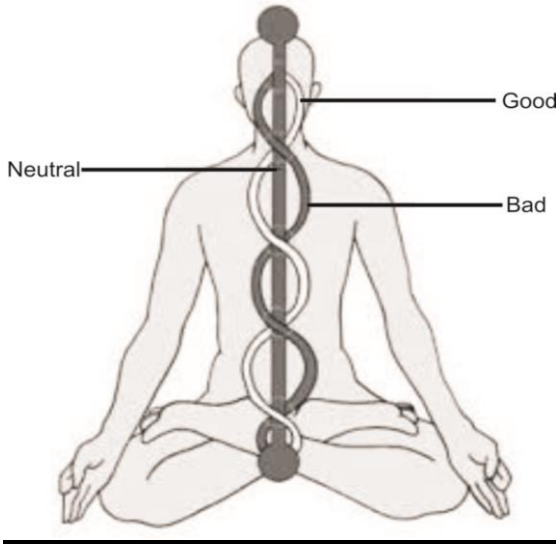
**Seventh Stage: -** Those who complete all the seven stages they will be able to understand everything, they know whole universe because when they live in this stage they connect themselves to the universe, including living & non living things. This is the stage where people live beyond the five elements. It's like meditaion ,spirituality, & wisdom.

| | Country | Name | Picture | Birth | Death | Birth place | Education | Work Area |
|---|---|---|---|---|---|---|---|---|
| **Spiritual designing life** | Indian | Krishna |  | 18 July 3228 BCE | 18-July-3228 BCE | Mathura | Well Educated | Gita |
| | Indian | Gautama Buddha |  | 563 BCE or 480 BCE | 563 OR 480 BCE | lumbini | Well Educated | Tripitak |
| | Romanian | Jesus Christ |  | 7–2 BC | 7 TO 2- BC | Bethlehem | Well Educated | Bible |
| Other Names: Moses, Muhammad Ibn Abd Allah etc. | | | | | | | | |

- **Two process to achieve Excellencies**

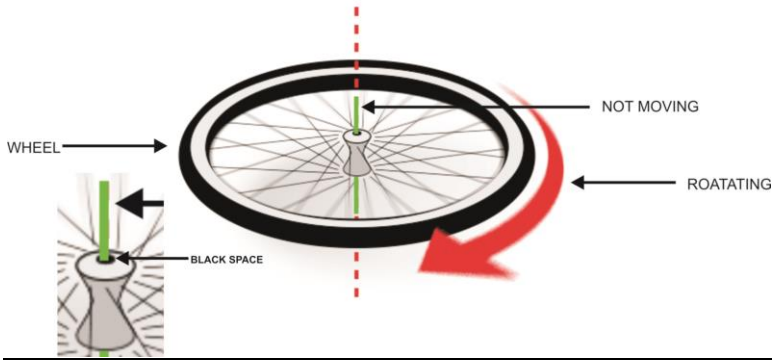
There are thousand ways to achieve excellencies in the world, but here I am trying to explain only two process one is neutral & second is zero.

"a. Live with neutral energy"




a.

a. Above image will help you to understand to live with a neutral energy process in different fields. The image shows us the bad, good & neutral energy in our body, in the same manner bad energy related to bad work, good energy related to good work & neutral has no relation with any one, neutral works as a spectator. We have to only observe bad & good things & stick with neutral energy. For example, if you are developing any beautiful fashion product (expensive jewellery) for women's, to some extent designer is developing good design & designer is also thought that he is doing good work, but if you see the other side of the product you will find that everyone cannot reach this product & because of that, other designers will try to replicate this product from different material which would be cheaper. If you see closely you will find that those who are copying the product they are doing wrong things. Those who are developing original design they are also indirect responsible for duplicate design, that is the different thing that they are not aware of their indirect responsibility. If designers live with neutral energy then they think about only design they will not think about the material (platinum, gold, silver, iron, etc.) because when we think about the material, it automatically comes under matter world, if designers not thinking about any material, it means their design comes under neutral process & because of that they will not fall into the bad & good energy. If they do only design the result will be beyond expectations.




b.

b. Before we understand zero, we have to understand the concept of objective & subjective, we all knows what is objective & subjective. When the things are not coming under objective & subjective, it comes under zero, now the question comes how we can achieve the zero. To achieve zero, we have to leave our egos, desires & "I". I (self) am the main hinder to achieve zero. We have to forget ourselves & try to focus in our specialized field in such a way so that we forget ourselves & "I", if we forget ourselves, then we will be able to achieve this process & we can live like zero & during that time only work will exists, when only work exist then the quality of the work would be like experiment & we will get new results. Whatever work we are doing doesn't matter, we have to live like zero during our work to achieve excellency in our fields.

Image 'b' will be able to understand the concept of zero. There are three things we can see a wheel, rotating & not moving. Here I am trying to relate the whole concept to human being. For example: if we say that wheel is related to our material body, rotation is related to our work & not moving is related to ourselves that is 'I'. In the same image we can see enlarged part of the middle wheel with black space, this space we will not be able to see but it exists & this space is zero.

If we remove zero between not moving part & wheel, then the wheel will not be able to work, if not moving part is getting too much friction with the wheel then also will not be able to perform, To give better performance there should not be any friction between not moving part & wheel, it means there should be proper space for better performance & this space is none other than zero.

To achieve perfection in our work we have to keep distance in the same manner between ourselves & our work, it does not matter which work we are doing, we cannot remove not moving thing which is 'I', if we remove 'I' then we will be able to create zero, but we will not be able to work, for perfection we required both the things 'I' & zero. During work if we stay with zero for a longer time than this zero work as a magnetic field & the perfection of the work would be like a genius.

- **How to implement process to achieve Excellency**

We all want to achieve Excellency in our field & everyone use different paths, but in every path there are always possibilities to reach our destiny. Before we implement a process in our life we have to have full theoretical knowledge of our subject, apart from the subject we should also be aware of great persons biography, Like their daily routine life, how they live, what they do etc & what is the difference their personal & professional life & how they divide & utilize their time. Once we understand these things, then we will be able to find out our own way which would be different from the others & after understanding of in-depth study of our field, we can easily find out the neutral energy & zero within ourselves. There are thousands of process in the world, but I have mentioned only two processes (Neutral & Zero) which we can use to achieve our perfection.

Though it's not easy, but it's also not tough, what we have to do is, we have to believe ourselves.

## Conclusion

For last 20 years the world is moving towards informative world, which is good for students & society. Knowledge is everywhere and we should be aware that the knowledge is also exists within us. The purpose of the paper is to find out the right path to achieve excellency in every field. The study shows us ways & methods to develop our ability & analyze each & everything including eminent people's life. The research would be beneficial to find out several neutral ways for their expertise areas for the present & upcoming generations. One thing we should always remember that nothing is separate from us, everything is part of our life & whatever is present in the universe, the same thing also exist in our body, whatever we think we can create only path we have to find out.

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# THE NOTION OF SUBJECT AND SUBJECT POSITION IN SINHALA

**M.G. Lalith Ananda**

**Abstract**

The notion of subject in generative grammar has been defined in structural terms (Chomsky 1965, McCloskey 1997) along a number of properties. For example, the subject carries the Agent theta role, can act as a binder, takes a wide scope, subjects are either positionally and/or morphologically marked, and subjects are always nominal (McCloskey 1997). The developments in cartography have further decomposed subject properties along feature-encoded unique head positions (Pollock 1989, Cinque 1999).

Sinhala being a Subject – Object – Verb (SOV) language, Null Subject, thoroughly left-branching, many word-order variations, with Dative, Instrumental, and Locative subjects, volitive and involitive verbs, and the absence of agreement offers fertile ground for research. This paper aims to study the notion of subjecthood and the position/positions of the subject in the Sinhala clause with respect to the subject-related properties outlined above. In particular, it seeks to find answers to such questions as "Is the subject left-dislocated to Specifier of the Inflectional/Tense Phrase or does it stay in Verb Phrase (VP)? How many subject positions can be proposed for Sinhala and what are they? Can a Topic/Focus phrase host a subject? To what extent does Sinhala align with the theoretical claims made by other SOV languages in this regard?

The data for the study consist of the grammatical judgments of about 10 native speakers of Sinhala, including the researcher himself. Some of the major conclusions of the paper are that in Sinhala, the external argument moves out of VP and the motivation for this movement is Phi-feature checking and Nominative case marking. Further, it is also proposed that the Spec-positions of a number of functional heads as expounded in cartographic literature could serve as landing sites for the external argument. This is due to the morphological realization of the information structure related information such as modality, topic, and focus in Sinhala. As for the exact location of these head positions, Rizzi's C (omplementizer) space (1997) is proposed. With respect to the typological alignment of Sinhala facts, it is shown that the conclusions regarding Sinhala are not Sinhala specific, but are supported by empirical facts from Maale, Gunbe, Lele, (Aboh 2002) and Hungarian (Kiss 2002). The study will contribute significantly to the body of empirical and theoretical literature related to the subjecthood and subject positions, notably in the absence of a well-articulated study on Sinhala in this area.

***Keywords: Subject, Subject positions, Sinhala clause***

## Introduction

Over the years, along with the radical changes that have taken place in generative grammar, the notion of subjecthood too has undergone significant changes. As the volume of research in generative syntax increased, so have been the perspectives and interpretations of subjecthood which have resulted in new insights and theoretical standpoints about the same. The notion of subject does not exist as a primitive in generative grammar, but was rather defined in structural terms (Chomsky 1965, McCloskey 1997) attributing it a number of properties. For example, the subject is the bearer of Agent theta role, it can act as a binder, it takes wide scope compared with elements in other argument positions, it can license a Negative Polarity Item, subjects are either positionally and/or morphologically marked where the latter property is displayed upon the subject itself in the form of

case and agreement, and subjects are always nominal (McCloskey 1997). Further, the Extended Projection Principle (EPP) proposed by Chomsky (1965) makes the subject further prominent by making it mandatory for all clauses. This diversity of phenomena associated with subjecthood convinces one the theoretical centrality of subjecthood despite it being not treated as a theoretical primitive in generative syntax. The more recent developments in cartography have further distributed these different syntactic properties of subjecthood along unique head positions which are attributed with the relevant feature/features.

Sinhala being a Subject – Object – Verb (SOV) language, Null Subject, and left-branching offers fertile ground for research. On the one hand, it displays similarities with many other SOV languages and thus subscribe to the same theoretical claims made by them such as in-situ properties of Wh-questions, Scrambling, and other movement possibilities. On the other, it offers a special case due to the possibility of having subjects with other case types such as Dative, Accusative, Instrumental, and Locative, existence of volitive and involitive distinction in verbs, morphologically marked discourse phenomena, and the absence of agreement.

This paper aims to study the notion of subjecthood and the position/positions of the subject in the clause with respect to the subject-related properties outlined above as proposed by McCloskey 1997. In particular, it seeks to find answers to such questions as "Is the subject left-dislocated to Specifier of the Inflectional/Tense Phrase (Spec IP/TP) or does it stay in VP?, how many subject positions can be proposed for Sinhala and what are they?, In which positions can subject end up? Is it in the V(erb) domain, I(nflectional) Phrase (IP) domain or can a subject position be proposed for a Topic/Focus phrase above IP or below it? To what extent can Sinhala be accommodated with the theoretical claims made by other SOV languages with respect to subject positions?

**Methodology**

The data for the present study consist of the grammatical judgments of native speakers of Sinhala. Although the researcher himself is a native speaker of Sinhala, grammatical judgments of at least 10 native speakers were sought. The data presented in the following sections were first subjected to the grammatical judgments of the native speakers of Sinhala for both accuracy and verification. The analysis attempted here aligns with both the existing theoretical claims and empirical arguments.

**Diagnostics of Subjecthood and the Sinhala Facts**

(a) **Agent theta role and Nominative Case**

In Sinhala, both the transitive and intransitive sentences generally appear with Nominative subjects, as it is the case with other languages (1, 2).

(1) Nimal kaareka seeduwa
Nimal(Nom) car washed
'NImal washed the car'

(2) Nimal diuwa
Nimal(Nom) ran
'Nimal ran'

The above examples are straightforward. They indicate active voice, subject is the agent, and it occupies the highest argument position. Yet, Sinhala facts do not show such transparency everywhere as we will see in the later sections.
Some evidence for the non-conclusive nature of subjecthood in Sinhala can be provided with a construction in Sinhala which indicates passive like characteristics. In such constructions, the highest argument does not indicate volition, and therefore does not look like an agent. This construction can

be labeled 'athing/by hand' construction where this postposition occurs with a Nominative subject indicating involitive-instrumental relation. The verb should be involitive (3,4).

(3) Mama-athing pingana binduna
I(Nom)-by-hand plate broke(Invol Pst/Intransitive)
'I broke the plate accidentally'

(4) *****Mata-athing pingana binduna
I(Dat)-by-hand plate broke(Invol Pst/Intransitive)
'I broke the plate accidentally'

Despite Nominative case requirement, the subject does not have any volitive properties to be called an agent as in a transitive sentence. This contrasts with (5), the active transitive one.

(5) Mama pingana binda
I(Nom) plate broke(purposely)
'I broke the plate purposely'

**(b) Nominative case and other case marked subjects**

Sinhala can also have Accusative (6), Dative (7) and Instrumental (8), subjects. In these, the claim for subjecthood can be made only on the basis of its position being the highest argument in the clause. Thematically, it is a patient in (6), experiencer in (7) and instrument in (8).

(6) Nimal-va vaetuna
Nimal(Acc) fell
'Nimal fell'

(7) Lameya-ta badaginii
Child-Dat hungry
'the child is hungry'

(8) Buurupola-ta polisi-yen paenna
Gambling-place-Dat police-Instr jumped
'police raided the gambling place'

A plausible explanation for the above is the specific nature of the verb which requires a particular case-marked subject. For example, the accusative subject requirement can be attributed to the intransitive nature of the verb as generally such subjects have a co-occurrence restriction for the verb to be intransitive. The Dative case marked subject requirement can be attributed to volitive-involitive distinction of the verb that Sinhala displays and therefore, once again, is a selectional property of the specific verb. Dative subjects occur with perceptual/psych verbs. However, in all these, the external argument is affected.

Besides, a unique characteristic of Sinhala is the possibility of having involitive sentences with an involitive verb where the subject should be essentially in the dative case (9, 10).

(9) Mata naetenava
I(Dat) dance(Invl)
'I get to dancing' (such as when I hear music)
This contrasts with the transitive (10).

(10) Mama natanava
I(Nom) dance
'I dance'

Although the subject of (10) can be called an agent, the subject of (9) can be hardly called an agent.

As for the occurrence of the Instrumental subject, it can be mentioned that the verbs that C-select Nominative subjects also can C-select the instrumental. Nevertheless, the instrumental subject should convey 'collective, organizational, or corporate' nature of the subject, as indicated by 'police' (Gair 1998).

The above examples indicate the strong selectional restrictions with respect to the external (subject) argument in the Dative, Accusative, and Instrumental cases. The VP internal argument is not affected. Hence, it can be observed that the theta role assignment for the above is lexically specified and thus the case marking is lexically determined and therefore, inherent. The mechanism of Nominative case marking and whether the subject argument moves out of VP is to be examined under 'subject positions in Sinhala.'

**(c) Agreement**

Colloquial Sinhala lacks subject-verb agreement which is one of the most crucial subjecthood diagnostics (11).

(11) mama/api/eya/Nimal/ eyala veda karanava/veda kara
I/we/he or she)/Nimal / they work do /work did
'I/we/he or she/Nimal /they work/worked'

Yet, Sinhala displays some other kinds of subject-verb agreement. For example, it has a volitive-optative verb form realized by the suffix –nnam which triggers agreement with the subject. The volitive-optative verb form indicating volition and futurity shows co-occurrence restrictions with person. That is, this particular verb form requires a first person subject (12).

(12) Mama/Api gedara yannam / *yaavi
I we home go(future) /go (future)
'I / we will go home'

Besides, Sinhala also displays some agreement like properties when there is a focus or modal marker having narrow scope. In such cases, the verb takes a special –e ending, as opposed to normal –a ending, which Kariyakarawana (1998) identifies as focus agreement (13,14)

(13) Mama/api/Nimal thamai gaha kaepuw-E /*kaepuw**a**
I/we/Nimal Foc tree cut(Pst)-E /cut(pst)
'It was I /we/Nimal who cut the tree'

(14) Mama/api/Nimal lu gaha kaepuw-E /*kaepuw**a**
I/we/Nimal Evid tree cut(Pst)-E /cut(pst)
'It is said that it was I /we/Nimal who cut the tree'

These are some marked instances which can be explained in terms of specific discourse-pragmatic notions and hence, lie outside the main argument-thematic VP layer or the Inflectional layer of the clause. Yet, they make crucial predictions for subject positions as we will see later.

**(d) Reflexive Binding and Control**

One notable argument brought forward to show the prominence of the subject over the other elements in the clause is binding and control. The subject may bind reflexives and reciprocal pronouns in other argument positions but may not itself be bound by elements in such argument positions.

Sinhala has an anaphoric pronoun tamaa/tamun which generally emphasizes co-reference (one's own) and is strongly subject oriented (15, 16)

(15) Nimal taman-va kannadiyen daekka
Nimal(Nom) self-Acc mirror(Instr) saw
'Nimal saw himself in the mirror'

(16) *taman-va Nimal kannadiyen daekka
self-Acc Nimal(Nom) mirror(Instr) saw
'Nimal saw himself in the mirror'

One of the commonly used subjecthood diagnostics is the ability of the subject to bind and control an empty category, generally labeled as PRO in the literature. In Sinhala too, in the subject control constructions, the implicit subject of the embedded clause is identified with the subject of the matrix clause, irrespective of the case of the subject (17).

(17) Mama [PRO nidaganna] utsaaha-kara
I(Nom) [PRO sleep(Inf)] try-did
'I tried to sleep

The following example also shows that only the subject of the matrix clause can be the controller of PRO in the adverbial clause.

(18) $PRO_i$ /*$_j$ vaeda karana-gamang $Nimal_i$ $Seeta\text{-}va_j$ vivechanaya kara
PRO work do-Prog Nimal(Nom) Seeta-Acc criticize-did
'While (he was) working, Nimal criticized Sita'

Both the reflexive binding and control facts establish the subjecthood in Sinhala. This also highlights the scope properties of the subject argument as the subject is the highest in the projection of core argument structure relations which C-commands other elements to its right.

(e) **Morphological Marking**

Nominative subjects are unmarked in Sinhala, just as they are in English. Yet, as we saw in the preceding sections, dative, accusative, and instrumental cases are overtly marked despite their ability to occur in other argument positions too. The accusative case marker is often dropped in the object position (mandatory in subject argument) and therefore colloquial Sinhala adds further complexity to its free order phenomenon. Despite its canonical order established as SOV, Sinhala shows a great deal of word order variation (Kariyakarawana 1998, Gair 1998,). Hence, SVO, OVS, VSO, VOS, OSV are other possibilities.

**Subject Positions in Sinhala**

Having examined some putative subject properties with respect to Sinhala, let us now turn to the question of subject position/positions in the Sinhala clause. Yet, before we attempt this, the following brief digression into the recent developments in syntax is necessary.

The subject in formalist syntax is structurally defined as the external argument of the verb which thus occupies a unique structural position outside of VP's domain. The different transformational grammar theories/models that have evolved over the years have identified this position as Spec IP/TP in a regular X-bar projection. The introduction of the VP Internal Subject Hypothesis (Kuroda 1988, Koopman & Sportiche 1988) identified Spec VP as the base-generated subject position, which then moves to Spec-IP for Case/agreement. With the introduction of feature-driven syntax, the Extended Projection Principle (EPP) is generalized as a requirement that the phrase associated with it should have a filled specifier, and in later theories, (Chomsky 2001) the EPP itself is treated as a feature.

In the cartographic approaches, the subject position is distributed among a series of functional projections (Pollock 1989, Cardinaletti 2002, Rizzi 2002, Cinque 1999) which motivate the argument that there are many more subject positions than has previously been assumed and that these subject positions are differentiated according to formal features.

Sinhala, being pro-drop and with many possible word orders (though canonical is SOV), and displaying no subject-verb agreement defies neat conclusions with respect to EPP. Yet, the occurrence of adverbial elements between the subject and VP (19, 20) as well as other agreement types (volitive-optative, focus, modal) show the existence of an Infl(ectional) node to host such agreement-like features and that it projects the IP position to check such agreement.

(19) Vaasanavata, Nimal vibhage pass-una (adverb IP adjoined)
Luckily, Nimal(Nom) exam pass-did
'Luckily, Nimal passed the exam'

(20) Nimal Vaasanavata vibhage pass-una (adverb between VP and IP)
Nimal(Nom) luckily exam pass-did
'Nimal luckily passed the exam'

**An analysis and Discussion**

We have already noted that despite Sinhala lacking Phi-agreement properties, there are restrictions on the subject argument depending on the predicate type. For example, the optative-volitive verb form –nnam requires the first person subject as in (21).

(21) Mama/Api gedara yannam / *yaavi
I we home go(future) /go (future)
'I / we will go home'

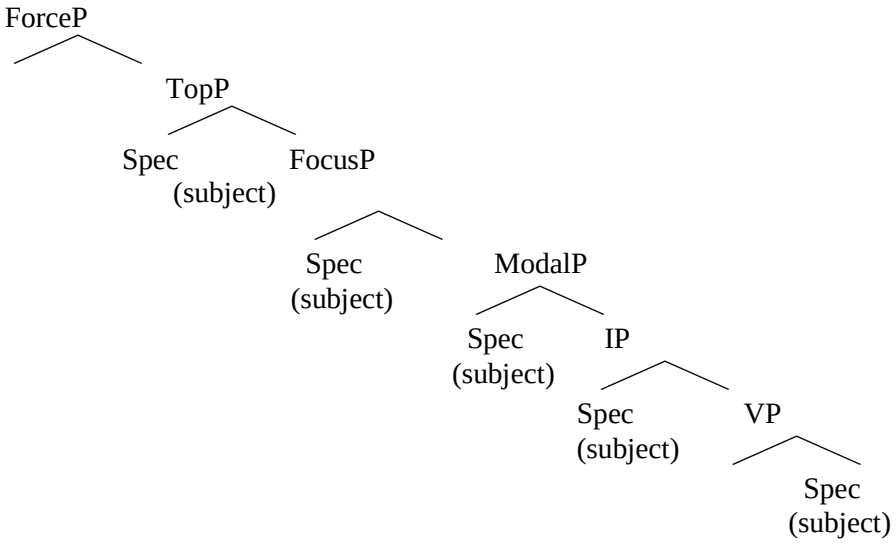
Also we have already noted the Focus/Modal agreement in Sinhala where a focused element or an element under the scope of an epistemic modal marker requires the –e form of the verb as in (13, 14) above.

This morphological realization of Sinhala modality (Evid *lu*, Epis *yae*, Eval *ne*), topic (*nang*) and focus (*thamai*) strongly supports the distinct head positions expounded in cartographic literature (Rizzi 1997, Cinque 1999). This is empirically supported by a number of other languages too which realize information structure related information morphologically. Aboh (2002) provides evidence from Maale, an SOV North Omotic language spoken in Southern Ethiopia, Lele, a Chadic language, and Gunbe to support the claim that information-structure related information is encoded in the lexicon. Miyagawa (2010) argues with respect to Japanese that topic/focus feature is a grammatical feature in discourse configurationally languages which are equivalent to Phi-agreement feature in agreement languages. He proposes a separate projection - aP, above TP and below CP. The *a* head may also host a grammatical feature, and when there are two grammatical features—topic and topic/focus, for example—one occurs on *a* and the other on T, and both involving A-movements. This too supports the cartographic approach to syntax which claims that discourse related features are visible for computation.

What all these arguments suggest is that the external argument has a number of landing sites in the Spec positions of unique functional heads. Depending on which feature is checked, the subject argument moves to the relevant functional head for Spec-Head agreement. Their head order is determined by their order of occurrence in the clause.

The fact that the verb inflects for the –e form (soodannE/seeduwE) when there is a modal/focus/Q particle in the clause having narrow scope indicates some form of agreement. Also, the first person restriction with the volitive-optative verb form (-nnam) too suggests the presence of a projecting INFL. Thus I propose that the subject moves to Spec-IP to check Phi-agreement first. Also, the

nominative case which is the only unmarked case in Sinhala is assigned here as it is assigned in English. As in Rizzi (1997) the [1]topic-focus field is activated only when there is such a particle in the clause. In Sinhala, I propose to add modality also to the functional layer so that we have not just topic-focus field, but topic-focus-modal field which is activated only when a related head is present. Each of these positions is a possible landing site for the subject depending on which discourse particle is present in the clause. Spec Focus can host the Wh-operator too as Focus and Wh are in complementary distribution in Sinhala. The subject positions will look like the following.




That Sinhala may have a number of subject positions is not surprising given the morphological character of its discourse related information and the empirical literature on cartographic approach to syntax. Kiss (2002) proposes a similar analysis for Hungarian based on referentiality and operator features.

**Conclusion**

The focus of this paper was the notion of subjecthood and the position/positions of the subject in the Sinhala clause with respect to the subject-related properties outlined in the literature in general and the properties proposed by McCloskey (1997) in particular. It attempted to find answers to a number of questions related to subjecthood phenomena and subject positions. With respect to the first question "Is the subject left-dislocated to Specifier of the Inflectional/Tense Phrase (Spec IP/TP) or does it stay in VP?', the solution we proposed was that in Sinhala, the external argument moves out of VP and the motivation for this movement was Phi-feature checking and Nominative case assignment. As for the second question which was related to the number of subject positions and their labels, we proposed an answer along the cartographic approach where the Spec-positions of a number of functional heads could serve as landing sites for the external argument. This was a result of the morphological realization of the information structure related information such as modality, topic, and focus in Sinhala. As for the exact location of these head positions, Rizzi's C(omplementizer) space was proposed. With respect to the typological alignment of Sinhala facts, it was shown that the conclusions regarding Sinhala are not Sinhala specific, but are supported by empirical facts from Maale, Gunbe, Lele, (Aboh 2002) and Hungarian (Kiss 2002).

[1] Sinhala topic marker is 'nang' as in IP [Nimal nang O V]. Yet, there is no e-marking on the verb.

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# SMALLHOLDER ENTREPRENEURSHIP DEVELOPMENT; BEST PRACTICES OF DAIRY FARMING

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**Abstract**

Milk prices are normally volatile. But, a good dairy farming practice can manage the economic risks of the business. Dairy farmers are the primary producers in the supply chain. Opportunities are open for them to add value to their primary product. Farmer's ultimate objective is to maximize profit and maintains an economically viable business. If the farmer wants to get into a profitable business he/she should apply good management practices in feeding & breeding, animal health, milk hygiene...etc. A better understanding of the internal and external environment is essential for sustainability.

If the demand is favourable and the opportunities are open for value addition, what actions should be taken by the farmer to grab the opportunities? Three strategies are available for dairy farmers to gain the competitive advantage. They are cost leadership, differentiation and focus *(Porter's Generic Strategy model, 2006)*.At the initial stage, it is not advisable for dairy farmers to practice "differentiation" or "focus" strategies as they tend to increase the cost of production. The success of cost leadership as a competitive strategy also depends upon the ability to produce low-cost milk as compared to the competitor.

## 1. Introduction

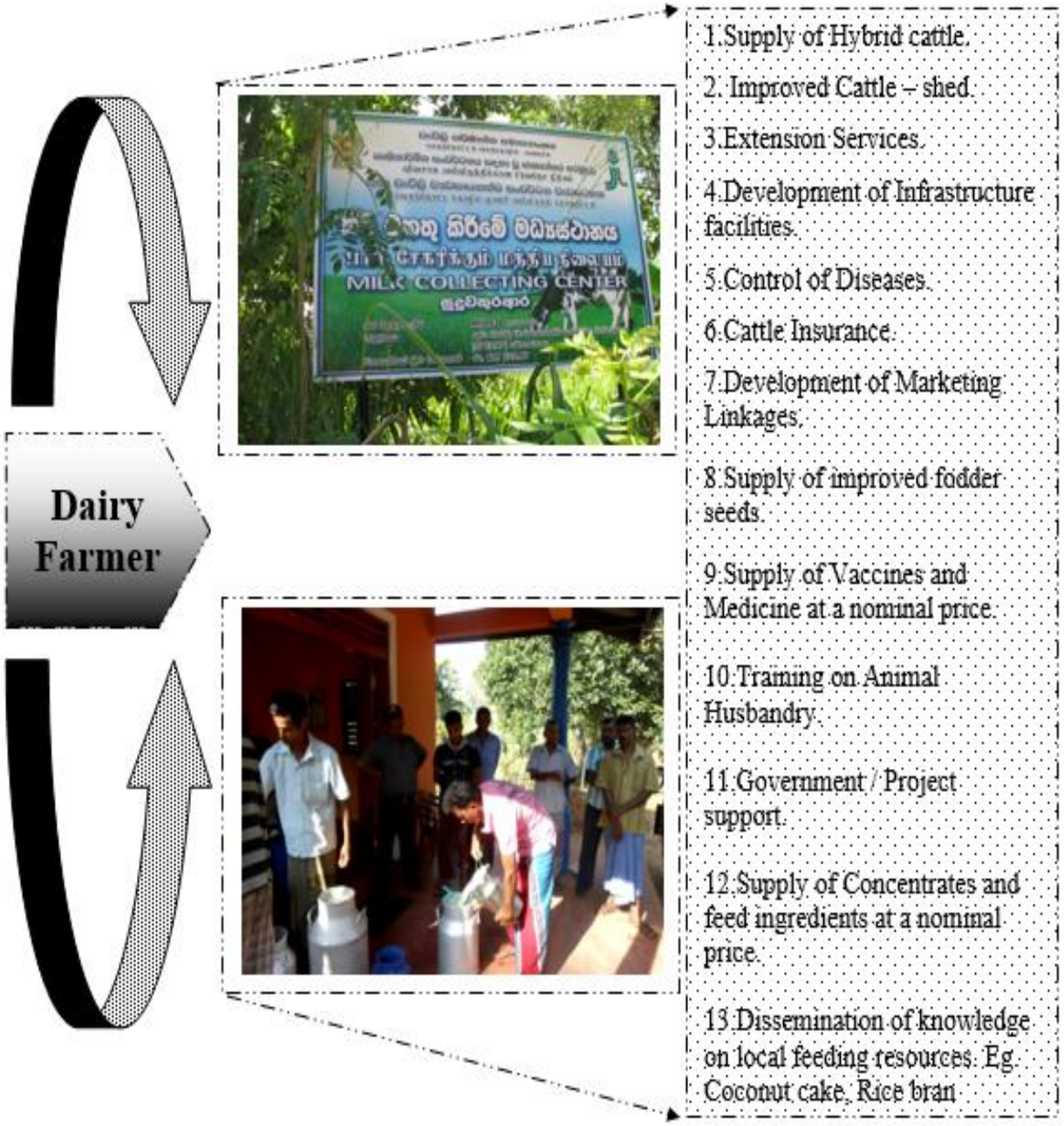
### *The Role of SPEnDP towards Dairy Development*

Smallholder Plantations Entrepreneurship Development Programme (SPEnDP) was formulated by the International Fund for Agricultural Development (IFAD) and executed by the Ministry of Plantation Industries. This project has designed to encourage the prospective beneficiaries to undertake tea re-planting, rubber new planting, dairy development, improving infrastructure facilities, intercropping, land surveying, rural financing ...etc. The total cost of the project is 29.23 US$ millions (3,885 LKR millions). One of the development objectives of the SPEnDP is to achieve a sustainable increase of income and living standard of the poor farmers in the Mid country & Moneragala regions. Since, there is a heavy demand for the natural milk and dairy products within the country; SPEnDP had set development targets to extend the dairy sector in line with the policy of the government.

### *Reaching the Unreached*

TheSPEnDP identified the major constraints in developing the dairy sector in the project implementing area (Figure 1).

Figure 1: Discovering needs of a Dairy farmer:SPEnDP Integrated Dairy model




Source: Author's Construction, 2016

There is a very high potential for improved breeds. Hence, SPEnDP implemented a programme, in collaboration with the provincial Department of Animal Production & Health to provide improved breeds for the poor. More than 46 LKR millions worth, 612 matching grants were disbursed for the poor farmers to purchase dairy cows. The matching grant ratio applied as 70:30 (70% from the SPEnDP & 30% from the beneficiary). Total expenditure spent on constructing 700 cattle sheds within the project implementing area is 35 LKR millions. Training on animal husbandry, fodder grass cultivation, cattle shad management, book keeping...etc. were given to the farmers to uplift their knowledge on dairy management. The programme initiated that the improvement of quality milk should be given the priority for increasing the nutritional level and the income level of the households. Therefore, the program has constructed six Milk Collecting Centres in Wellawaya, Monaragala, Buttala, Madilla, Badalkumbura, and Medagama District Secretariat divisions. Completed Milk Collecting Centres were handed over to the milk-producing societies in the area.

## 2. Methodology

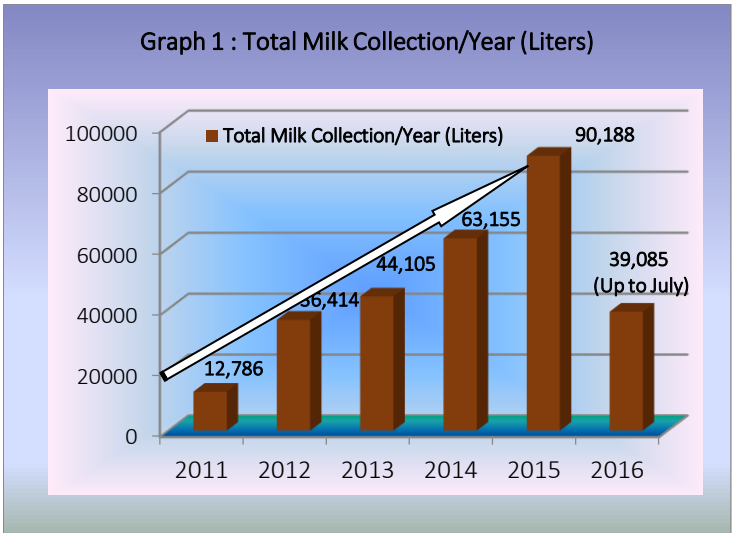
***Suduwathura Ãra Milk Collecting Centre - Monaragala***

At the initial stage, Suduwathura Ãra farmers had a temporary shed for collecting milk. SPEnDP identified the difficulties faced by the farmers and emphasized the requirement of a permanent centre for collecting milk. As per the decision that was taken by the SPEnDP, a new milk collecting centre has constructed and handed over to the Suduwathura Ãra milk-producing society in 2013. SPEnDP has mainly concerned about food security and the hygiene of the milk in order to improve the quality of the milk. With the intention of increasing the nutritional level and the income level of the households, LKR 840,625 worth grant has given to construct a new milk collecting centre at Suduwathura Ãra. The project staff has given the guidance and assistance to form a formal business group of dairy farmers. Initially, there were 21 cattle in the area. The project has given matching grants for the poor farmers to purchase hybrid cattle. As a result, the herd size had considerably increased up to 153 during the last four years and the quantity of milk also subsequently increased. Appropriate training on cattle management has given to the members of the dairy business group.

The project officers supported the milking society to connect with a proper marketing channel. Milco is a 100% State-owned largest dairy company located in Monaragala area which purchases 185,000L of fresh milk from local dairy farmers daily. Currently, Milco is coming to the doorstep of the Suduwathura Ãra Milk Collecting centre for purchasing milk and paying an average of LKR 65 -75/- per litre, subject to the fat content of the milk. Thus, each and every farmer is getting a reasonable value for their natural milk. The project has given management training for the in-charge of handling operations of the Milk Collecting Centre. Selected few members have given training on value-added milk products. After nearly three years of commencing the operations of the Milk Collecting Centre, the total membership has grown up to 51 and the total milk collection per day has considerably improved from 120L to 325L. Most of the farmers who are registered with the Milk Collecting Centre have improved their income by LKR.700/day on average. Thus, the positive impact has been identified in terms of income generation.

## 3. Results

***The statistics and what they show***




The Graph-1 explains the pattern of increasing the milk collection over the period (2011 – July 2016).

SPEnDP farmers are performing much better than the other dairy farmers in the Suduwathura Ãra area. As the dairy business had continuously improved its operational effectiveness, the business had started moving towards the productivity frontier. However, the operational efficiency can be further improved to get the superior performance out of the business.

Source: Author's Survey, 2016

Those who want to do an excellent business should strategically position their dairy products Eg. Organic milk production, Omega 3 enhanced fluid milk production. During the past period, the monthly average milk collection has increased from 1,065 L to 7,516 L. Revolving fund of the business group also improved from LKR 43,000/- to LKR 190,000/-.

Most of the dairy farmers, who started with matching grants, have improved their income by increasing the herd size and the milk productivity. Six SPEnDP supported Milk Collecting Centres are connected to 265 suppliers for increasing the volume of the milk collection in Monaragala district. Currently, the six centres are generating approximately 2,000L/day and it contributes 6% to the total daily milk production (Approx. 30,000 litres) in Monaragala district. The International Fund for Agricultural Development (IFAD) supervision mission that fielded during July-2016 has recommended applying the existing dairy development model for the Mid Country region. According to the results of the informal assessment done by the SPEnDP staff, the average milk collection per cow per day had increased from 8L – 12L and the milk yield of the Suduwathura Ãra area had increased by 52%. In addition, the average income (only from milk) per day had increased from LKR 503.38 to LKR 714.80 (42% increase) and thus, the household economy had recovered with a vast progression.

***Cost - Revenue Analysis – Suduwathura Ãra Milk Collecting Centre***

***Revenue***

| | | |
|---|---|---|
| Average price of milk (Rs. 65/- to 75/-) | = | Rs. 70.00/litre |
| Average monthly milk collection (90,188 litres/12) | = | 7,516 litres |
| Average Monthly Revenue of the business group | = | Rs. 526,120/- |

***Cost***

| | | |
|---|---|---|
| Average Cost of Production (COP) of milk/Litre | = | Rs. 40.00/litre |
| (COP of milk shows vast difference among management system. The COP is the highest in an intensive management system while the lowest in an extensive management system. Labour cost which, is an opportunity cost for family labour, is the main cost component of milk production. The major portion of the labour cost is allocated for grass cutting). | = | Rs. 40/- x 7,516 liters<br>Rs. 300,640/- |
| Average monthly charge for the manager of the MC (Farmers pay Rs. 1.75 per litre of milk) | = | Rs. 13,153/- |
| Expenditure for Electricity (cost/month) | = | Rs. 650/- |
| Expenditure for Water (cost/month) | = | Rs. 200/- |
| Expenditure for cleansing ingredients, brushes (cost/month) | = | Rs. 200/- |
| Average total Expenditure for milk production (cost/month) | = | Rs. 314,443/- |
| Average Net Profit of the business group per month | = | Rs. 526,120 - Rs. 314,843 |
| | = | Rs. 211,277/- |

***Return On Invest (ROI)*** = $\frac{\textit{Gain from Investment – Cost of Investment}}{\textit{Cost of Investment}}$

= $\frac{\textit{Rs. 526,120.00 - Rs. 314,443.00}}{\textit{Rs. 314,443}}$

= *67 %*

As the total revenue is much greater than the total costs, the business is potentially worthwhile and should be further evaluated as a realistic investment.

## 4. Discussion

***Growth opportunities***

As the business group is performing well, intensive growth opportunities (to achieve further growth within the current industry) and integrated growth opportunities (build or acquire a business that related to current business Eg. Yoghurt manufacturing) are opened for the future expansions. Prospects are available to transform the current subsistence-level dairy production into a viable commercially oriented activity. Several precautions and management practices have been introduced by the Department of Animal Production & Health to minimize the risk of contamination of diseases and productivity loss. Good quality improved fodder grass are available, which can be used as a substitute for "poonac". Weather conditions are somewhat favorable for growing low-cost, high-quality grass as a substitute for high-priced concentrated feeds. As the business is growing, there will be an emerging possibility of getting the advantage of economies of scale through mass production, which can be lead to increase the bargaining power of the farmers.

***Challenge beyond the farm gate***

Threats are possible that the farmers have to mitigate. SPEnDP initiated Milk Collecting Centres are getting substantial profits than other natural milk producers. Getting high returns will attract new entrants to the industry. The market is open for rivals.

Natural milk prices are very competitive and volatile. Farm gate price is largely determined by the two-three large dairy companies (Milco, Fonterra, Pelwatte Dairy Industries and Lucky Lanka Company) in Sri Lanka. The entire milk food industry is in the hands of these companies and therefore the farmers are uncertain about the farm gate price of milk. The farmers can demand only when the fat content is high. The cost of production (COP) is the key determinant of the farm gate price of milk. Almost all the large-scale dairy food companies have operations in the Monaragala district, so far, they have not access the Suduwathura Ãra area except Milco. Hence, no competition can be identified among buyers within Suduwathura Ãra, where Milco gets the complete advantage.

There are very limited substitutes for milk. Soy milk can be used as a substitute for cow's milk. However, because of the distinct flavor of the Soy milk, it is not popular among Sri Lankans. Goat's milk producers are also available in Monaragalaarea and it is an excellent alternative to cow's milk. Goat milk is rich with vitamin A & B1 content and **slightly sweeter** than cow's milk. Shortage of good quality dairy stock is the major problem faced by the dairy farmers in Suduwathura Ãra area. The government has no clear strategy to control cattle diseases. The diseases like mastitis, foot-and-mouth disease, infertility... etc can be easily identified in any dairy herd. In many areas, smallholder dairy farmers do not have adequate land to grow grass. Good quality year-round feed at the farm level is limited. Changing attitude to grow pasture or fodder as a crop for the dairy stock is another challenge for implementers. A few large-scale feed millers (Ceylon Grain Elevators of Prima, CIC feeds, The Colombo forage stores) control the animal feed industry in Sri Lanka. Adverse weather conditions also affect the productivity of a dairy cow.

## 5. Conclusion

Commercial milk production has to be further enhanced by creating competition among dairy farmers. The sustainability of the dairy industry solely depends upon the cost and the income of farming. Development of the business mind of the rural community is a key activity of sustainability.

Most of the farmers are more comfortable with their scope of current operations and keen to expand their business. To ensure the sustainability after the end of the external support of the project, linkages with the Department of Animal Production & Health, extension officers, veterinary officers..etc. have to be properly strengthened. The business is showing symptoms of growing and there is a provision to

form a registered business entity under the Company Act. All the SPEnDP supported dairy related activities are integrated and interrelated to "fit" the dairy business. The business focuses only natural milk segment of the dairy industry. Within that segment, the business obtained the advantage of cost leadership. Achieving the lowest cost of production leads to entertaining a higher profit margin. 70% of the initial cost (Cow + shed) has been borne by the project. Dairy feed and medicine are available at a nominal price. Therefore, the cost of production of milk is comparatively low when compared to the other milk producers in that area.

After the exit of the project, business groups have to carry out their activities on their own as a true commercial entity and no further backing can be claimed from the project. According to the literature, many scholars recommend for developing business groups as commercial entities in order to eradicate the poverty, while some researchers predict that this type of small business entities will gradually disappear in future. Hence, the future of these business groups is controversial.

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# THE RELATIONSHIP BETWEEN GEO-MAGNETIC FIELDS AND MAMMAL DISTRIBUTION.

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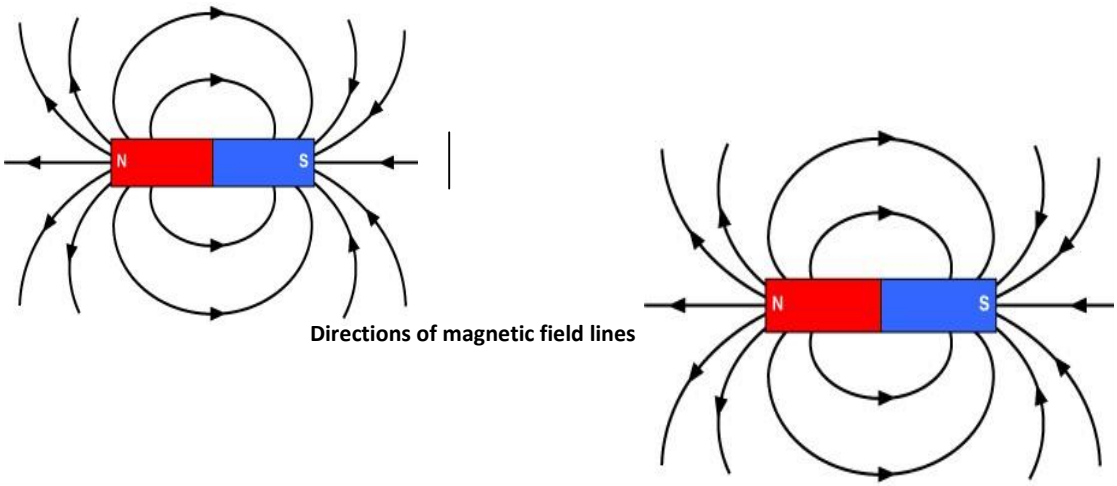
**Abstract:**

Most of the mammalians have magnetic senses. Several mammalian species spontaneously align their body axis or jump some direction or work, eat, or sleep etc. with respect to the Earth's magnetic field lines in diverse behavioral context.

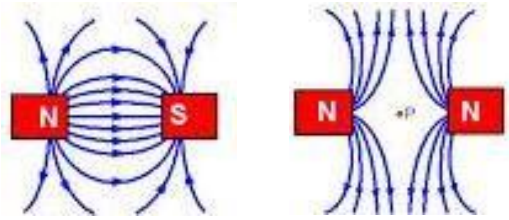
Experiment carried out referring research papers regarding mammal distribution and geomagnetic fields and tried to find how mammals sense the geo-magnetic fields, how they react and how geo-magnetic fields affects their distribution pattern. Generally most mammals are distributed according to their behavior and niche/habitat. The study was carried to see whether there is the correlation between mammalian and geo magnetic fields. It indicates that apart from humans (*Homo sapian sapian*) the other entire mammals have a correlation.

## Magnetic Field

Magnets show repulsion or attraction force around itself. The area affected from the force of magnets called **Magnetic field.** A magnetic field is invisible to naked eyes. However, if we put a sheet on the magnet and put some iron filing on this sheet we can easily observe the magnetic field around the magnet with the shapes of the iron filling. The shape of magnetic field lines showed in the picture given below.




Directions of magnetic field lines



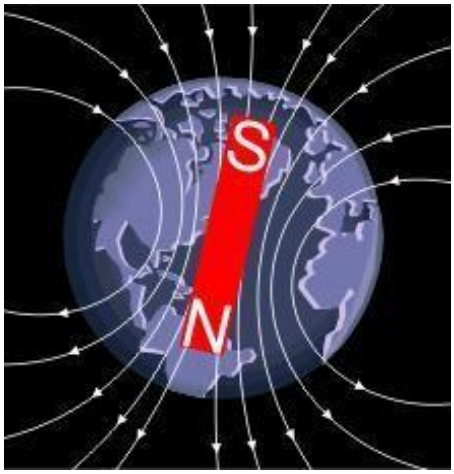

The lines get closer to each other; this means that magnetic field is strong in that region.

**What does a geo magnetic field mean?**

Magnetic field associated with the Earth. It is essentially dipolar (earth has two poles: - the northern and southern magnetic poles) on the Earth's surface.

A bar magnet or a compass when hanged from their gravitational center, they come equilibrium at north-south pole direction of the earth. This situation shows that there must be magnetic field acting on compass and bar magnet. This magnetic field is the earth's magnetic field.

Away from the surface, the field becomes distorted. Most geomagnetisms explain the field by means of dynamo theories, whereby a source of energy in the Earth's core causes a self-sustaining magnetic field. In the dynamo theories, fluid motion in the Earth's core involves the movement of conducting material within an existing magnetic field, thus creating a current and a self-enforcing field.




**Earth magnet field line**

Magnetic fields are measured in units of Tesla (T). The Tesla is a large unit for geophysical observations, and a smaller unit, the **nanotesla.** The geo magnetic field generally measure nano-Tesla (nT).

$$B(T) = \frac{F(N)}{q(C).v(ms^{-1})}$$

B= magnetic field (T)
F= Force (N)
q= electric charge (C) v= velocity ($ms^{-1}$)

**What does human and mammal distribution mean?**

Scientists are convinced that life came from the sea and from there the living organisms conquered, through the necessary evolutionary stages, both the Earth and the internal freshwaters (Timothy Kusky, 2007). These steps, moving from the sea to the other environments, occurred in very ancient times, when the living forms were poorly developed and poorly specialized. Later on, the living beings, even though spreading all around, found impassable boundaries that confined them to certain regions. These boundaries were mountain ridges, deserts, seas, rivers, temperatures, available water, the presence of oxygen in the water, geological events (continental drift, rising of the sea). This spreading is called mammal evolution and distribution. All types of mammal and animal distributions in the world follow some distinct pattern.

Just like Random, Individual and Group distribution…

**Animal are migrate**

**What is Human and Human distribution**

Human are primates. Physical and genetic similarities show that the modern human species, *Homo sapiens*, has a very close relationship to another group of primate species, the apes. Human and the great apes of Africa (Chimpanzee) originated from a common ancestor that lived between eight and six million years ago. Humans first evolved in Africa and much of human evolution occurred on that continent.

Early human, first migrated out of Africa into Asia nearly between 2 and 1.8 million years ago. They entered Europe somewhat later, between 1.5 and 1 million years. Species of modern humans populated many parts of the world much later. For instance, people first came to Australia nearly within the past 60,000 years and to the Americas within the past 30,000 years or so. The beginning of agriculture and the rise of the first civilizations occurred within the past 12,000 years.

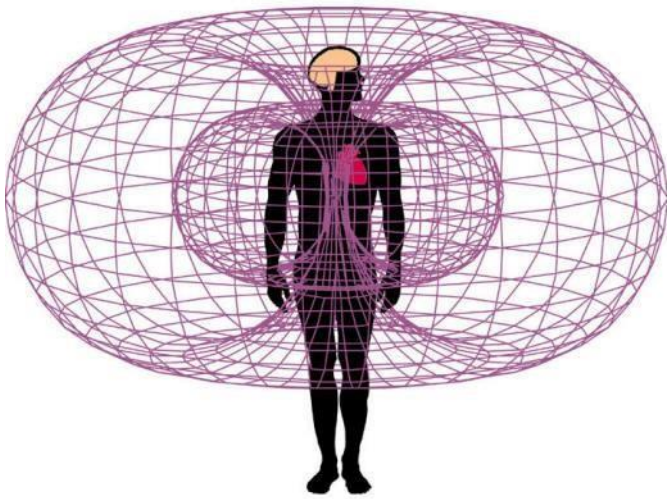
**Human body magnetic field**

Bio-magnetism is the phenomenon where magnetic fields are produced by the living organisms, especially by the human body. Human electricity energy is generated by chemical processes in nerve cells. Billions of nerve impulses travel throughout the human brain and nervous system. A nerve impulse is a wave of electrical activity that passes from one end of nerve cell to another. Each impulse is same in size; it is the frequency, impulses per second, that carries information about the intensity of the nerve signal.

The nervous system is a network of cells called neurons. Neurons are the basic unit of the nervous system which transmits information in the form of electrical signals. Neurons are responsible for sending, receiving, and interpreting information from all parts of the body.
There are around 100 billion neurons in the brain and a similar amount is found in the nervous system tissues throughout the rest of the body.

As electricity passes through a metal wire it causes an energy field or magnetic field. In a similar way, human electricity in the brain and nervous system creates human magnetic fields. There are billions of nerve impulses in the body and these are constantly creating complex human magnetic fields.

The human heart is a source of electro-magnetism, which is detectable by modern scientific instruments even at a few meters distance.



**Human body magnet filed**

The human Heart is now documented as the strongest generator of both electrical and magnetic fields in the body. A fact of great Importance, because we've always been taught that the brain is where all the action is. While the brain does have an electrical & a magnetic field, they are both relatively weak compared to the Heart. The Heart is about 100,000 times stronger electrically & up to 5,000 times stronger magnetically than the brain. Important, because– as we know the physical world is made of those 2 fields: electrical & magnetic fields of Energy. Physics now tells us that if we can change either the magnetic field or the electrical field of the atom, we literally change that atom and its elements within our body and any property in this world.

## How geo-magnetic fields do is related to humans?

The scientific consensus is that human don't have such ability. It's clear that human don't have anything approaching the natural orientation abilities of migratory birds or homing pigeons (Robin Baker, 1980), (Steven Reppert, 2013). We don't migrate long distances when the seasons change (unless we're retired and wealthy). Our homing ability depends mainly on conventional senses, memory, and, more recently, technological devices. If unable to rely on vision and hearing to orient ourselves, if we forget our route, or if we don't recognize landmarks, we get lost.

However some humans are sensitive to magnetic fields because humans have magnetite (a natural permanent magnetic iron ore) in the retina of the eye and in the brain as well as the ethmoid sinuses bone region and the nervous system.

New scientific research tells us many animals can sense the Earth's magnetic field. Animals and humans have a magnetic field which surrounds them - very much in the same way that magnetic field surrounds the Earth as its protector (Steven Rappert, 2013,), ( Thorsten Ritz, Klaus Schulten

,2007). As it relates to humans, and perhaps various animals, charged particles from the Sun and our Milky Way can cause negative emotions.

In this study Russian researcher Oleg Shumilov states: *"If animals can sense the Earth's magnetic field; so why not people."* Shumilov looked at activity in the Earth's geomagnetic field from 1948 to 1997 and found that it grouped into three seasonal peaks every year: One from March to May, another in July and the last in October. He also found that the *"geomagnetism peaks matched up with peaks in the number of mood disorders i.e. depression, anxiety, bi-polar (mood swings) and even suicides in the northern Russian city of Kirovsk over the same period."*

The pineal gland, which regulates melatonin production and the circadian 24 hour rhythm, is sensitive to magnetic fields. Posner states: *"The circadian regulatory system depends upon repeated environmental cues to [synchronize] internal clocks. Magnetic fields may be one of these environmental cues."*

Recently related study published in the scientific journal 'Geophysical Research', indicates a dormant gene is residing within all of us just ready to be tapped. It is known as 'Cryptochromes' (CRY). Cryptochromes (CRY) are a class of blue light-sensitive flavor proteins found in plants and animals. They are involved in the 'circadian' - 24 hour cyclical rhythms of daily life.

However, it is very hard to conduct a practical study on human body magnetic field, because not only due to the requirement of sophisticated and expensive technology (special camera, magnetometer, external magnets…etc) but also it is difficult to perform an experiment to observe their reactions by keeping human subjects under a controlled magnetic field.

Therefore, it was decided to observe the behavior of some other mammals and "Rats" of order Rodentia were selected as test subject. The reason was to select this mammals' order because their distribution is all over the world and density is high in some places.

In past researches have been done based on animal behavior in relation to geo-magnetic field.
e.g.:

- Geo Magnetic alignment is effect of grazing and resting cattle and deer ( Sabine Begall, Jaroslav Cˇerveny´, Julia Neef, Oldrˇich Vojteˇch, and Hynek Burda, 2008).
- Directional preference may enhance hunting accuracy in foraging foxes.( Jaroslav Cˇerveny, Sabine Begall, Petr Koubek, Petra Nova´kova and Hynek Burda , 2011)
- Directional orientation of birds by the magnetic field under different light conditions (Roswitha Wiltschko, Katrin Stapput, Peter Thalau and Wolfgang Wiltschko 2009)
- The geo-magnetic sense and its use in long-distance navigation by animals. Like birds, whale, turtle(Michael M Walker, Todd E Dennis and Joseph L Kirschvink, 2002 )

**What is meant by Rodent?**

Any of the relatively small placental mammals that constitute the order *Rodentia*, having constantly growing incisor teeth specialized for gnawing. The group includes porcupines, rats, mice, squirrels, marmots, etc

**Rodent characteristics**

Rodents are relatively small, prolific mammals. All rodents have a pair of front teeth that continue to grow throughout their lives; they must gnaw on food (or other objects) to grind these teeth down. The name Rodentia is derived from the Latin word "rodere", which means "to-gnaw".

Most rodents are herbivores (plant-eaters). Some rodents, like the house mouse, are omnivores (eating plants and animals). A few rodents, like the Australian water rat, are carnivores.

The Rodentia is by far the largest mammalian order; nearly half of all mammal species are rodents. They are worldwide in distribution and are found in almost every terrestrial and freshwater habitat, from the shores of the Arctic Ocean to the hottest deserts. They are variously adapted for running, jumping, climbing, burrowing, swimming, and gliding. Many of them have dexterous forepaws, which they use as hands while sitting on their haunches in a position characteristic of many rodents.

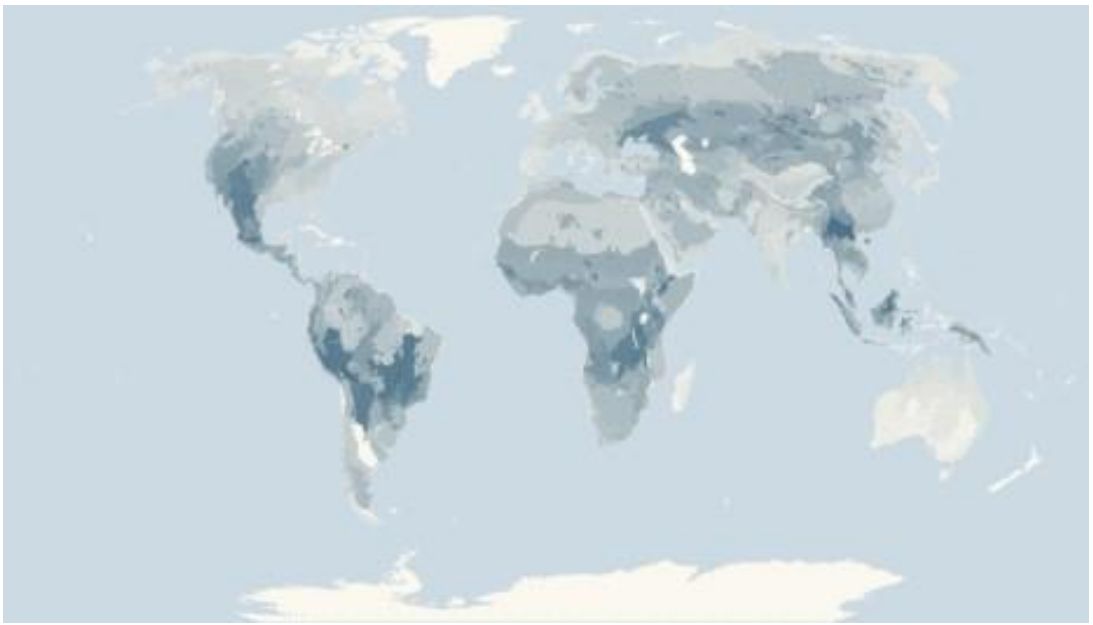
There are about 2,000 different species of rodents alive today. The biggest rodent is the Capybara, which is almost 4.5 feet (1.3 m) long. The smallest rodent is the Pygmy jerboa, whose body is just over less than two inches (47 mm) long.

**Rat**

**Capybara**

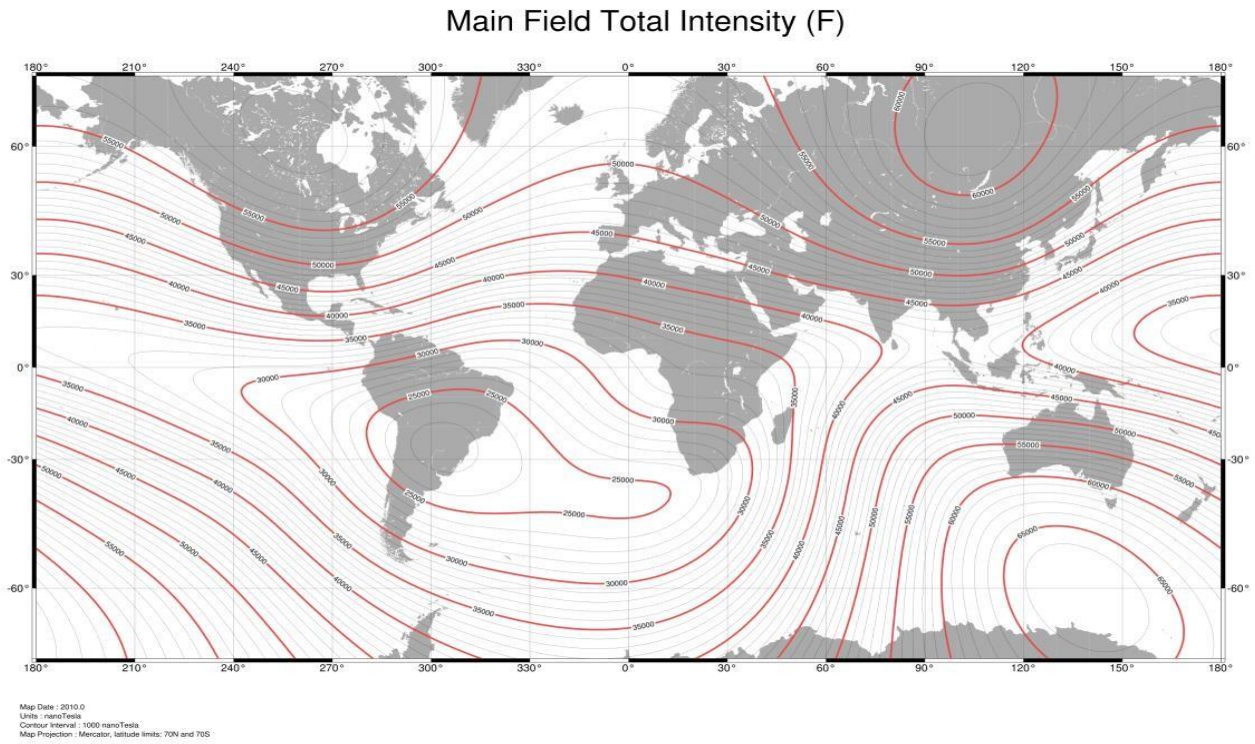
**Rodent's distribution in the world.**

Normally in all over the world we can see this order mammal, basically Rats and Mice. But in some areas have very high density and in some areas have low rodent's density. Rodents generally like to live as a group or some species live individually. Therefore, first of all some rodent's density and distribution maps were collected and studied. Then the areas were identified with high and low rodent's density in the world.



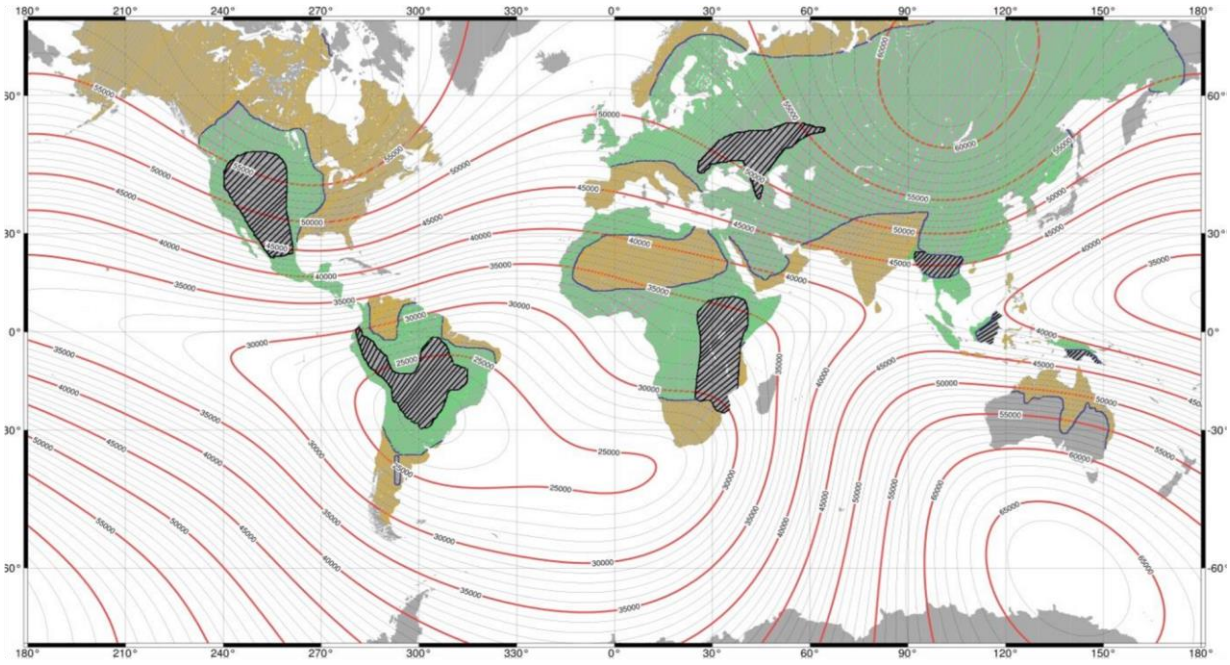
**Rodent's density world map**

Then world's magnetic field was studied using geo magnetic map, related document and different type magneto calculator in the Internet**.**




## Results

A map of Rodent distribution and geo-magnetic field was developed using above two maps and data.



***Rodent-ion distribution and Geo-magnetic field***

Species richness per square kilometer in the about the map.

Gray - 000-300

Yellow - 301-600

Green - 601-1050

Black -1051-1400

Geo-magnet filed line 25000

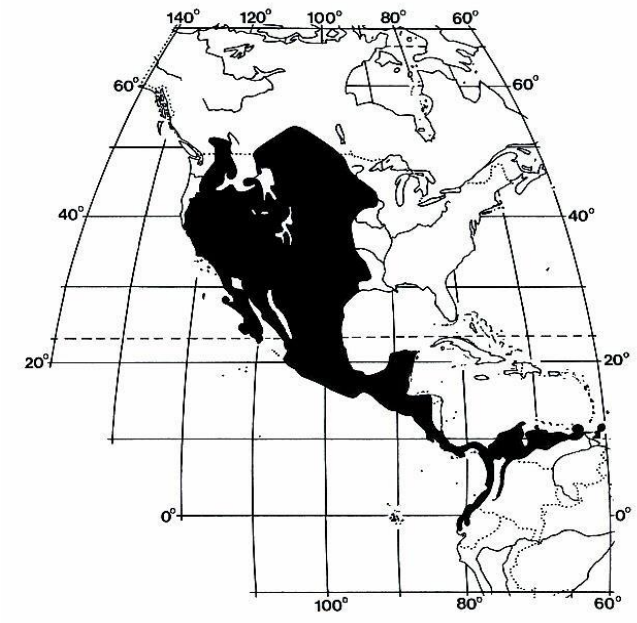
Rodent mammal number gets accumulated whiting the eco-region.

Some references show that higher magnetic field density results depression conditions, sicknesses, excitability also abnormal behavior in humans (A.L Tchijevsky, 1951). Human and rodents both are mammals. Accordingly rodents also could have these bad effects from higher magnetic fields. Therefore they migrate and/or gathered to lower magnetic field areas.

Every continent has low magnetic fields area. North America has 43000nT - 57000nT region, South America has 23000nT - 25000nT region, Europe has 49000nT – 57000nT region, Africa has 35000nT region, Asia has 43000nT – 47000nT region, Australia has 45000nT - 53000nT region.

Those regions have very high rodent's density.

North America have manly North American beaver, Mountain beaver, North American capybara, Ord's kangaroo rat, Eastern gray squirrel … etc,

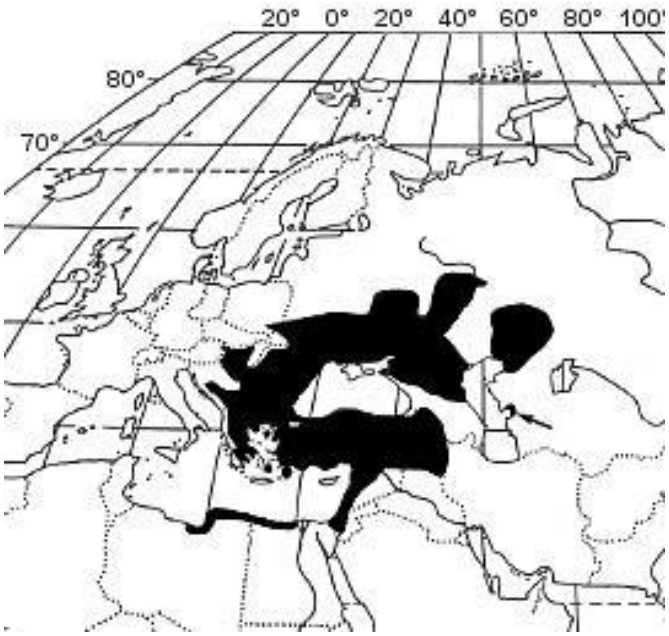



**More Rodent distribution region in North America**

South America have manly Streaked dwarf porcupine, Short-tailed chinchilla, Chilean rock rat, Bolivian chinchilla rat, Golden Atlantic tree-rat …etc,

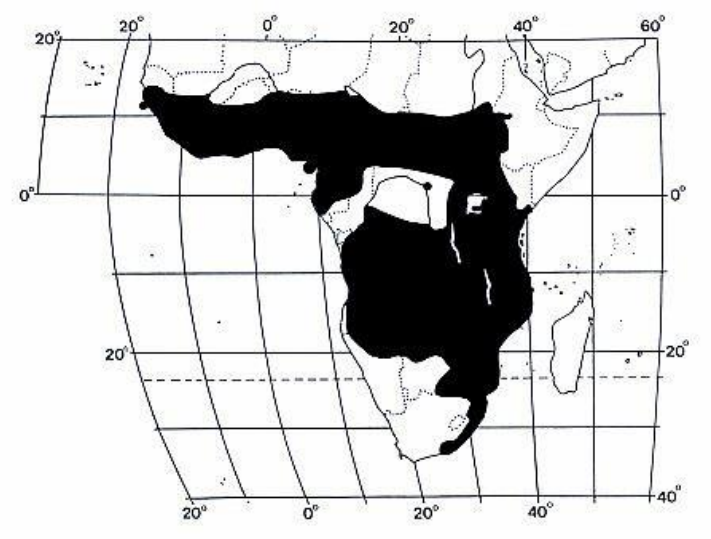

**More Rodent distribution region in South America**

Europe have manly Black rat, Sandy mole rat, Algerian mouse, European ground squirrel, Eurasian beaver … etc,



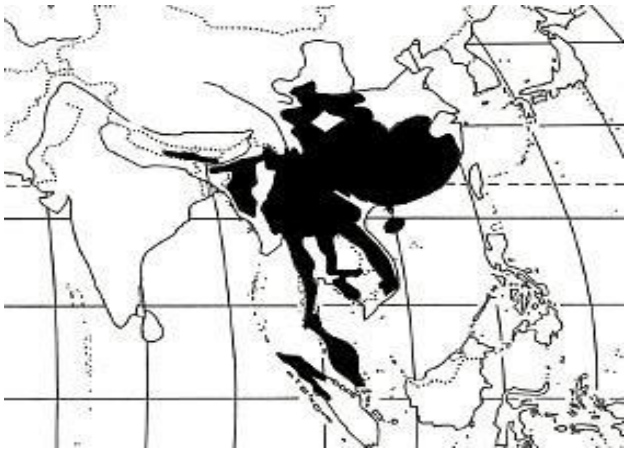

**More Rodent distribution region in Europe**

Africa have manly African brush-tailed porcupine, Silvery mole rat, Wood mouse, Naked mole rat, African pygmy mouse …etc,




**More Rodent distribution region in Africa**

Asia have manly (Himalayan striped squirrel, Black Giant squirrel, Malaysian wood Rat, Asian House Rat, Malayan Porcupine …etc,



**More Rodent distribution region in Asia**

Australia has manly Mitchell's Hopping Mouse, Australian swamp rat, Rakali, Pilliga mouse, Gould's mouse, Central rock rat …etc. However North Australia has more Rodantion density in the Australia. Because of North Australia have low geo-magnet fields in the all Australian region.

## Conclusions

According to the results it was found that distribution of Rodents is affected by geo-magnetic fields. Because of Rodents are less populated in areas with higher magnetic field and highly populated in areas with lower magnetic fields. Based on these observations experiments have been planned to do with some rats under a controlled environment (Eg. With a known magnetic field) and to check the effect of magnetic field on their behavior rats.

**Acknowledgment**

**Authors would like to thank the Institute of fundamental studies. Prof. Rohan Senadeera, Department of Physics, The Open University of Sri Lanka and the staff of the Institute of Fundamental Studies for their supports to make this research a success.**

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# GENDER BASED VIOLENCE: A THREAT TO WOMEN'S REPRODUCTIVE HEALTH IN INDIA

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**Introduction:**

Gender-based violence is the most extreme expression of unequal gender relations in society. It is first and foremost a violation of human rights and a global health issue that cuts across boundaries of wealth, culture, religion, age and sexual orientation. Whenever GBV occurs it is a major obstacle for the achievement of gender justice posing a serious threat to democratic development and public health and is a critical barrier to achieving sustainable development, economic growth and peace.

**Objectives of the Study:**

- To explore the concept and causes of Gender Based violence.
- To analyse how Gender-Based violence is linked to a variety of negative health outcomes for women including severe reproductive and health problems.
- To suggest measures how to tackle the reproductive health problems induced by gender-based violence.

**Methodology:**

The study is based on secondary sources of data. Data has been collected from Government reports, books, journals, websites and case studies.

**Women's Rights and Reproductive Health Status: An Overview.**

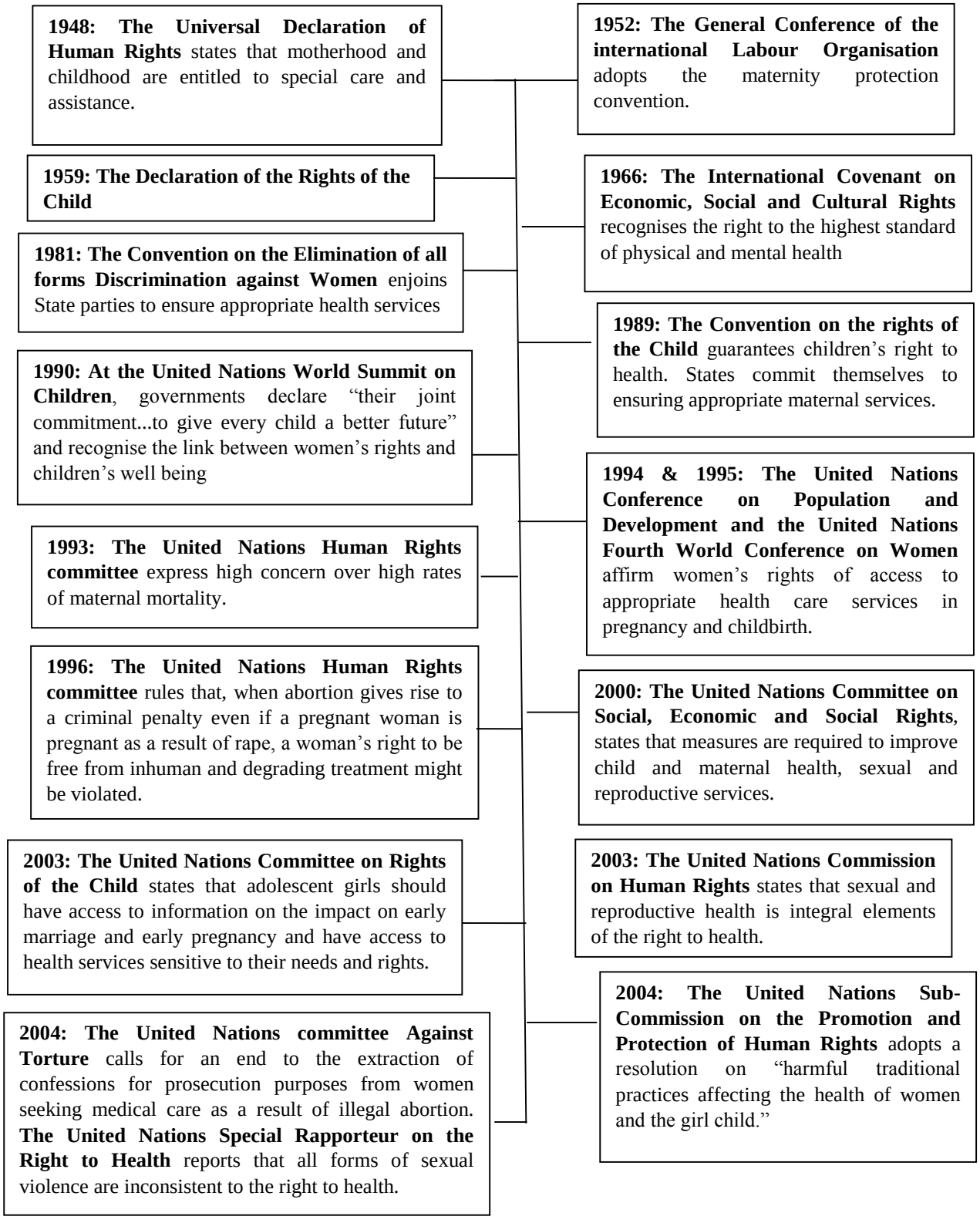
Many years ago reproductive health status was a global problem, however at the beginning of the 19$^{th}$ century many European governments invested time and effort in developing public health care generally and women and children's health specifically as a way of building up its human resources to satisfy its military and political aspirations. Prior to this such concerns were seen as a domestic matter, an attitude that still brings true today in many developing nations where the reproductive health of women is neither seen as important nor perceived as a factor, which if eliminated, could improve the economic potential of a country. The economic cost of violence against women is considerable – a 2003 report by the US Centres for Disease Control and Prevention (CDC) estimates that the costs of intimate partner violence in the United States alone exceed US$5.8 billion per year: US$1.8 direct medical and health care services, while productivity losses account for nearly US$1.8 billion.

**International Law:**

Gender equality and indeed global reproductive and sexual health rights have been included on the international agenda almost since human rights were first recognised in the universal Declaration of Human Rights in 1948. Support of these rights has been seen in various international human rights document, particularly with the ratification of the convention to End all Discrimination against Women (CEDAW), and the adoption of the Cairo Programme (1994) and the Beijing Platform

(1995). Over the last 50 years the importance and the influence of maternal and infant health have been incorporated into various conventions and documents as listed below.

**Fig. : Development of Conventions and Documents with regards to Women's Rights and Reproductive Health.**

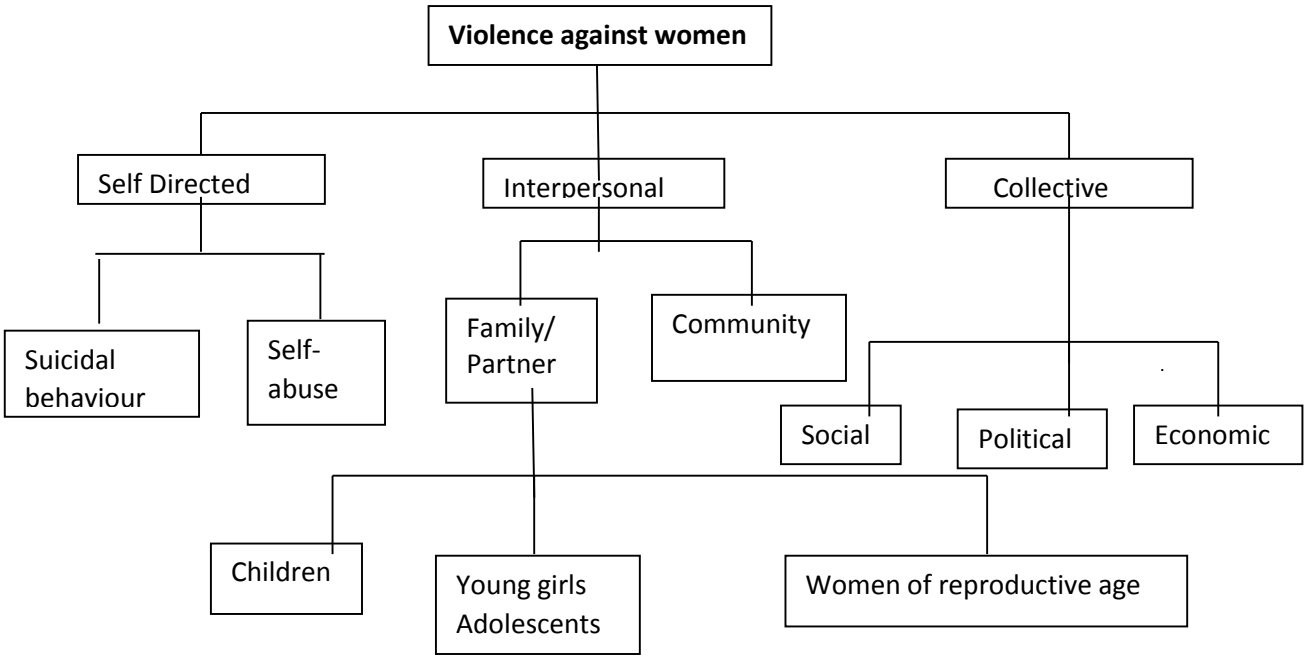


The importance of addressing this issue and its connection with gender equality finds itself at the epicentre of the Millennium Development Goals with goals regarding reproductive health offering multiple rewards that can accelerate social and economic progress, with lasting impact on future generations.

## SECTION-I

a. Violence against women: What it includes?
b. The Concept: Violence against Women.
c. Underlying Causes.

**a. Violence against women: What it includes?**




**(A typology of violence against women, modified after the world report on violence and health, WHO)**

VAW includes, but is not limited to:

- **Psychological violence:**

Encompasses various tactics to undermine a woman's self-confidence such as yelling, insults, mockery, threats, abusive language, humiliation, harassment, contempt and deliberate deprivation of emotional care or isolation.

- **Physical violence:**

The most obvious ranges from pushing and shoving to hitting, beating, physical abuse with a weapon, mutilation and murder.

- **Sexual violence:**

Any form of non-consensual sexual activity i.e. forced on a person- ranging from harassment, unwanted sexual touching to rape. This form of violence also includes incest.

- **Financial violence:**

Encompasses various tactics for total or partial control of a couple's finances, inheritance or employment income. May also include preventing a partner from taking employment outside the home or engaging in other activities that would lead to financial independence.

- **Spiritual abuse:**

Words to destroy an individual's cultural or religious beliefs through ridicule or punishment, forbidding practice of a personal religion or forcing women or children to adhere to religious practices that are not their own etc.

**b. <u>The Concept: Violence against Women</u>**

The United Nations Declaration on the Elimination of Violence against Women (DEVAW) defines VAW as:

"Any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life." (DEVAW, Article 1)

"Reasons that sustain and escalate Gender-Based Violence are:

- Cultural Gender –specific socialization
- Culturally demarcated roles for men and women
- Expectations of performing fixed roles in familial relationships
- Women's economic dependence on men
- Limited rights over land and property
- Limited employment opportunities and adverse employment conditions
- Legal Discriminatory laws on marriage, divorce, property and violence
- Low levels of legal literacy
- Insensitive treatment of women and girls by the police and judiciary
- Political Under-Representation of women in positions of power in politics
- VAW not considered as a serious political issue
- Notions of the family being private, beyond State intervention.

**c. <u>Underlying Causes:</u>**

- **Historically unequal power relations:**

The political, economic and social processes that have evolved over many centuries have kept men in a position of power over women.

- **Control of women's sexuality:**

Many societies use violence as a way to control a woman's sexuality and likewise in many societies violence is used to punish women who exhibit sexual behavior, preferences and attitudes that violate cultural norms.

- **Cultural Ideology:**

Culture defines gender roles and some customs, traditions and religions are used to justify VAW when women transgress these culturally assigned roles.

- **Doctrines of Privacy:**

The persistent belief in many societies that VAW is a private issue seriously impedes attempts to eradicate this violence.

- **Patterns of conflict resolution:**

Links have been identified between VAW in the home and community in areas that are in conflict or that are militarized. Often heightened insecurity means that tensions within the home are more pronounced and can contribute to the perpetuation of VAW in the family. Equally, because eyes tend to be on the conflict, women's suffering is often overshadowed. VAW is also frequently used as a formal military tactics.

- **Government inaction:**

Government negligence in preventing and ending VAW establishes a tolerance of VAW throughout the community.

## SECTION – II

**Literature Review on Gender Based Violence and Health Consequence.**

Violence can occur during any phase of women's lives. Many women experience multiple episodes of violence that may start in the prenatal period and continue through childhood to adulthood and old age (see Table 1). A global synthesis of lifetime prevalence data on intimate partner violence reveals high prevalence rates among young women, indicating that violence starts early in women's relationships. Among ever-partnered women aged 15 - 19 years, 29% have experienced physical and sexual violence by an intimate partner. Prevalence reaches its peak in the age group of 40 - 44 years (37.8%) and declines for women aged 50 years and older (WHO, 2013).

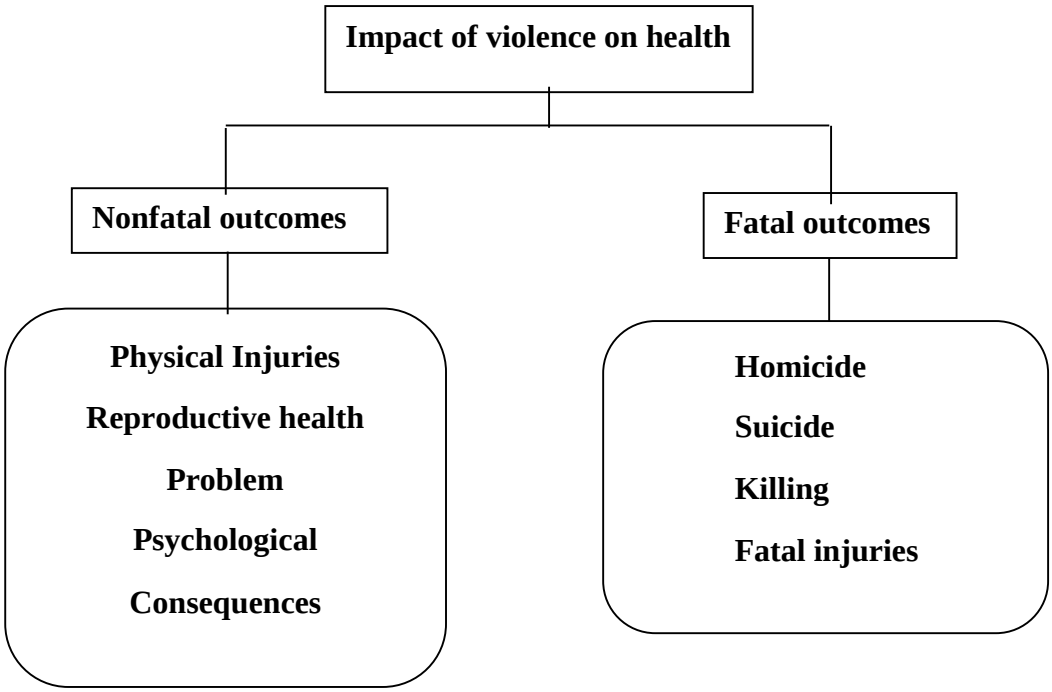
Table illustrate that women faces violence in different phases of their lifecycle, which make it understand the cumulative impact of violence, especially in terms of its long-term effects on the lives and health of women. Violence experienced in one phase can have long-term effects that predispose the survivor to severe secondary health risks, such as suicide, depression, and substance abuse (Heise et al., 1994).

**Table 1**

**Stages of Violence faced by women in their lifecycle**

| Life stages | Violence faced |
|---|---|
| **Before birth** | Sex selective abortions |
| **Infancy** | Female infanticide, emotional and physical abuse, differential access of food and medical care |
| **Adolescences** | Forced marriage, sexual abuse, sexual harassment, forced prostitution, trafficking etc. |
| **Adulthood** | Marital rape, intimate partner violence, psychological abuse, forced abortion etc. |
| **Old age** | Physical abuse & violence, emotional violence, economic violence, isolation etc. |

Source: Heise et al., 1994.




Health consequences of gender-based violence can be both, immediate and acute as well as long lasting and chronic; indeed, negative health consequences may persist long after the violence has stopped. The more severe the level of violence, the greater the impact will be on women's health. Furthermore, exposure to more than one type of violence (physical and sexual) and/or multiple incidents of violence over time tends to lead to more severe health consequences (see Figure).

A recent study published by the WHO in 2013 systematically reviewed studies providing data on health effects of physical and sexual intimate partner violence and non-partner sexual violence against women. The report stated that globally, 38% of all murders of women are reportedly committed by intimate partners.

Similarly, out of all women who experienced physical and/or sexual violence by an intimate partner, 42% experienced injuries. On the other, the study also indicated that compared to women who have not experienced partner violence, women survivors of such violence face a 16% higher risk of having a low-birth weight baby, are more than twice as likely to have an induced abortion, and are more than twice as likely to experience depression (WHO, 2013).

The study of Popa (2009) on domestic violence and its consequences on health stated that violence has deep-rooted influence on the health status of the entire community. A woman who lives in a violent relationship loses confidence in herself and in her ability to participate in activities of individual life. Mistreated women present difficulties of access to information and the existing health services. Consequences of domestic violence may persist long after the act of violence itself is consumed, and repercussions in time of the different types and multiple episodes of violence are cumulative. The violence is even more serious, the impact on physical and mental health is more profound.

A study conducted by Lozano (1999) on the health impact of domestic violence on women in Mexico City indicates that women who have faced marital violence suffered from different kinds of physical, psychological, and sexual consequences of non-fatal intentional injuries.

Mathur (1996), "Crime, human rights and national security," New Delhi, Gyan Publishing House: This work has revealed that according to theory of patriarchal control, husbands develop standards of gratification for completely dominating their wives and children. When this domination is threatened they feel deprived, suffer psychic distress and in their uncontrollable rage they beat their wives for domestic domination."

Das S, Bapat U, More N.s, Alcock G. Joshi W, Pantvaidya S and Osrin D (2013), Intimate partner violence against women during and after pregnancy: a cross – sectional study in Mumbai slums, BMC Public Health 13(1): article 817: The study has focussed that women's employment may challenge patriarchy, provoking violence but employment may be an effect rather than a cause, a means of survival rather than a manifestation of empowerment. A woman may be more likely to seek work if her family is poor, her home environment unstable and her husband drinks or is having extramarital sex.

In recent years there has been a rising interest in women's reproductive health development researches and programmes to enhance reproductive health across the globe. Universal access to quality sexual and reproductive health services is regarded as a key component to fulfilling many of the Millennium Development Goals especially the ones relating to maternal and child health, HIV and gender equity. Researches demonstrated that SRH is of fundamental importance to national health and to the economic development at large. (Mishra and Lohiya, 2016)

Literature Review on reproductive health indicates an escalating concern on domestic violence and its repercussion on health and overall wellbeing of women and children. Research in India show links between experiencing physical violence, lower likelihood of adopting contraception and increased likelihood of unwanted pregnancies.

Studies in many countries including the Maldives and Pakistan have identified that physical abuse has been associated with higher rates of miscarriage, bleeding in late pregnancy, premature labour on delivery, still births, abortion and late entry to parental care.

Intimate partner violence during pregnancy has been linked to maternal deaths. In Bangladesh where the maternal mortality ratio (MMR) of 340 per 100,000 live births far exceeds the South Asian average of 280, an estimated 14% of maternal deaths are attributed to violence. "In India and Sri Lanka, a significant proportion of violent deaths in pregnancy are recorded as due to homicide committed by the partner and suicide which is often linked to IPV."[2]

A study based on National family health Survey, 1998-99 in India revealed that women who were physically mistreated by their husbands were almost twice as likely to experience unintended pregnancies. (Begum, 2010), Another NFHS (2005-2006) based study including 65610 married women in reproductive age (15-49) reported that 23.9% of women experienced at least one form of IPV and had pregnancy related complicacies.[3]

Apart from direct impact on health status GBV tends to undermine women's reproductive control, inadequate communication and cooperation regarding family planning, sexual and reproductive health issues, poor delivery preparedness and pre and post natal care.

Growing evidence supports the fact that state of maternity does not have any significant protective effect on women from violent spousal behaviour. The incidence of domestic violence during maternity in India was reported to be 21% -28 %, ( Das, 2013)

[2] ARROWS for change, Women's Gender and Rights perspectives in health policies and programmes, Vol.17, No.2, 2011,p.1.
[3] Winter and Stephenson

Pakistan reported that more than 30% of Pakistani women suffer from some form of domestic violence. This situation is especially vulnerable for women who become mother of a premature age.

The average median age at first birth in South Asia is far lower than observed in other parts of Asia (17.9 years in Bangladesh, 19.9 years in Nepal and 21.8 years in Pakistan). (NFHS, 2016 – 2017)
Forced sex is associated with a range of gynaecological and reproductive health problems including HIV and other sexually transmitted infections, unwanted pregnancy, vaginal bleeding, fibroids, pelvic inflammatory disease, painful intercourse, urinary tract infection and infertility.

In addition to GBV more abhorrent forms of violence are female foeticide and sex selective abortion which are becoming increasingly popular in South Asia and represent emerging challenges for achieving gender equity and enhancing women's health and human rights.

Even when physical violence is not used to control a woman's behaviour, the fear of violence may greatly influence her sexual and reproductive decision – making. In South Africa, for example 57% of women living in the Eastern Cape believe that they cannot refuse sex with their partners. The fear of violence is commonly cited by married women as a barrier to using condoms with their husbands for STI or pregnancy prevention. For many women in sub – Saharan Africa, the withdrawal of material benefits if they refuse sex or use contraceptives against their partner's wishes can act as a powerful inhibitor of their sexual freedom and safe sex practices.

Violence in pregnancy may pose a threat to the life and health of the mother and the foetus. Physical violence during pregnancy is associated with miscarriage, late entry into prenatal care, still births, premature labour and birth, low birth weight. In a study of 400 villages in Pune, India 16% of all deaths during pregnancy resulted from partner violence. Partner homicide has also been identified as an important cause of maternal deaths in Bangladesh and United States.

## SECTION – III

**Concluding Observations:**

- Survivors of GBV need integrated and comprehensive care which addresses their legal, psychological and health needs and the barriers they face in accessing services. The health sector has a crucial role to play in both providing care and identifying those who have experienced violence. In 2013, the World Health Organization released clinical and policy guidelines on GVB which re-emphasized the importance of proper education and training of health providers ensuring privacy and confidentiality and having referral systems in place for women to access the necessary services.

- GBV is a ubiquitous public health issue around the globe but it has a special significance in the context of South Asia in general and India in particular owing to its deep-rooted socio-cultural barriers, social infrastructure and lack of institutional accountability. The study also highlights that GBV preventive measure must focus on strategic areas of women empowerment such as leveraging gender and sex education, job creation, designing gender – sensitive public policy, law enforcement and strengthening administrative transparency.

- Poverty and lack of access to productive resources among women significantly increase the risk of domestic violence and sex trafficking. Micro credit programmes positively correlate with decreased violent events and minimize gender disparity in funding. Gender based microfinance programmes introduced by the present central government in India can help the women to improve economic autonomy, decision making power, right to health and freedom from discrimination.

- Most people are not aware of the various health and socio – economic impacts of GBV and its negative repercussion on children, other family members and overall wellbeing of the family.

Nationwide anti – violence campaign and behaviour change intervention programmes should target awareness creation to reduce gender biases and encourage gender sensitive behaviour, eradication of health and gender related illiteracy and ensure men's participation at various levels of such programmes.

- While solid legislation acknowledging the rights of GBV survivors is a prerequisite, a major obstacle often lies in the implementation of such frameworks. For this reason, emphasis should be on bridging the gap between law and practice through the strengthening of accountability mechanisms to follow up and evaluate the implementation of laws addressing prevention and response to GBV.

- Long – term success against GBV will require the adoption of interdisciplinary framework by incorporating a wide spectrum of cross cutting strategies and enhancing multi stake – holder engagement in the overall development process. Political commitment are vital to minimize policy related barriers and developing a gender – friendly political environment. Creating a greater synergy between government and civil society organisation is equally essential to understanding the barriers to implementation of policies and how they can be overcome.

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# A COMPARATIVE STUDY OF KERALA DANCE RITUALS AND LOW COUNTRY DANCE RITUALS

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## Introduction

This research study is basically focused on the comparative analysis between ritualistic theatre in Kerala and Low country dance. History reveals that Sri Lanka and Kerala were consummated with similar nature and qualities. Both have maintained a good relationship with each other. Sri Lanka was also mostly invaded by the rulers of Chola Empire like King Karikalin, King Parantaka I, King Rajaraja I and King Rajendra Chola. Therefore, South Indian culture and their traditions easily developed in Sri Lanka, while examining the nature between Kerala and Sri Lankan dances, it can be said that both dance traditions are originated from their native rituals, folk traditions, cultural and religious aspect.

Hence the following aspects have been covered in this study:

- Study the types of both Kerala and Low country dance rituals which were celebrated in the former period to present
- Study ritualistic theatre in both traditions along with the devotional system, celebrations, presentation methods, different adornment, people's belief and reliance as well as various cultural influences
- Comparison of various presentation methods in both Kerala and Low country dance rituals
- Analyze the similarity, differences and uniqueness on both dance rituals in Kerala (South Indian) and Low country (Sri Lankan) dance traditions

## Methodology

This is a field research which observed data from live ritualistic performances in both Kerala (South Indian) and Low country (Sri Lankan) dance traditions**.** Data also collected from important expertise through interviews and discussions regarding ritual nature in both regions. On the other hand, data can be also selected from written evidence like famous treatises, chronicles, research articles and book reviews which relevant to the rituals and ritualistic theatre.

## Results and Discussions

According to this study, certain evidence analyses that both Kerala and Low country dance rituals can be identified similar and different features in accordance to their presentation methods, although both maintain their inherent ritualistic culture and uniqueness as well. When analyzing data it showed the strong interrelationship between both dance rituals.

In this research, I analyzed important data under these categories,

- Devotional concept
- Ritual arena and arrangements
- Ritual performance

- Time duration
- Birth story, myth or legend
- Ritual  syllable, rhymes and poems
- Music and musical instruments
- Ritual adornments

When examining the common feature between Kerala and low country rituals, it can be said that both celebrated Shakti form or goddess. Kerala dance rituals like Teyyam, Mudiyettu, Tirayattam, Tiyattam, Kummattikali and Patyani are associated with the cult of goddess Bhagawati, Kali and Durga while low country dance rituals such as Devol madu, Sanni yakuma, Rata yakuma, Suniyam yagaya worship goddess Pattini as one of their main deities. Generally, both dance tradition follows the masculine art of dance and performed only by male dancers. It is an open theatre performance, generally performed in front of the village temple and continues for a long time period, may be taking 12-18 or 12-24 hours. The dancer performs specific dance and songs along with describing myths and legends of the appropriate god. Likewise Kerala rituals, most of the rituals in Low country dance consummated with attractive, vibrant and colourful decorations. The ritual arena complete with various elaborate decorations which were made out from several natural leaves, trees, flowers and fruits, trees, flowers and fruits.

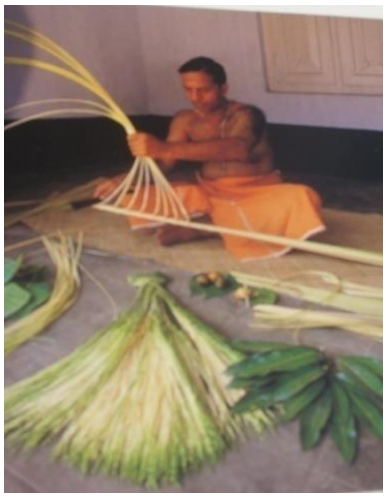

***Figure 01:***

***Preparation of Teyyam dance* ritual**

***Figure 02:***

**Teyyam dance ritual**

***Figure 03:***

***Preparation of Law country dance ritual***

***Figure 04:***

***Law country dance ritual***

As same as a Low country "Dahatasanniya" some Kerala "Teyyam" and several rituals wear masks for appropriate characters, some colourful and fearful masks are very similar to each other. Both are adorned with rich coloured elaborated costumes, mostly they are all made from natural components.

Some prominent images which show similar features in both Kerala and Low country dance rituals

***Figure 05: Teyyam dancer***

***Figure 06: Low country dancer***

***Figure 07: Low country dance ritual***

***Figure 08: Teyyam dance ritual***

In accordance with the unique feature which I found on both rituals have their inherent music and musical instruments, both used percussion instruments in different ways. The special unique feature is that Low country dance uses a mask with characteristic feeling while Kerala ritual mostly used face painting to communicate their feeling to the audience. Dance techniques of these two rituals generally follow their movements according to their traditions.

## Conclusion

This research denotes that dance rituals in Kerala (South Indian) and Low country (Sri Lankan) traditions have many common features while presenting their rituals. According to historical background in both Kerala and Sri Lanka, it can say that both traditions have been maintained their relationship and some ritualistic features were influenced by each other. This study supported to make comparative research ideas between south Indian and Sri Lankan dance traditions.

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# EFFECT OF SELECTED YOGA PRACTICES ON ANAEROBIC CAPACITY OF VARSITY SOCCER PLAYERS

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**Abstract**

The purpose of the study was to determine the effect of selected yogasana practices on anaerobic capacity among varsity soccer players. To achieve this propose of the study sixty (N=60) men soccer players (beginners) were randomly selected as subjects, who were from the various Departments of Sabaragamuwa varsity of Sri Lanka. The age of the subjects were ranged from 19 to 22 years. The subjects are performed selected yoga asana in the morning time for 30 to 60 minutes per five days/week over the period of six (6) week which was given by the yoga experts. The subjects tested on speed using 50m dash. The collected data was statistically treated by using independent't' test, 0.05 level of confidence was fixed to test the significance. The result shows that there was a significant difference in Speed between pre and posttest.

***Keywords: Yoga Practice, Anaerobic, Soccer Players, Varsity***

## Introduction

Yoga is an ancient philosophical and religious tradition which is thought to have originated in India in at least 1000 B C (Feuerstein, 1990). It refers to a large body of values, attitudes and techniques. The word yoga is probably derived from Sanskrit word "Yuj" which means to "unite" or "connect" and higher levels of yoga this is often said to mean the experience of union of the individual self with universal self (feuerstin 1990). The word yoga bringing together two things into a relationship. There are many examples of union in yoga, like union of mind and body, the union of yin and yang. Integrating yoga into elementary physical education offers more possibilities for wider group of students than traditional sports and fitness classes (finger 2000). Since it has triangular relationship of body, mind and spirit "yoga is a sophisticated system for achieving radiant physical health, mental health and peace of mind" (Schiffmann 1996). Most commonly yoga is regarded as a physical discipline, one that teaches strength, speed, agility, flexibility and balance of body. Hatha yoga improve the physical disciplines is a form of Raja yoga which has recently become extremely popular in the west (Corliss 2001). The techniques of Hatha yoga place particular emphasis on physical, breathing, and concentration methods for regulation of the body's energy (Iyengar 2001).over the last ten years, a growing number of research studies have shown that the practice of Hatha yoga can improve strength, agility and flexibility, and may help to control such physiological variables as blood pressure, respiration and heart rate. Exponents of yoga believes that other exercise systems only have a physical beneficial effect on the body whereas yogasanas result in the development of the physical, mental, spiritual well-being, physical exercise performed vigorously are helpful in develop in muscles and flexibility in health peoples.

## Purpose of the study

The primary aim of this study was to determine the effect of selected yogasanas practices on anaerobic capacity among varsity soccer players.

## Methodology

The purpose of the study was to determine the effect of selected yogasana practices on anaerobic capacity among varsity soccer players. To achieve this propose of the study sixty (N=60) men soccer

players (beginners) were randomly selected as subjects, who were from the various Departments of Sabaragamuwa University of Sri Lanka. The age of the subjects were ranged from 19 to 22 years. The subjects are performed selected yoga asana in the morning time for 30 to 60 minutes per five days/week over the period of six (6) week which was given by the yoga experts. The subjects tested on speed using 50m dash. The collected data was statistically treated by using Independent't' test, 0.05 level of confidence was fixed to test the significance.

**The Sequences and Duration of the Yogasanas included in the Training Programme are...**

| Yogasanas | Repetitions | Time /minutes |
|---|---|---|
| Suryanamaskar | 3 | Six minutes |
| Ardha kati chakrasana | 3 | Six minutes |
| Ardha salabhasana | 3 | Six minutes |
| Padahastasana | 2 | Four minutes |
| Pascimottanasana | 2 | Four minutes |
| Paripurana navasana | 2 | Four minutes |
| krauncasana | 2 | Four minutes |
| Salabhasana | 3 | Six minutes |
| Phujangasana | 3 | Six minutes |
| Dhanurasana | 3 | Six minutes |

**Result**

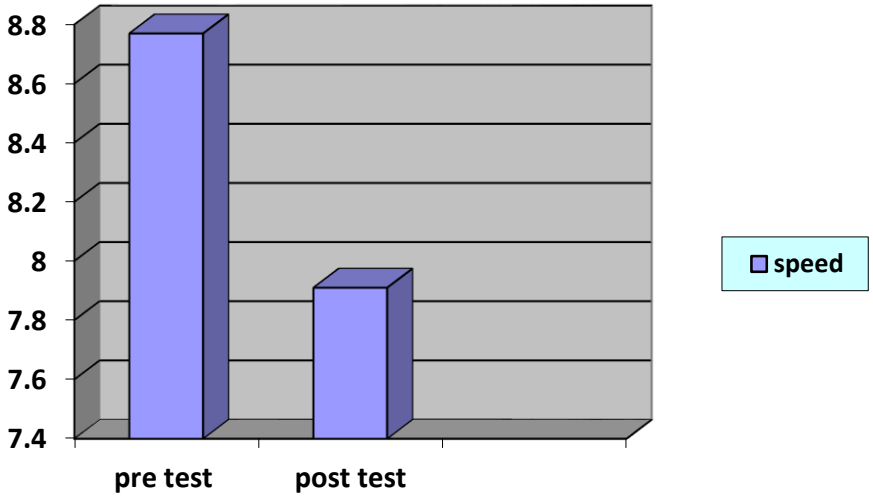
**Table 1**

**Computation of't' ratio Between Pre and Post tests on anaerobic capacity among varsity Soccer Players**

| SL. NO | Variable | Test | NO | Mean | S.D | 't' value |
|---|---|---|---|---|---|---|
| 01 | Speed | Pre - | 60 | 8.77 | 0.69 | 25.88* |
| | | Post | 60 | 7.91 | 0.67 | |

***significant at .05 level of confidence with df (1, 58) is 2.00**

**Figure: 1 bar diagram of the pre and post test mean value for Speed**




**Discussion**

Yoga is one of the most important things to every human to improve the health. But the question of improving the components of bio motor is substantiated by the results of the present study. The results corroborate the findings of similar studies conducted by Sahu Bhole(1993) in which significant improvement in speed, Moorthy (1982) has documented significant improvements in fitness. However, where as Morrthy (1982) found significant improvement in flexibility. The former study was contacted on young boys and girls where as the latter study involved aged peoples. In such case it was concluded that the age should also be taken into consideration in assessing the effect of yogasana training.

**Conclusion**

Based on the results of the study it was concluded that, there was a significant improvement in anaerobic capacity (speed) of varsity soccer players. Further, Depend upon the extended duration of yogasana practices on selected variable may improve better level to achieve the goal.

**Implication**

Yogasana practices will be recommended to improve the anaerobic capacity to maintain good health and fitness further to the player's excellent theatre performance.

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# A STUDY ON PHILOSOPHY, RELIGION AND SCIENCE

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Here a succinct note is placed on philosophy, religion and science. Philosophy is broadly regarded as an intellectual discipline aiming at reasoned analysis on any subject for arriving at clarity, eliminating confusion as far as possible. It has a long tradition in human thought -construction since horary past. Although there is no one-way of presenting philosophy, despite accepting its rational backbone. It is, therefore, different types of philosophising like philosophies of ontology, language, linguistics literature and so on. In one recent world congress of philosophy, there has been noticed certain unconventional naming of discussion of philosophy as philosophy for child, philosophy over death, philosophy as therapy and so on.

In human course of civilization, philosophy, and its cultural tradition with various facets of religion is found to have been placed a dominant role in divergent parts of world phenomena. As a matter of fact, it is noticed that right from the ancient stage to the mediaeval period both religion and philosophy are found to have been discussed in a common platform to arrive at a unitary conclusion. Particularly in the classical Indian philosophical tradition, since past, the unitary approach for both the subjects is found to have been supported by thinkers and it is continuing today in some corners.

In western tradition, the philosophical rational basis in general is differentiated from the religious orthodoxy and, as such, the emphasis on reason for the sake of philosophical journey is favoured taking of diverse standpoint and avoidance of blind faith as far as possible.

Scientific study and research have been advanced throughout the globe somewhat little late. The Copernican revolutionary heliocentric hypothesis is a landmark in the scientific pursuit and perhaps has decisively played a blow to religious conservative dogmatic surmise of geocentric hypothesis. In continuation of the Copernican tradition, there has been found rapid development in various forms of scientific discoveries and innovation, which have not only given rise to phenomenal account of global perspective but also has obtained significant result in treating and eradicating biological deficiencies in men and animals.

While moving for observation and experiment, with their various mechanism, knowledge about world phenomena has definitely increased, though by means of certain mishandling of it, and misapplication men have faced certain number of tragic situations. In other words, it is not science rather misuse of science that has led to some terrible consequences.

Amidst all these brief encounters, it seems to be quite pertinent to mark affinity and difference among all the aforesaid three subjects. In the south Asian countries, Hinduism has its presence since long. Though the two terms in Sanskrit i.e. dharma and *darshana* are lexicographically having different connotation, in actual behavioural usage there is taken to be somewhat close resemblance between the two. In the dominant circle, darshana has been used to supplement and support divergent thinking by the commentators of different original scriptural texts. Though, by and large, darshana stands for reasoned conclusion (*Siddhanta*). It is meant to support/strengthen religious belief /faith.

Of course, there are variations to such general stand, by the thinkers /writers since long past. For instance, in Indian tradition one comes across of Chanakya / Kautilya (author of *Arthasastra)* of around 400 B.C. who has mentioned darshana as *Anukshiki* meaning thereby critical enquiry cum investigation based on ground or reason. This point has been instantiated by him in Indian philosophical systems like Samkhya, Yoga and Charvaka. For, during his time, these three

philosophical views are found to have been based solely on rational foundation (*yukti*) on the foot-hold of cause (*hetu)*. There is no mention by Chanakya about Vedic, Jaina and Bauddha tradition though those were prevalent during his time. Most probably because those where considered as dharmic belief and not on philosophic reason. Subsequently in this oriental tradition there is adherence to scriptural orthodoxy. Philosophical interpretations are advanced by commentators to support the religious oracles /scriptural sacredness. Later on, it is further strengthened by means of emphasizing on surrender to divinity and relinquishing completely reasoned argument (***BiswasemilaiHari tarkebahudur***). This sort of fuse between dharma and darshana has made a blow to the distinctive approach to darshan as being grounded on the method of argument and counter argument for arriving at conclusion (***Vade vadejayate tattva bodha***).

In the western philosophical tradition, philosophic temper primarily has grown in Greece and subsequently has flown to other parts of Europe including Great Britain of the past. In its early phase, philosophical discussion has not been so much intermingled with religion, though during the mediaeval period, on account of religious domination (mainly on Papal authoritarianism), the tradition has moulded the philosophic temper to support /defend theological orthodoxy in some way or other. In that way, philosophical discussion has left open texture and has become almost a hand-made of theology. As hinted earlier, in the modern phase, there has been a gradual shift of religious overtones from philosophical discussion in general as it is more grounded on reason and not a mere faith.

Of course, in the early period rational emphasis philosophical discussion has not been fully free from the theistic root and that has continued for some centuries in the west. Subsequently, due to freedom and openness in philosophical analysis; the discussion has made a meaningful shift from the impact of religious conservatism and has not been fully opaque to the wise and development in the realm of science and social science. New issues and problems are found to be plausible. Because of such rise and progress, philosophical discussion has begun to take note of all these. Theory, it does not of course, become a hand-made of science (as in case of being hand- made of religion, of the past); rather it has become careful and cautious to pinpoint area or domain and thereby, it has made a searching analysis of the concepts employed in areas and disciplines inclusive of science, social science and religion.

There has been the growth of new domain of analysis, logical empiricism /logical positivism, phenomenalism, existentialism, analysis devoid of positivism and emphasis on ordinary language as the thrust of philosophical discussion on language and so on. As hinted earlier, philosophy has taken the mode of going beyond the set philosophical jargon and has been broad enough to have its analysis on different new issues and problems and it has cropped up in recent times like depth, gender, therapy, issues concerning children and so on.

From all these remarks as sated above, one may sum up the whole discussion philosophy, religion and science together: whereas both philosophy and science are aimed at academic –cum- intellectual pursuit in some way or other, religious quest seems to have been more circumscribed to some sort of faith or belief in divine transcendence. Reason or rational argumentative discussion is limited to practical efficacy or workability in the phenomenal sphere. It does emphasize upon ideal form of theoretical transcendence which may or may not be practically useable. That shows, it is not confined to academic standard of intellectual pursuit through reason and objectivity. That is how personal element of some sort of emotional passionate longing works within the frame-work of religion. On that ground, it is stated in certain quarters that religion moves beyond reason and the usually accepted sense of reason is placed therein by intuitive force of direct experience which goes beyond rational sense of objectivity. That is how the sense of transcendence therein lurks underneath.

Now, in case of science and philosophy as it is noticed, a difference is found between these two and religion. While religion is mostly aimed at otherworldliness, philosophy and science by means of their approach are confined to this worldliness. Science by large and (social science) is based on their respective study and research on observation social and factual phenomena. But sciences of natural type accounts observation with all its complex mechanism move for experiment of various types in the factual source. In other words, the method of investigation there seems to be only factual in its

diverse facets. But the same social scientific studies is devoid of factual investigation; only it is by and large limited to observation and not so much for mechanized experimentation.

Philosophy is equally concerned with rational analysis of broader type. In that way it is not opaque to hypothesis (provisional supposition) found in researchers both in science and social sciences. Only those are not based on factual research are principally not included in philosophical pursuit. It, on the other hand, seems to have given sole emphasis on the rational analysis of various concepts sued in science and common sense and philosophy aims at such conceptual analysis for attaining clarity and avoiding confusion as far as possible. To put in other words, philosophical studies seem to be more confined to conceptual analysis.

In that way, philosophical analysis has been extended to religious concepts too in the name of philosophy of religion. So also, concepts used in common sense usage are held in current times in the philosophical sources also as hinted before.

# BE SEATED & KNOW EVERYTHING

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## ABSTRACT

It is very much a matter of thinking that time is running or we are running, though in the right sense, we are running and time has just sat. Time is constant, that is why it keeps all the information of the entire universe; if we say that time is the encyclopedia for keeping the information about the universe and the world, and then it will not be wrong. Now the question arises whether a person understands time or not, if we do not have the answer, then we all are thinking right. Humans have amazing potential, whatever they can think of, they can do it themselves, and can understand the knowledge of the entire universe. In order to know the universe, in the second century of the ancient Indian history Patanjali had discovered a few number of techniques through which person can achieve anything. Be seated & know everything is an ancient & unique process. People can develop these techniques with the practice of their body. Patanjali has developed eight steps for body practice in a chapter of a pantajali yoga sutra book. Although there are three more chapters besides this, and the four texts are respectively *Samadhi* lessons, S*adhan* lessons, *Vibhuti* lessons & *Kevalya* lessons. There are about 195 formulas in all the texts, all the formulas are in Sanskrit. This study will help to achieve Excellency, knowledge & wisdom in all the streams.

*Keywords: Practice, Breath, Mind, Relation, Silence, Enlightenment.*

## Introduction

Both knowledge and science are helpful in the development of human beings, knowledge and science have no boundaries and it is beyond the understanding of ordinary people. If it is to reach the common people, then we have to tell them the way. The path is very simple; man will have to leave only a little while to understand this knowledge and science. Let's talk about science first, there are two types of science in this world, one science outside the human body and another science is inside the body. In this research paper, we will talk about the science inside the human body. Man's body is not a common body; it is very different from all the other creatures. The ability to think and understand it is more than all the other animals. Humans have to understand their own body, and when they fully understand their body, and then the science of the body will also be understood by them. There are many processes to understand the science of this body, but in this research we will study the techniques told by the Patanjali. Through the study and practice of these techniques, the human body will fully understand the body science. The final form of understanding of the process of this physical science is knowledge. This knowledge, which has the capacity to completely change the person, will not only change his thoughts but will also make the person physically fit. If you look at external science then it has also worked for man, but it is not so effective. Looking at the science journey of the last 20 years, we find that the science has been discovered to measure the health of a person's body with the help of machines. Mental disorders have also increased with the help of excessive external science. The science of Patanjali will not only solve physical but also mental disorders. Through body science, a person will be able to do all the tasks of his life wonderfully. When a person's development will become physically and mentally, then he will be able to save himself from the bad things happening in society, and a common person will also have a big role in the reform of society. In the right sense, the development of the ability of the right and wrong decision of the human beings is the goal of knowledge and science, and the goal can be accomplished through the Yoga sutra of Pantjali.

The term of Patanjali yoga sutra is believed to be around the second century BC, it is very ancient tradition, through this method the information of the entire universe can be obtained. By its use, many humans have changed their lives, have done and will continue in the future.

- ## Research Method:

The method of research is empirical: Empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

- ## Objective of the studies are:

  - **To understand the science of body**
  - **To understand the unlimited possibilities of body**
  - **To understand the relationship between science of body & knowledge**
  - **How to implement science of body & knowledge in life, society & world**

    - **To understand the science of body**

Man's body is synonymous with many chemical actions, and its potential is very infinite. Through the Ashtanga Yoga, described by Patanjali, a person can control all the actions of his body. This is a very good medium to fully understand the science of the body. Let us now try to understand these Ashtanga Yoga. All the sources of Patanjali are in Sanskrit, and information has been given about it in the 29th sutra (formula) of second chapter.

**Chapter 2- साधन पाद**

**सूत्र 29 -** यम नियमाअसन प्राणायाम प्रत्याहार
धारणा ध्यान समाधयोऽष्टावङ्गानि।

Translation - Yama, Niyam(rule), Asana, Pranayama, Pratyahara, Dharana, Dhyan and Samadhi are the eight parts of yoga.

Interpretation- Improves the outward behavior of the Yama, the inner correction is done by the rules, the body is purified from the Asanas(body posture), the purification of breath is done through pranayam, the senses are purified with food habit , the mind is pure from perception, meditation improves temperament, and intellect improves in samadhi. From the purification of all these, the mind is cleansed and the soul is the knower of the truth.

Understanding the soul is the best science, and understanding of these eight limbs only makes the body fully aware.

If we look at in design perspective then we have to see famous artists those who have also accidently done the same thing and achieved Excellencies. Let’s take few examples:-

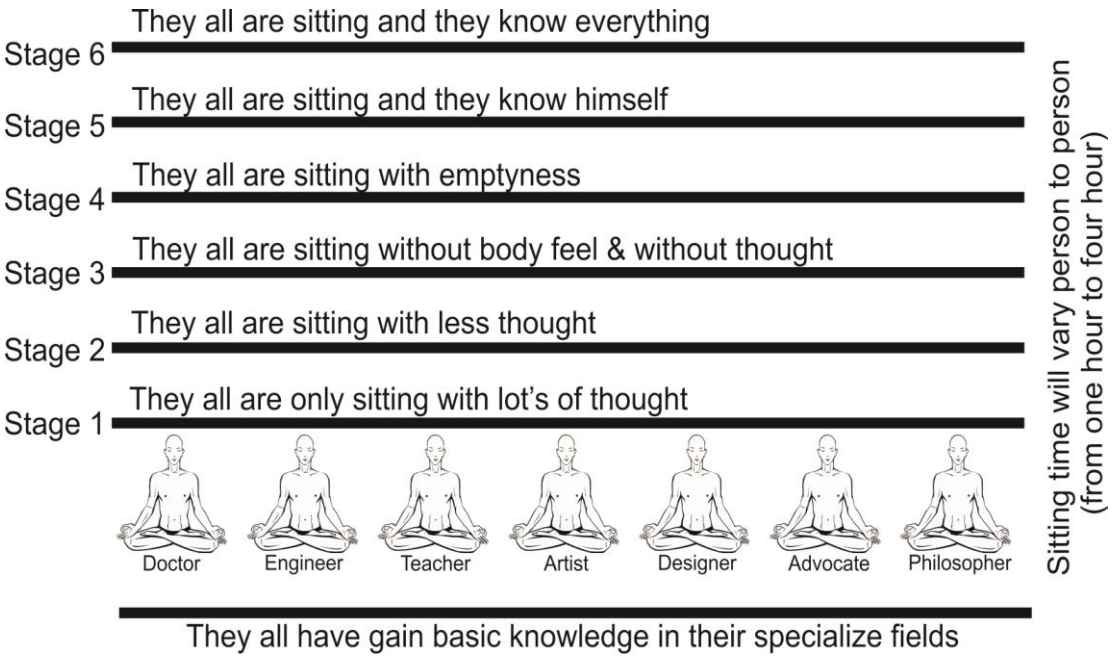
| Artist | Country | Name | Picture | Birth | Death | Birth place | Mental State |
|---|---|---|---|---|---|---|---|
| | Netherlands | Vincent van Gogh |  | 30 -03-1853 | 29-07-1890 | Zundert | Psychosis, What is real and what is not, false beliefs, seeing or hearing things that others do not see or hear, schizophrenia |
| | Italy | Leonardo da Vinci |  | 15-04-1452 | 02-05-1519 | Vinci | Powers of observation, lateral thought and huge diversity of obsessions |
| | Italy | Michelangelo |  | 6 March 1475 | 18 February 1564 | Caprese | Michelangelo's single-minded routine, According to descriptions by his contemporaries, the painter was "preoccupied with his own reality." |

Science says that Vincent van Gogh, Leonardo da Vinci and Michelangelo are suffering from schizophrenia, power of observation and preoccupied with his own reality. But the fact is, these are not sufferings, basically these are inner body science Excellencies and can be achieved through yoga sutra. If any artist have basic knowledge of design elements & principal of design and also do practice of yoga sutra then in the seventh stage (Dhyan), artist would be able to articulate design elements & principal of design to create extraordinary work.

- **To understand the unlimited possibilities of body**

The physical capacity of the body is linked to the entire universe. It is not a mistake, if the sun is destroyed now, then we will also finish within 15 minutes. It means that whatever is in the universe, all the influence on human beings. A person should be specialized at least in one asana and he also has stamina to sit for longer time. Here sit means "be seated".

The "be seated" concept can lead to a person to "know everything" let's take example:-




When they all come back from stage 6 then they will be able to transfer "know everything" In their specialize fields. Now question comes that, is it possible or not, then again we will have to look

towards spiritual leaders ( Budha, Mahavir, Lao Tzu, Mahavtar babaji, Shyama charan Lahiri etc.), because only they have used this method to achieve Excellency. If other professionals will also follow the same technique, then they will also attain the same knowledge. This practice can be attained through pantjali yoga sutra.

- **To understand the relationship between science of body & knowledge**

According to Gita (spiritual book), body is a mixture of five elements and these five element are: -

Earth Water, Fire, Air, Ether.

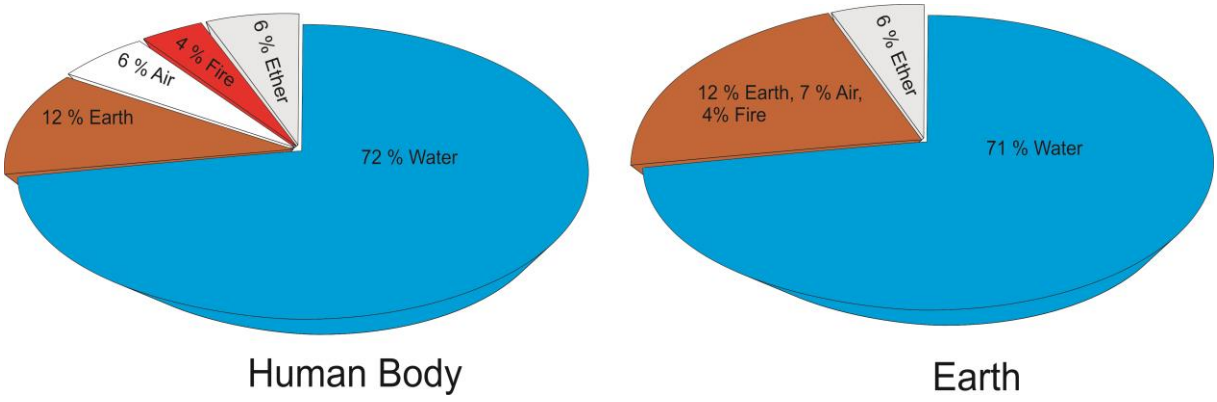
Earth – All the material exists in the earth, the same material also exist in human body.

Water – It also exist in human body and in the same proportion it exist on the earth.

Fire – It exists in the form of heat, energy & to digest food.

Air – without air human can't survive, human knows that it start from nose and no one knows that where it ends.

Ether - We all required ether & space to live in outer world as well as inner world, universe is a space & the similar space also exist in humans mind. We can't fill the universe & we also can't fill mind.




If we look at the above pie chart then we can see that human body & earth have almost similar element & with similar percentage. According to pantjali yoga sutra, if human understand the body then it is possible to understand the earth. Let's study below mention Sutra number 40 & 28. According to these sutra human can attain lots of knowledge. Only practice required.

**Chapter 1- समाधि पाद**

**सूत्र 40 - परमाणुपरममहत्वान्तोऽस्य वशीकारः |**

**Translation** - The mind based from the aforementioned measures stabilizes in all the subjects from the gross and the very subtle (from atom to the ultimate significance).
**Explanation** - Once the mind is stable, it can be firmly fixed in the gross and subtle subjects like atom to greatness. He gets full control over his mind. This is called Vashikaar. It leaves the playful nature of the mind and becomes stable.

**Chapter 3- विभूति पाद**

**सूत्र 28 - ध्रुवे तद्गतिज्ञानम्।**

**Translation** - By continence in the Dhruva (Star), the knowledge of the speed of those stars becomes known.

**Interpretation** - Scientists say that our Sun is also revolving its own Solar System along with Dhanurashi (Sagittarious). Sagittarius is the center of our world (Universe). But according to Indian perception, its center is Dhruva & around which all these stars are rotating. Therefore, if the Dhruva is restrained then the knowledge of the speed of all these stars becomes known.

- **How to implement science of body & knowledge in life, society & world**

Patanjali has said that if a person sits for a long time at one place and meditates, then that person can acquire knowledge. During this sitting, no part of the body of the person should move, and then only he can attain knowledge. But some people only understand that if they get stuck, then knowledge will be attained, but Patanjali is not only stressing on the sitting of the body, but it is putting too much emphasis on the thoughts sitting of the person. If a person controls both thoughts and the body, then he will understand the science of the body very well. After understanding the science of the body, the person will know all the elements. Now it will be easy for him to know that both the elements of the earth and the elements of the body are the same. So he will understand the possibilities of these elements and beyond their boundaries. The implementation of basic yoga sutra body science could be implemented in the school but for perfection it should be at graduation level so that student can understand its intricacy.

Once a person is aware of it, he can bring a revolution in his life. The revolution of the life of a person can bring changes in the society and the world. The transformation will be in all areas, for example: - inventions, doctors, medicines, engineers, teachers, artists, designers, philosophers etc. With the help of this knowledge Vincent van Gogh, Leonardo da Vinci, Michelangelo, Mahavir, Lao Tzu, Mahavtar Babaji & Shyama Charan Lahiri etc, have made many changes in their life as well as in society and the world. Such knowledge will not harm anyone; it will be for the welfare of society.

## Conclusion

A person is great with his work, and in today's society, the person's work is only for achieving wealth, and for this reason the person does not distinguish between his right and wrong. If you study religious books of the world, then you will find that everyone has said the same thing. In all the civilizations, there is also information about understanding the science of the body, which has been neglecting for thousands of years and the result of this is that the person is most disturb. If a person needs a change in his life then he must understand the science of his body, otherwise he will go into a dark state after a few years. After acquiring body science, one can understand the natural order; he will know that every creature in the universe like him, he will also know that no natural system should be harmed. The loss of natural system is actually a loss of human beings. Man's body is also natural and it is never appropriate to hurt one nature to another nature. The Yoga Sutras of Patanjali are completely natural arrangements, and this is the reason that by its use, natural man can understand the natural order of entire universe. As there are scientist sources, through which new gadgets are invented, in the same way, through the 195 sources of Patanjali, the capacity of the person increases very much. The practice of these sources can be done at any age, but if they are used in a young age, then a person can contribute to the welfare of the society for a long time.

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# MULTI AGENT APPROACH TO TIME BASED VEHICLE ARRANGEMENT IN A TAXI COMPANY

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## Abstract

Taxi services consist of several identities such as Client (Customer), Taxies (Cab or Car), Drivers and etc. These entities involve in completing a hire. Development of communication technologies and communication networks is an essential part in taxi service. Taxi companies always concern about accountability of driver, location awareness of taxi using GPS (Global Positioning System), dispatching most economical taxi considering distance to client (consider as lost millage) , waiting time of taxi without job, daily earning of taxi, type of taxi (hybrid or sedan), color of taxi and special services requested by customer. Those are the most essential requirements of a booking in all reputed taxi companies. Keep a promise to customer that his vehicle is on the way is the repute of every established taxi company's goal. This dissertation discusses the satisfaction approach using multi agent and reliable internet services in reaching the above goal of reputed taxi companies. It includes key design decision, schedules the taxi according to customer requirements, reschedules the taxies for bookings to gain the economic advancement, applies the ride sharing concept to utilize the limited resources and novel approach of booking sharing (arrange multiple taxies to one booking) to minimize the customer hail on roads. This multi agent approach applies to competitive taxi company in Colombo, Sri Lanka and compares the results of existing system with the new approach.

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## Abbreviations

| Abbreviation | Standard |
|---|---|
| GPS | Global Positioning System |
| SMS | Short Message Service |
| NMEA | National Marine Electronics Association |
| GPRS | General Packet Radio Signal |
| GIS | Geographical Information System |
| ICT | Information & Communication Technologies |
| GCM | Google Cloud Messaging |
| JADE | Java Agent Development |
| FIPA | Foundation for Intelligent, Physical Agent |
| AOP | Agent Oriented Language |
| BDI | Belief–desire–intention |
| ACL | Agent Communication Language |
| GUI | Graphical User Interface |
| QoS | Quality of Service |
| AMS | Agent Management System |
| RMS | Remote Management System |
| DF | Directory Facilitator |
| DEMA | Dispatch Event Management Agent |
| EA | Environment Agent |
| BEA | Booking Execution Agent |
| TDA | Taxi Driver Agent |
| WTK | Within Ten Kilometer |
| RSA | Ride Sharing Accepted |
| DDA | Dispatched Driver Agents |
| FDA | Free Driver Agents |
| DEF | Dispatched Evaluation Factor |
| ETA | Estimate Time of Arrival |
| MAS | Multi Agent System |
| TMSF | Taxi Management Simulation Framework |

# Chapter 1 Introduction

## 1.1 Introduction

Taxi service is supporting to national transportation system to reduce their work load and make comfortable transport experience to customers. Last few years, new software architecture for managing taxi service at the tactical and operational level has emerged. It views the taxi service as composed of a set of intelligent software agents, each responsible for one or more activities in the taxi service and each interacting with other agents in the planning and execution of their responsibilities. Agents are really helpful to minimize the complexity [14] of problem generated and scalability of agent help to making reliable decision and self-organize the system.

## 1.2 Problem Definition

Leading Taxi Companies in Colombo, Sri Lanka have successfully developed and implemented call management application for them.

It has facilities to

1) Manage customer information (when a customer calls to call Centre, system will identify the existing customer and popup the booking history details on screen. It helps to quick booking for officers in peak hours)
2) Manage hire booking information
3) Manage hires dispatching. (re-dispatching option is also included in existing system)1
4) Manage SMS as well (When dispatching operator dispatched a taxi for booking, system generates a SMS to send to driver which consist of client pick up address and a SMS to send to client which consist of driver and taxi details)

### 1.2.1 Nature of taxi service

Following details results from analyzing the current database of above company for last two years.

01) Call Centre operators are receiving hire booking orders concurrently with a maximum of 15.
02) A considerable fleet of more than 100 cars and drivers wait for hires in field per day. After every hire, a driver has to complete a log sheet based on the information provided by the taxi meter.
03) 1200 - 1500 orders per day. More than 65% of hires are credit hires for weekdays and it has changed according to day category such that weekends and holidays. In some peak hours hire booking order flow exceeds the rate of 300 per hour in weekdays.
04) The important attributes of booking are customer mobile number, pick up address, pick up time, drop location, urgent or advance booking and special requirements (cash or credit, VIP customer or not, normal or hybrid car, color of car, model of car, requested driver and customer preferable language)
05) Types of customers are probably personal (cash hires) or corporate (voucher hires). Some corporate hires are done for cash.
06) Driver attributes are capability to complete special jobs, driver experience (knowing of roads of Colombo area or not) and known languages
(Sinhala, English, Tamil and etc.)
07) A hire booking has to complete several statuses in real time (Table 1.1)

| Short Name | Description |
|---|---|
| Unplanned | Booking has registered in system |
| Planned | Dispatching operator selects a suitable taxi for registered booking according to parameters concerned |
| Active | taxi and driver details are informed to client and driver has started to reach the client pickup location |
| Complete | Driver successfully reached the client destination |
| Canceled | Hire is canceled |

Table 1.1 Booking Status

08) Car attributes are type of car (hybrid or not) and current location of the car. A taxi driver has to pass several statuses in the working period. These are a) Waiting for a job (WAIT), b) On the way to job (OWJ), c) At the place (ATP), d) Passenger on board (POB), d) Job finish (JFIN), d) Going to free (GFREE)
09) Approximate time to pick up the client is decided by call Centre operators after seeing location board which marked the predefined location with free car's button in manually or after calling the driver.
10) Choosing a driver for hire, dispatching a car for hire, rearranging the location for drivers according to day events prepared by company, deciding the road conditions and sharing the knowledge of day events and conditions are done by well experienced dispatching operators.
11) Taxi drivers are tightly coupled to the taxi service and have no permission to reject the job assigned by company and have no permission to do the ad-hoc hires (directly come from field) without informing the base(venue of dispatch operation) officers.
12) Two types of waiting scenarios are found on current system. One of waiting time starts after starting the hire and traveling some distance and it is more common with cash hires. Second one is waiting starts before starting the hire and without traveling any distance. It will more predict with credit hires. Some time, average waiting time duration during hire is more than 1.5 hours. Average waiting time duration before starting the hire is more than 2 or 3 hours.
13) When there is a failure of the arranged taxi for client, company is responsible for arranging another vehicle for it as soon as possible.
14) Dispatchers are always responsible for economical dispatching to reduce the lost mileages (distance travel to pick up the customer during 'on the way to job' state) and reduce job waiting time and equality earning for every drivers. In that case, dispatchers should be responsible to perform right decisions in right situation.
15) Client can request a driver to his journey, with permission of company.
16) Company is flexible to unmark (every taxi work for the company should stick the company logo left and right side of car. Without it the car is called an unmark car) the car in special situations.
17) Daily hire cancellation ratio is up to 6-8% and hire cancellation after dispatch is up to 2-2.5% compared with daily hires. Late arrival was main reason for 70-75% of cancellations after dispatched.

Arrangement of vehicle under above conditions is a complex process. In case, miss up any day condition or customer behavior, cancellation ratio may go high. This kind of situation is handled by well experience officers who have expertise in this problem domain. The proposed automated system contains multi agent model to accomplish the above task based on past experiences of everyone which can theoretically identify and simulate according to agent technology.

## 1.3 Objectives of the study

The main goal of this study is to identify and implement high efficiency automated dispatch management system to reduce the hire cancellation ratio using multi agent architecture. Other main goals as follows.

01) Minimize the lost millage of a taxi
02) Make win-win situation between company and corporate customer applying ride sharing concept for booking reservation using multi agents.
03) Test the novel approach of booking sharing (applying more taxies for one booking) concept to reduce the client hail time on roads using multi agent technologies.

## 1.4 Structure of the dissertation

The next chapter consists of descriptive literature reviews which were previously published studies by various researchers regarding the intended problem domain. Each of the studies was reviewed critically based on the main requirement of this particular study. It also contains the novel approaches that have been conducted regarding the problem domain.

Third chapter includes the work that we tried out through our study. It also contains the research and development steps of the study with the brief theoretical background of each concept and technology that was used in the study. All theoretical and technical aspects were reviewed for selection of implementation methods and techniques.
Fourth chapter consists of results obtained using direct implementation methods. Results of the study were presented in more readable manner using suitable representing methods. This chapter also includes the discussion of results that we accomplish through our study.
Final chapter presents the conclusion of the study and the objectives that we were able to accomplish and the limitation of the study. It also includes the future work that can be carried out regarding the problem domain.

# Chapter 2
# Literature Review

## 2.1 Introduction

To achieve the objectives that have been set at the beginning of this study, it is compulsory to carry out a successful background study on previous works done and currently ongoing researches regarding the same problem domain. This chapter includes the reviews of previous works carried out with respect to the selected problem domain and the researches that have been carried out regarding Taxi Dispatching, Complexity Analysis and Agent Technology. This review was conducted in order to obtain a better understanding about problem domain and different agent approaches to archive their goals.

## 2.2 Vehicle Tracking & Monitoring

Real time vehicle tracking is a most wanted feature in taxi industry. Basically GPS (Global Positioning System) enable tracking devices are used to track the vehicle in real time. These trackers send data according to NMEA (National Marine Electronics Association) standard to reduce the data bandwidth. Most trackers support SMS (Short Message Sending) and GPRS (General Packet Radio Signal) to send the data to central point.
GIS/GPS/GPRS and Web – based Framework for Fleet Tracking [15] is one of the approaches for getting the overview of full fleet to one window in computer. According to the paper, many client devices can communicate with one central server using different platforms to collect the GPS data to database and newest data are always sent to the web interface to view on map.

## 2.3 Dispatch Management using Multi Agents

Real time scheduling and re-scheduling [01] of a taxi is not an easy task and it requires perfect domain knowledge significantly. Optimization of wide range of business and social systems can be managed with multi agent architecture. Selecting possible and economical vehicle for customer, reacting to events in real time and improving the fleet utilization are the most critical tasks in taxi serving domain. Multi agent technology is a reliable approach for large and scalable system optimization and for effective arrangement and rearrangement in real time.
Dispatching vehicle is a most important task in taxi field. It will decide the taxi drivers, lost mileages and customer reaching time as well. Road traffic condition is the non-considerable factor for humans. If systems aware to determine the road traffic condition in real time it is more helpful to dispatch operators to dispatch the economical vehicle for hires. [02] Within road traffic condition GPS enable system can make more effective dispatching solution for taxi industry. It will give the shortest time path to reach the customer and gain the good repute for taxi industry and more organized taxi fleet can meet the demand of service and gain higher service quality.
Dispatching strategies are varying from company to company and operator to operator in same company. It is the one of base knowledge of taxi industry and gain solution make the better company repute. All the dispatching strategies focus on economical and worth full decision for company. So, different methods are incorporated to gain success in dispatching task such that towards an automated approach [03]. Empirical analysis GPS enable taxi dispatching [04], Collaborative taxi dispatch [05],

self-organization for taxi dispatch [06] and taxi dispatching in real time sensing data [07] are the most valuable dispatching strategies.
In general scenario, one taxi can be assigned for one booking but here more taxis are dispatched for one booking to increase the customer satisfaction level [03] and taxi which reaches the customer first can pick the client. This dispatch system is more effective for reducing the customer waiting time. This same scenario uses the collaborative taxi dispatching [05] as well.
Inefficiency of dispatching task is mostly coming with the peak time in hire request due to no more vehicles to dispatch. Problems of real time dispatching are the missing of the most suitable taxi due to busy environment and failure to deliver a taxi in peak hours. GPS enable taxi dispatching schedule [04] could reduce the hassles like this in real time taxi scheduling.
In manual method for dispatching, officers are using a board called 'location board' which mention geographical location name and taxis which are free, waiting for hires according to location. This method is modeled as a computer system which can change geographical locations dynamically and identify the free taxis dynamically. Self-organizing taxi dispatching [06] systems based on dynamically change location infrastructure can make better dispatching solution than the tradition systems. It can decrease the total waiting time up to 25% and taxi utilization up to 20 %.
Re-locating drivers is a method to gain the ad-hoc (instance hires) hires from field. For this, coordination is a most important factor until getting a hire. Uncoordinated actions could make inefficiency situation in taxi field and it will stimulate the real time traffic congestion on road too. Receding Horizon Control [07] is a much better approach to control the above condition and reduce average total idle distance up to 52% and reduce the total supply demand across the city.
When dispatching a vehicle to hire, another key factor is to consider the hire type such that urgent or advance booking. Normally, advance booking is skipped to a little while the urgent booking is considered under usual circumstances because of time factor. So, we need to focus on this type of booking also to manage the taxi fleet very effectively and efficiency. Current booking and advance booking manage with microscopic traffic simulation helps to gain better operational performance [08].
The performance can be improved for advanced booking if it gets in to the dispatching queue before 30 minutes from client pickup time [09]. This strategy is based on pickup and delivery problem. This method implies lower fleet ownership for companies, lower taxi fare for customers and high revenue for taxi drivers.
Re scheduling are most essential things in real time problems. To gain more reliable utilization of limited resources of taxies new concepts are acceptable. As a result, a modern world concept of ride sharing is applicable to taxi fields and more algorithms also try to reach depth of this concept. Ride sharing concept is more effective, environment friendly and it can gain the winning situation to both the customer and company [10]. It can bring substantial benefits on energy consumption and operation efficiency. But most of the customers are not willing to share their ride and it is a big drawback for applying this kind of scenario. Further it has socio-cultural challenges as well [11].
Complexity management becomes easy with multi agent, but it needs more memory requirement when it's operating. In that case, we need more light weight multi agent framework to manage this type of problem very efficiently. MaSMT [12] is a very light weight agent framework which is used for language translation.

# Chapter 3
# Methodology

This chapter consists of a description about work carried out through the whole study. It basically includes sections such as selecting technologies, appropriate methods, tools and design techniques.

## 3.1 Associated Technologies

To achieve the main goals of this study, it is necessary to be equipped with wide area knowledge on following core technologies.

#### 3.1.1 NMEA, GPS data protocol

National Marine Electronics Association (NMEA) is an institute who maintain the standard for GPS (Global Positioning System) data receivers in order to send data. This is basically used in GPS trackers for sending GPS data to a server. A well-defined data protocol supports all the services which are provided by GPS trackers. To retrieve data from a server, first it should be extracted by NMEA and GPS data protocol and be saved in the server database. These saved data are used to view the current location of tracker of any GIS (Geographical Information System) such as Google map.

#### 3.1.2 Android Technology

The android technology is the most popular mobile operating system in present which is developed by Google Corporation USA. Fully open technology advancement of this system allows any body to do anything in proper manner. We have used this technology in order to develop an intelligent driver app and a sophisticated client app. This technology helps to communicate in between the driver and server and to grasp the client requirement easily.

#### 3.1.3 GCM service (Google Cloud Message)

Google Cloud Messaging is a service which is provided by Google Corporation, USA for third party developers to communicate through notification data or information. It is an advanced feature to communicate in server client architecture. Establishing a connection between client and server, it needs continuous communication. But using this feature, developers can communicate with client when server requires. GCM plays a major role in this study in communicating with driver in real time.

#### 3.1.4 JADE (Java Agent Development)

Java Agent Development is a framework which allows managing the intelligent agents created by itself. The creations of these agents are based on Fundamental of Intelligent, Physical Agents (FIPA). This framework is based on Agent Oriented Programming (AOP) to adding very few add-ons to JAVA. This framework works as Belief–desire–intention software model in programming intelligent agents.

Since the agents can be operated without any human touch or third party interactions, they are autonomous. At the same time, they are social too, because they make the communication easier with any third party using Agent Communicate Language (ACL). Agents are reactive, because they perceive its environment and respond in a timely fashion to the changes in the environment. Finally, the agents are proactive, because they do not simply act in response to its environment but are able to exhibit goal directed behavior by taking initiative.

JADE contains basic features of creating agents, creating agent task, communication with agent or any third party, agent discovery (yellow pages service) and agent control GUI for easy use.

In advance features of ontology and content languages preparing, simple to complex behaviors constructing and calling using external applications are inbuilt to JADE framework.

### 3.2 Implementation

To establish a proper, efficient and optimized vehicle arrangement, for requested booking, it is needed to know the exact location of customer, location of real taxis, final destination and some other customer specific requirements. To initiate a solution for this problem, first it is needed to supply a suitable mobile application as an interface of communication with drivers. For this solution to be completed, a GPS based real time tracking devices should be fixed for the taxies. Furthermore, it is needed to have a management tool for bookings, drivers, taxis and real time traffic condition information system. Managing complexity of the above problem, a better solution can be provided by multi agent architecture and real time traffic conditions supplied by Google currently in Sri Lanka. Additional methods of ride sharing and novel approach of booking sharing concepts are applied in current dispatching system and the old system is compared together with comparable parameters. Initially, current dispatching system deploys for work in standalone and parallel to the current system for comparison purpose.

### *3.2.1) Automated system aims*

1) Minimize the cancellation ratio
   1.1) Fulfilling the lack of real time data(Traffic Condition on Road) such that call Centre operator can see the map and Estimate Arrival Time(ETA) to reach the client location
   1.2) Find and inform the shortest traveling distance to client using Google is a one way to reduce lost millage of vehicle.
2) Minimize the cancellation after dispatch ratio
3) Arrange the vehicle, based on time
4) Increase the Quality of Service (QoS) in the taxi industry
5) Increase the efficiency and reliability of the current system.

### *3.2.2 Vehicle Tracking and Monitoring System*

Initially, the GPS tracking devices were fixed in vehicles and connected to GPS server to record the GPS data in every 20 seconds time period continuously. All the real time data were plugged to the web interface to view every vehicle in real time on Google map. (Figure 3.1)

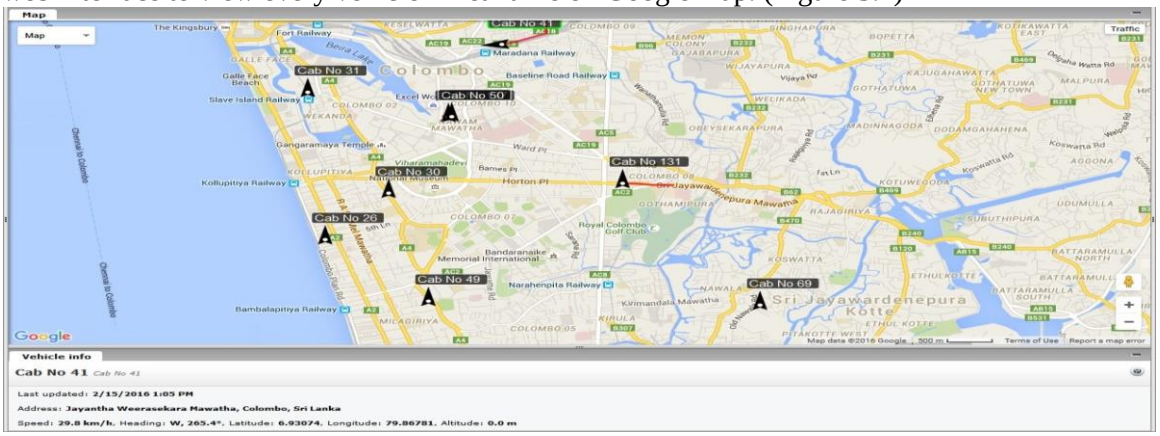


Figure 3.1 Vehicle Tracking & Monitoring Map Window

### *3.2.3 Intelligent Driver Mobile App*

Driver mobile app is totally based on GPS information and it will continue the conversation with driver every time. The entire message system decides by central server and sends the question and information to driver with YES and OK options only. If the driver's answer is YES they should tap the YES button, If NO, it is not necessary to tap the button, they just have to ignore the message. It contains very helpful Google navigator to find the fastest way to customer with live traffic details. Central server detects each and every state of driver, taxi moving and bookings to continue the message passing system. Driver receiving questions and answers to driver app are decided based on entity status changes detected by central server. Driver, Taxi moving state and booking status changes are described in the following section.

#### *3.2.3.1 Driver status changes*

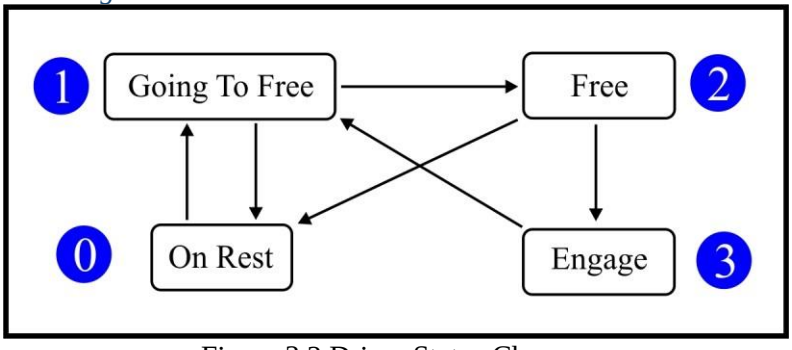


Figure 3.2 Driver Status Changes

Driver status (Figure 3.2) of On Rest is initialized as a zero (0) state. It has two different types according to the resting time such as short term rest and long term rest. Driver has long term rest when he is in holiday and short term rests when he is on the field breakfast, lunch and tea breaks. A driver can get a maximum of three short term rests per day when he is working.
Driver has to let the call going to free when he is coming to field yet he is not ready to get hires.
Then driver has a state defined as free and initialized as two (2) when he is ready to get hires. Every drive has to inform this state to get new hires from company.
Free driver can have new hires by accepting new hire using driver app. Then driver state automatically changes to Engage and he will be involved in getting hire job. After finishing his hire the driver can get back to free state and looking another hire.

### *3.2.2.2 Taxi moving status changes*

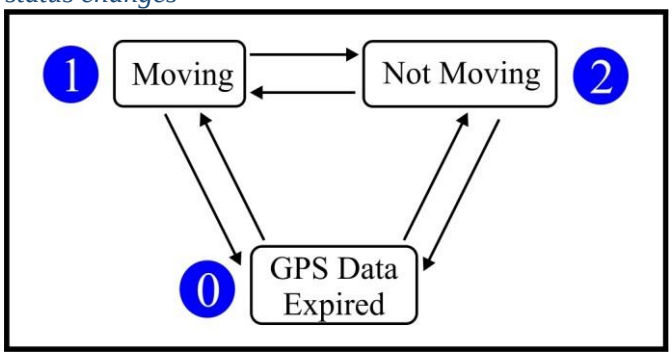


Figure 3.3 Taxi Moving Status Changes

Taxi moving state is initialized as moving (1) and not moving (2). But it has another state call GPS Data Expired initialized as zero (0) because the taxi moving and not moving status is decided by analyzing the GPS data from GPS server. Last updated GPS data record is not in the range of near real time (expire more than 10 minutes) and is called as GPS data expired. These status changes are show in Figure 3.3

#### *3.2.2.2.1 Deciding Taxi Moving Status Using GPS Data*

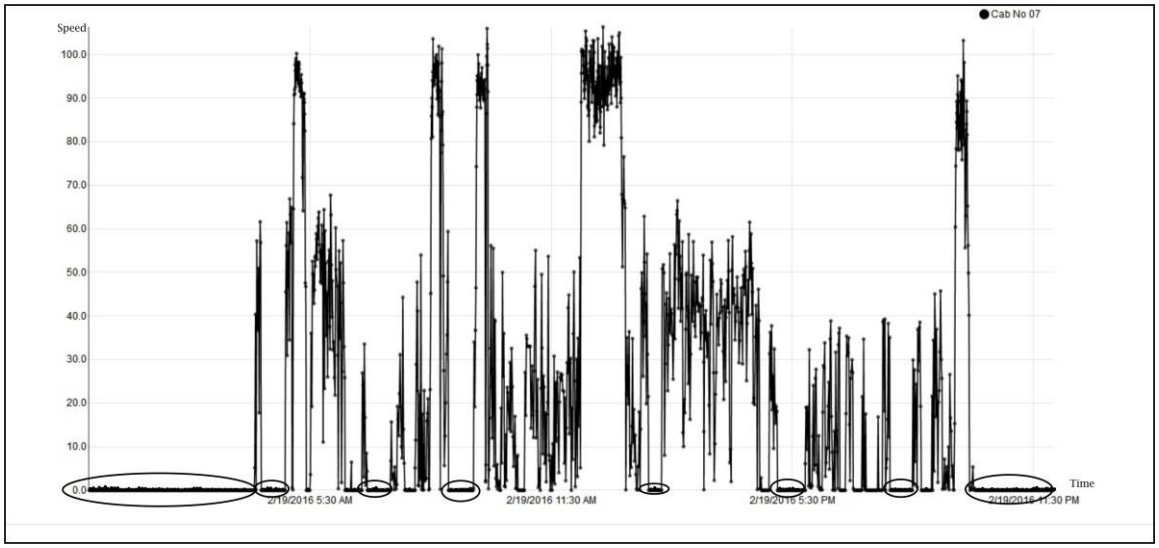


Figure 3.4 Speed Changes with Time of a Taxi

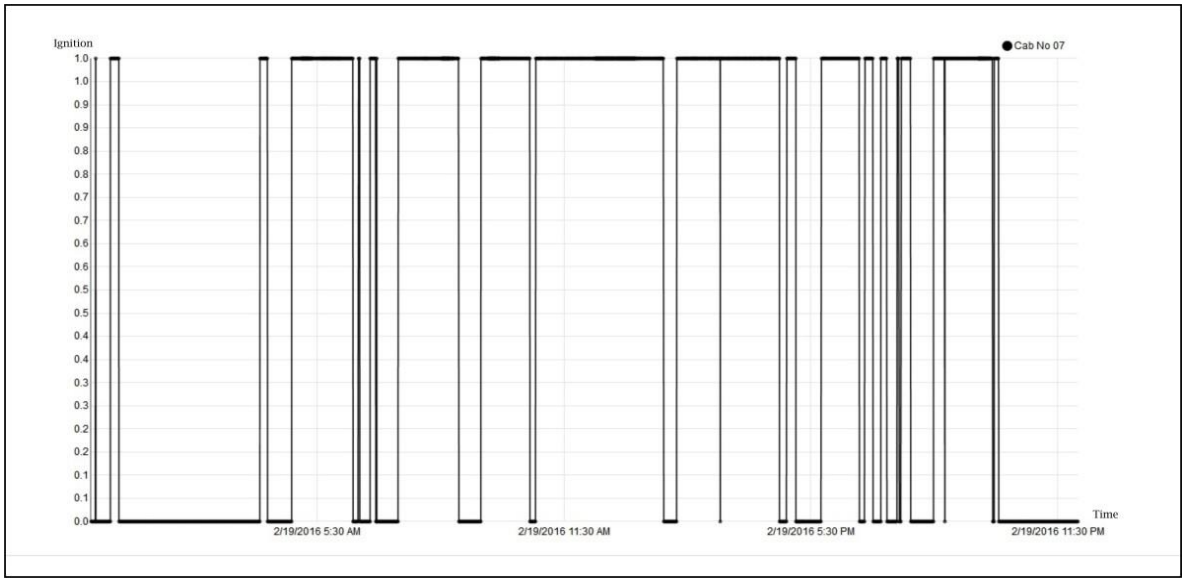


Figure 3.5 Ignition Changes with Time of a Taxi

In Figure 3.4, higher values of speed values but some of non-zero speed values were obtained for moving taxies while the non-zero speed values were generated by steady taxies (circled area of graph). In that case speed data is not enough to decide whether the taxi is moving or not.
Ignition data, which represents the taxi engine status (on or off) with the time factor, is shown in Figure 3.5. If engine state is off, then that taxi is not moving but the speed value can be non-zero. If the engine state is on and speed value is greater than 2 m/s then the taxi is moving definitely. 3.2.2.3 Hire (Booking) Status Changes

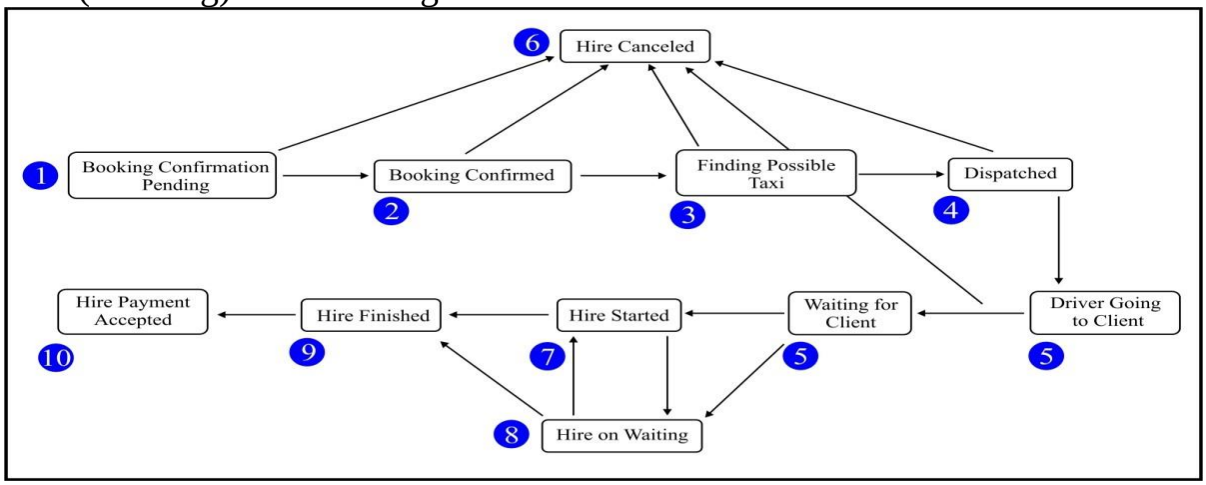


Figure 3.6 Hire (Booking) Status Changes

Figure 3.6 shows the state changes in hire (booking) when booking arrived in the system. This stage is initialized as Booking Confirmation Pending (1) when booking just arrived to the system, Booking Confirmed (2) When a booking has placed on the dispatching queue, finding a possible Taxi (3) When dispatching agent finds a possible economical taxi, Dispatched (4) When an agent has confirmed the driver who picked that booking. Then the driver is going to pick up the client called as going to Client and is initialized as (5) and this state expands when a driver has come to a client pickup location and waits until client arrives. Until client gets into taxi, booking can be canceled called as Hire Cancel and initialized as (6). When driver has started to going to client destination it is called as Hire start and initialize as (7). On the way to client destination hire can have any number of waiting period called as Hire on waiting (8). In some special cases hire waiting can on when driver located on client pickup location. It calls as start waiting and some corporate bookings exceed start waiting duration more than 2 or 3 hours. When the driver arrives at the client destination is called as Hire Finished initialized (9)

then takes the fee for hire. When accepted the hire fee, then current hire is marked as completely finished (10).
Server agents decide the next step, according to the above status changes of entities asking questions from driver through driver mobile app and updating the server according to the reply. Table 3.1shows the question and information, send to the driver according to entity status changes.

| Moving Status | Driver Status | Booking Status | Message to Driver |
|---|---|---|---|
| 1 | 1 | None | Are you free to getting hires? |
| 2 | 2 | 3 | Accept new job? |
| 2 | 3 | 4 | Are you at the place? |
| 1 | 3 | 5 | Did you start the hire? |
| any | any | 6 | Hire has been canceled! |
| 1 | 3 | 7 | Did you finish the hire? |
| 2 | 3 | 7 | Are you going to waiting? |
| 1 | 3 | 8 | Did you stop waiting? |

Table 3.1 Driver Receiving Messages with Entity Status Changes

### *3.2.2.4 Driver mobile User Interfaces*

Drivers get the interfaces shown in Figure 3.7 to answer or to provide information.


Figure 3.7 Driver Mobile App User Interfaces

### 3.2.4 Interactive Client Mobile App

Client mobile app has full features to submit the hire details to a central server when a customer requests a hire. It allows customer to select the pickup location taping on Google map or type on text field (it will popup the Google location suggestions according to country), select the destination taping on map. All special requirements under advance features and special features of ride sharing and booking sharing options are available on booking activity. Additionally, client can see on going booking status, dispatched driver details, taxi details, current location of taxi driver and estimate time for arrival to client location on client app.

#### 3.2.4.1Client Mobile User Interface


Figure 3.8 Interactive Client Mobile App Booking User Interface

### 3.2.5 Management Server (Agent World)

Agents are created using JADE (Java Agents Development Environment) [13] architecture (Figure 3.9). When the JADE framework is started, 3 agents namely AMS (Agent Management System), RMS (Remote Management System) and DF (Directory Facilitator) are automatically started. Using these agents the agent environment can be controlled and managed. The AMS helps to create two agents called DEMA (Dispatch Event Management Agent) and EA (Environment Agent). These two agents are life time. They will live until entire system dies. Main behavior of DEMA is creating BEA (Booking Execution Agents) according to bookings arrive to the system. Main behavior of EA is creating TDA (Taxi Driver Agents) according to taxies and drivers come to the field.

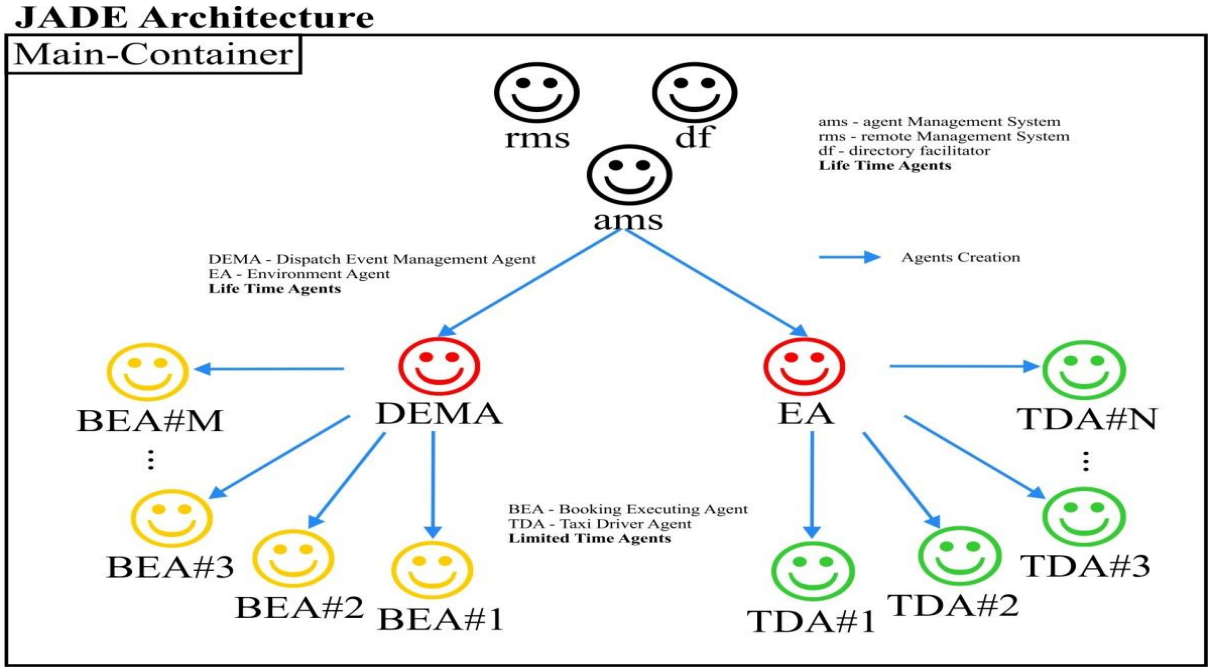


Figure 3.9 Agent World - Agent Creation

When booking is arrived in the system it will be added to the booking considering queue. Then BEA who is responsible for communicating with each TDA within 10 Km cluster is automatically created. Selected TDA reply to BEA with dispatch evaluation factor (DEF). BEA chooses one of the best evaluation factor senders as best TDA for this booking as dispatch taxi. Then it communicates with that TDA and sends the proposal accept message to inform it to the physical world driver through driver mobile app. The driver has 20 seconds to accept this job opportunity. If the driver did not accept the message within 20 seconds it will be disappeared automatically and the system will update this booking as new and with high priority booking in booking list. If the driver accepts the job opportunity, system will update the booking has been dispatched. After dispatching, dispatched driver and taxi information are informed to client and client pickup location is sent to driver with Google map navigation to get the shortest traveling path to client pickup location. Most importantly, the customers can see all these information through their mobile app. How the communication between agents is done in selecting a taxi is shown in Figure 3.10.

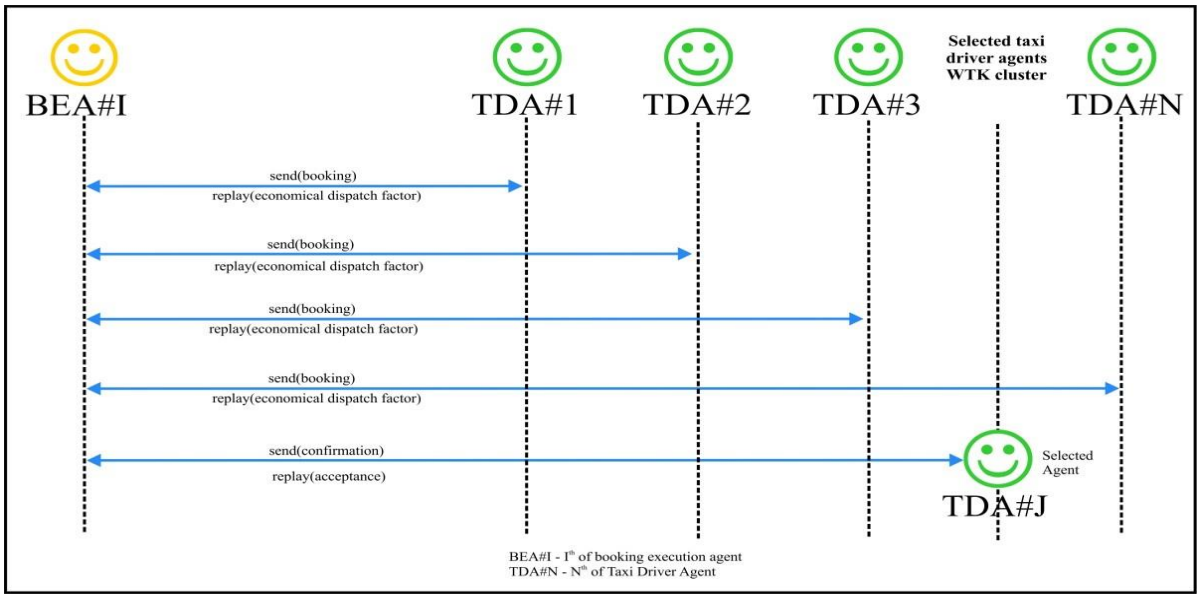


Figure 3.10 Agent Communication for Selecting Taxi

Drivers appearing on the field are un-predictable. Because of that rescheduling of the taxi fleet is necessary to gain the maximum benefit of dispatching process.
Mainly two types of re-scheduling concepts are use in this study. One method is to interchange the dispatched bookings in between the taxi drivers, according to economical dispatch re-scheduling and the other is to arrange the already allocated taxi for new hire according to customer start waiting history. Both of these methods are applicable in practically in real situation. Agents of this study are capable of re-arranging taxis without giving any additional hassle to the whole system.
Ride sharing concept is applied to this real time scheduling under more constraint and conditions. First of all, the customer allows the ride sharing option on mobile app to consider this concept. Before applying this method agents concern about more time factors according to real situation. Agent communication for applying ride sharing is shown in Figure 3.11.

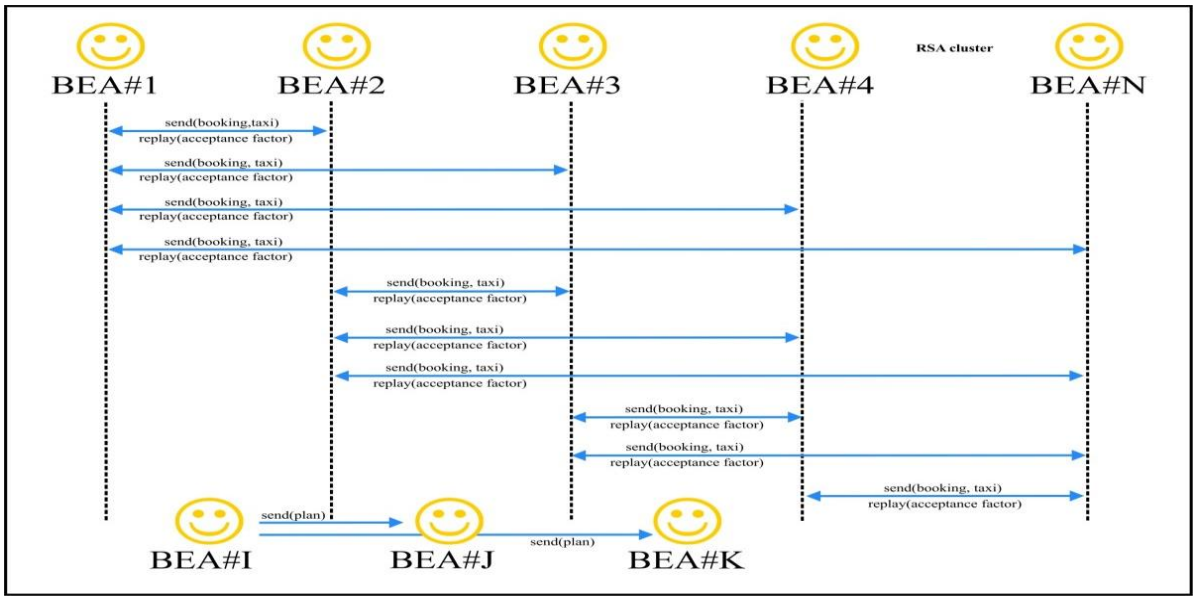


Figure 3.11 Agent Communications for Ride Sharing

The concept of booking sharing is a much better approach for minimizing the real time booking dispatching weaknesses. It will help to reduce the customer hailing time on the roads. To apply booking sharing concept, first of all client has to allow it, using client mobile app. When it is applicable to the real time scenario, more time factors should be considered to gain optimal booking sharing effect to the system. Figure 3.12 shows the communication between the agents for applying the booking sharing concept.

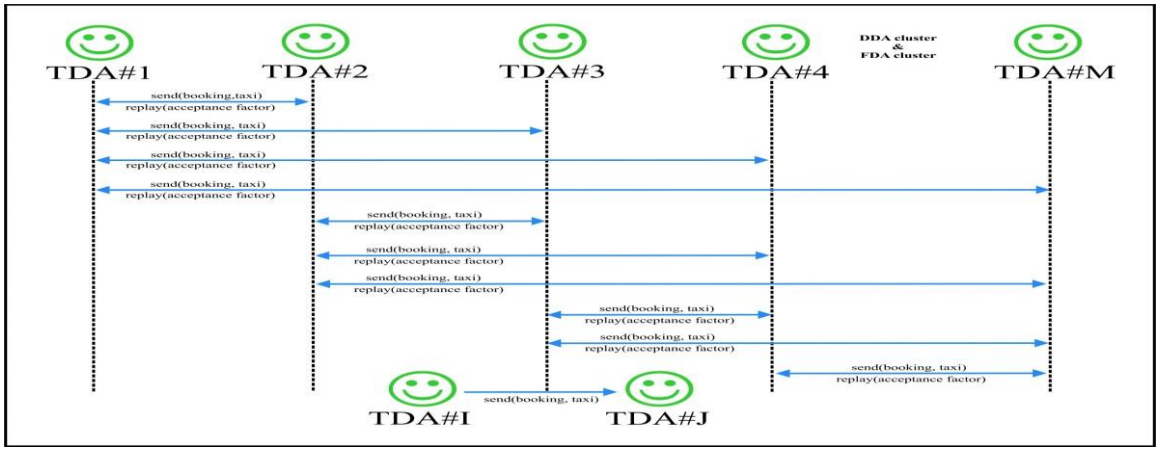


Figure 3.12 Agent Communication for Booking Sharing

### *3.2.5.1 How does it work?*

Taxis are always connected to the GPS server via GPS tracker and from these taxis GPS data will be sent to GPS server continuously in every 20 seconds. GPS server is interconnected to the management server and shares the location data of every vehicle to requests by the management server. Management server is responsible for connecting with each driver mobile app and asks questions and share information among drivers. Also it manages the hire booking status according to the state diagram shown in Figure 3.12. The client can request a taxi reservation via client app.

Agent world fully represents the real time situation on server. Taxi drivers on field represent as TDA and bookings arrived in the system represent as BEA. TDA are dying when driver has stopped the work and BEA is dying when booking has been completed or cancelled by the client. Until that all agents are alive in server memory.

Figure 3.13 explains the main system architecture and their connections of the distributed environment via the Internet. Some reliable cloud services are embedded to the management server for getting more reliable decision according to current conditions such as the traffic condition of roads and road arrangement of the day.

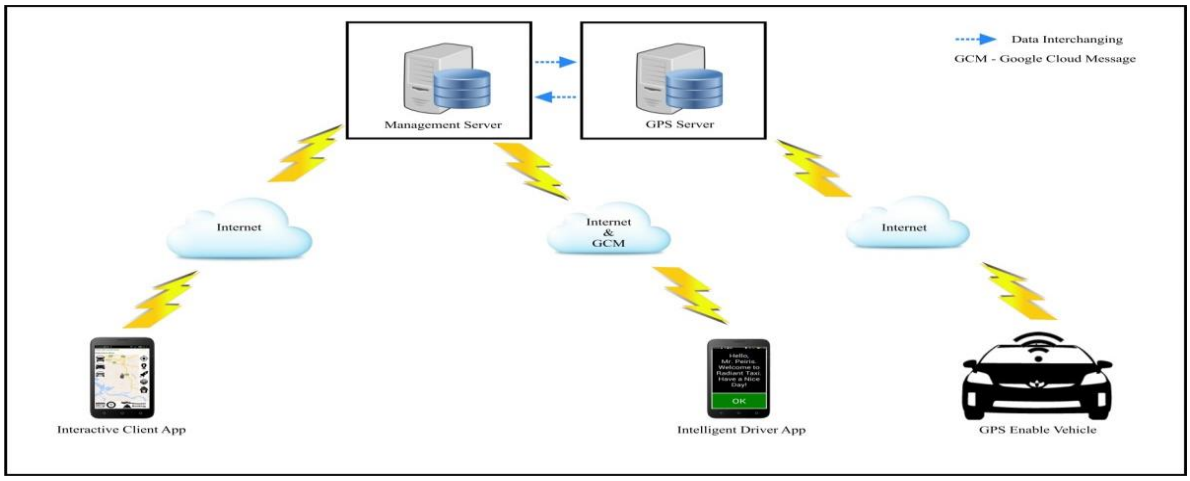


Figure 3.13 Full System Architecture Overview

Selecting a suitable taxi for booking is the main focus in taxi dispatching. Therefore all the experienced dispatchers are aware about managing this task efficiently. Figure 3.14 shows the new booking arrived in the system and 6 free taxi around the client pickup location. To resolve this problem booking execution agents communicate with each and every taxi selected by dynamic cluster. Each taxi has replies with their own dispatch evaluation factor to booking execution agent, according to booking data.

BEA is responsible to find the most suitable taxi, according to DEF and informs it to the relevant taxi driver to as soon as possible.


Figure 3.14 Selecting Taxi Problem & Parameters of Each Entity

After selecting the most suitable and economical taxi for booking taxi will move to the client pickup location. Economical dispatch factor is based on time taken (ETA) to reach the client pickup location in real time traffic, waiting time duration as free taxi, log sheet earning of taxi driver, customer requested taxi type, model and color, VIP customer or not, a client requested driver, knowledge of working area and preferred language of the client. These knowledge based parameters evaluate the Dispatch Evaluation Factor (DEF). Figure 3.15 shows the selection of taxi which has highest DEF.


Figure 3.15 Selecting Taxi Solution using Multi Agent

BEA's always aware to dispatch the appropriate taxi driver to clients according to real time condition of taxi environment. But some cases cause to loss efficiency due to driver on location and next free location of driver is un-predictable. In such cases system needs re-scheduling procedure to rearrange full system within a few seconds without any drastic changes. Figure 3.16 shows such a situation occurring in real time in which both dispatch and booking are not economical.

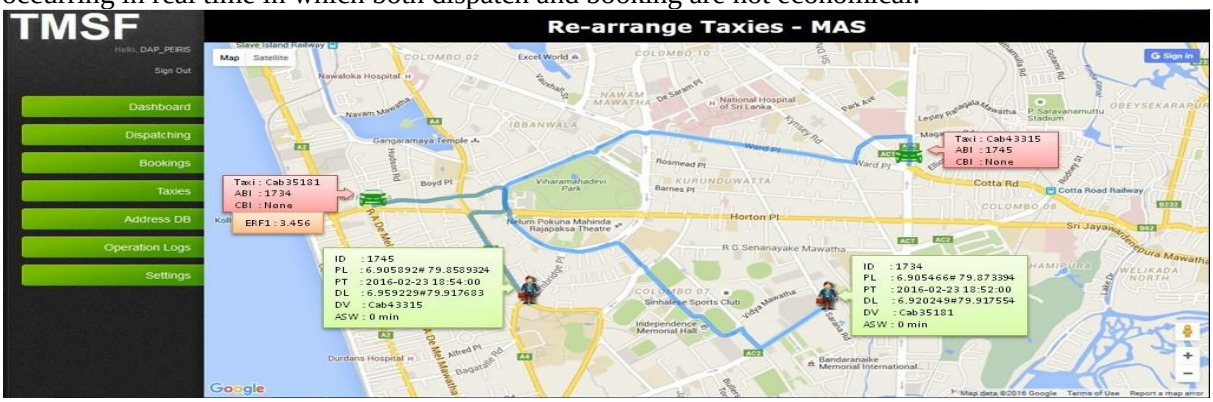


Figure 3.16 Re-arrange Taxi Problem & Parameters of Each Entity

TDA's are ready to resolve this kind of situation in real time. Dispatched taxi cluster considers this kind of situation and shares the booking details among taxis and replies with the re-arrange accept factor among taxis. If this factor lays within an acceptable level those taxis interchange their booking details and re-assign the dispatched booking as new interchanged booking. Then their pickup location changes as shown in Figure 3.17

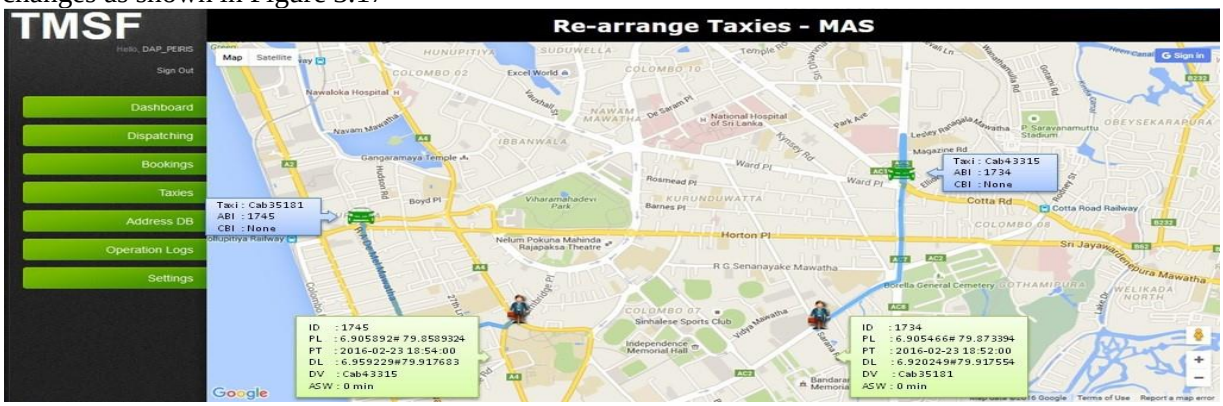


Figure 3.17 Re-aarange Taxi Solution using Multi Agent

One of most effective re-arrangement methods to minimize the cancellations is rearranging the dispatched taxi to a new hire. To consider these kinds of situations, it is needed to maintain the client history behavior to gain a more effective solution for this kind of complexities. Figure 3.18 shows how this situation occurs in real time.


Figure 3.18 Waiting Taxi Allocation Problem & Parameters of Each Entity

To resolve this situation TDA's refer one of BEA's parameter called average start waiting time duration and make the decision of re-arrangement of taxi to a new hire. Before allocating this new job TDA's confirm that duration of go to pick up location, drop location and come back to waiting job pickup location is less than average start waiting time duration. To make this kind of decision it should need the client destination to calculate the time factors. Figure 3.19 illustrates the solution of the above problem.

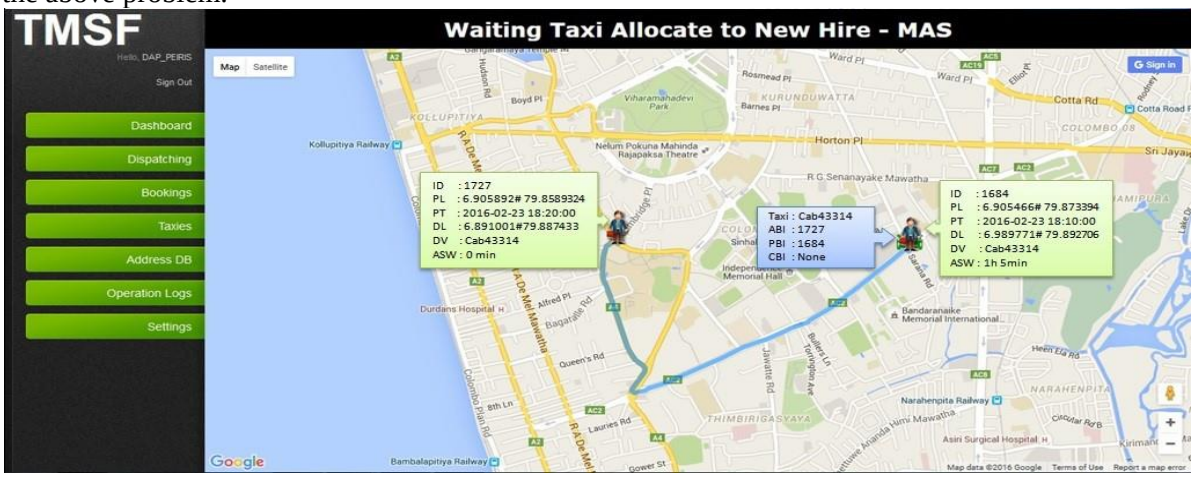


Figure 3.19 Waiting Taxi Allocation Solution using Multi Agent

Ride sharing concept is a good approach for minimizing the taxi resources. In this situation clients have to allow the ride sharing option in client mobile app. Getting real benefit of ride sharing concept is one of the responsibilities of BEA's. For this ride sharing allowed BEA's communicate with ride sharing allowed other BEA's and apply ride sharing concept, among the BEA's. Agent will decide pick up order of clients according to estimate time of arrival (ETA) in ascending order. After satisfying this condition, it will be checked with the second condition of reaching destination of clients are in the same way or not. Ride sharing is not efficient method when client destinations are not in the same traveling direction. In that case, it will again check the ETA for destination of each client and verify the ride sharing is optimized or not. If it optimized then BEA's interchange their acceptance factor applying ride sharing and mark both booking as dispatched bookings (Figure 3.20).


Figure 3.20 Ride Sharing Problem & Parameters of Each Entity

When ride sharing is applied to above two bookings it will decide the first pickup and then next pickup according to ETA and go to the destination according to optimized time constraint. Solution steps are shown in Figure 3.21


Figure 3.21 Ride Sharing Solution using Multi Agent

To reduce the hail time of client on the roads, the booking sharing concept can be applied successfully. This novel approach is really helpful to minimize the customer waiting time on road. Initiating booking sharing concept requires the client approval to perform it. If booking sharing is allowed then the system will consider the time factors to satisfy it. TDA's dynamic cluster called goes to the customer, checks the clients who allow the booking sharing and calculates the time factors for applying the booking sharing concept in real time.

Booking sharing behavior of agents is totally based on, not exceeding the client pickup times and free taxi should reach the altered client pickup location (pickup location of active booking of TDA).

After considering these conditions TDA's interchange their acceptance factors among them and new booking as dispatched booking. Figure 3.22 shows the booking sharing satisfaction level accepted in real time.


Figure 3.22 Booking Sharing Problem & Parameters of Each Entity

After applying booking sharing, the booking allocated taxi has to pick up new client and drop him/her to the allocated client pickup location and a new taxi arrive to the pickup new client. Figure 3.23 shows the solution state to booking sharing concept. First taxi picks up the client 2 and drops him at client 1 pickup location. Before dropping at client 1 pickup location taxi 2 has to arrive in client 1 pickup location.


Figure 3.23 Booking Sharing Solution using Multi Agent

# Chapter 04
# Results and Discussion

## 4.1 Introduction

The developed management system was successfully deployed in Taxi Company as a standalone system. All the booking details were duplicated and sent to a new dispatch management system for getting the review of the new system. The new system has skipped the package request by clients.
The results obtained are discussed in the following section.

## 4.2 Results

In the current system, cancellation ratio is maintained at 6-8% of full of bookings. The new system reduces it to 0.6% by applying quick dispatching, applying re-arrangement, start waiting taxi allocated to bookings, applying ride sharing and booking sharing to the system.
Normally, waiting time of booking to dispatch in the current system is 4 to 20 minutes. New multi agent system, it converts to 2 to 25 seconds. This is the one of the most valuable features of the new system.
Rearranging of taxis in real time is the one of techniques used to minimize the lost mileages of taxis. In the new system, rearranging percentage increases to 0.9% to 8.1% of total bookings. This scheduling method saves fuel cost to the company.
Most of corporate bookings have start waiting up to 1 hour to 3 hours due to client matters. For getting maximum advantage of this kind of bookings dispatchers' allocate the assigned taxi to another job. For improving this method system stores the average start waiting time parameter to make a quick decision of rearranging of a taxi.
Re-dispatching those taxis, which have already been dispatched but on start waiting state, for new bookings is one of the rearranging methods used in the existing system, and it applies for 0.22% from whole bookings. The new system increases it to 13.3% referring the historical data analysis of the client.
Limitation of free taxi resources is the main problem when dispatching vehicles to clients. To minimize this hassle, dispatches discuss with client and arrange one taxi to 2 or 3 clients traveling in the same direction. This method is improved and applied to real time taxi dispatching system to minimize the client complaints to the company. This is well applicable to corporate bookings as most clients are picked up at the same location and are dropped at the same location since they are likely to work in the same company and are friends of each other's. Corporate owner is the most gifted in this situation. Current system, maintain this percentage at 0.4%, but the new multi agent approaches achieve a percentage of 7.7 %.

The new approach of booking sharing is applied to reduce the client hail time on the roads. The current system doesn't apply this kind of method, but the new approach successfully applies 6.1% of bookings for booking sharing.

### 4.3 Discussion

Multi agent approach is a much better approach for managing complexity of this study. It has more features to manage the highly complex scenarios very easily.
In this study, selecting taxi for a client is not sufficient to utilize the limited resources of taxis. In that case we need to have another good approach to reserving the taxi. In this study, we have tried several approaches to getting maximum benefit of agent technology as such rearranging the dispatched taxis for clients, allocating hire waiting taxis to new hires, ride sharing (One taxi multiple clients) and novel approach of booking sharing (One client multiple taxis) to minimize the peak time headaches of real time taxi arrangement. Those approaches successfully gain maximum benefit of multi agent technology.

# Chapter 05
# Conclusion and Future Works

### 5.1 Introduction

Multi agent is a successful approach to solving the complexity of a problem and problem domain knowledge help to minimize the resource allocations hassle in real time. Here is the good example for reducing the booking cancellations ratio and allocate the taxis and drivers more economical way.
Studying of client history is essential in rearranging the taxi for the client.

### 5.2 Future Works

Distributed mobile multi agent is a good concept to achieve the intelligent driver mobile app and it will reduce the communication delays among the devices. To get more advantages of real time scheduling it would be really helpful to concentrate future work on this regard.
Environment hassle such as long term power cuts and network signal strength changes due to weather and service provider's availability is unpredictable. But real time decision making system needs to run every millisecond to manage it. To avoid this kind of situation we need faults tolerance system such that when main system is down it automatically plugs to the replication server and continues the work without any delay. This is another area for future work.
Vehicle tracking and monitoring system usually receives a large amount of data on taxis location. Taxis are the most suitable identifier of traffic condition of roads because of their movements all around the city per day. In that case location based services and real time traffic congestion updater is the new era of future works.

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# TOOLS PROPOSED TO MEASURE EFFECTIVENESS OF HUMAN RESOURCE (HR) FUNCTION IN AN ORGANIZATION: LEARNINGS AND INSIGHTS

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**Abstract:**
Human Resource (HR) functions deliverables are always considered to be intangible and unmeasurable. You cannot manage what you cannot measure and what gets measured gets done too (Ulrich, 2007). This questions keeps haunting HR at all levels, be it at individual HR Professional level, HR Team level or at the Organizational level. Measuring the effectiveness of HR function is important so that it can be strategized in order to effectively support the vision, mission and business strategy of an Organization. At the operational level of HR function, HR Professionals still look for answers to not so complex process of measuring effectiveness of HR function in an Organization in an objective way. This leads to management perception and conclusion also that effectiveness of HR function remains unmeasurable. Many Organization still use subjective processes to measure HR parameters like balance score cards. HR Metrics and Analytics are now being used by the Organizations in order to quantify HR processes. This paper provides learnings and insights, as to why to measure? How to measure? Value addition to an Organization by way of review of HR best practices of Indian Organizations. This paper includes some practical tools like, Competency Mapping; Performance Review; Audit of HR Department; X – Matrix process etc to measure effectiveness of HR function in an Organization in a very objective way at individual; departmental and Organizational level within HR Function. These will also help to measure and improve impact of HR practices on business results in an Organization.

***Keywords: Effectiveness of HR; HR Tools; Measurement; Organization***

**Introduction:** HR functions deliverables are always considered to be intangible and unmeasurable. You cannot manage what you cannot measure and what gets measured gets done too (Ulrich, 2007). This questions keeps haunting HR at all levels, be it at individual HR Professional level, HR Team level or at the Organizational level. What's the contribution of HR Function? Therefore it is very important for HR Function in an Organization to measure its effectiveness. It will help HR function to provide services and help Organization achieve the desired outcomes. It will also help to align HR policies, processes and systems to Organizational, vision, mission and business strategy. HRs are now moving towards becoming 'Strategic Partners' (Ulrich, 1998) of the firm which is about creating value both in terms of customer value and economic value. Measuring effectiveness of HR function is a vital requirement for any Organization. The strategic use and outcomes of HR metrics and analytics are increasingly associated with HR effectiveness and Organizational performance (Boudreau & Lawler, 2017). While it is not an easy task, indeed, we need to ask few vital questions to start with, viz. is the HR function providing services and achieving outcomes aligned to Organizations vision, mission and business strategy? Is HR function effective in providing the type of services required by its customers – internal and external? Is there a way to make HR function leaner? Also equally important is to find the areas of training and development for HR personnel within an Organization, optimize the structure of HR Department and to benchmark the performance of HR function, locally and globally.

**Methodology:** Exploratory research design was used to explore and understand types of Tools being used by various Indian Organizations to measure effectiveness of HR function. In this research, papers which are published in prominent HR journals were scanned. Papers pertaining to measuring effectiveness of HR function in various Types of Indian Organizations were examined in detail. The paper was qualitatively classified in accordance with selected dimensions. Process enables the researchers to carry out a systematic review and explore new. It is structured overview adequately reflecting upon salient and most pertinent aspects.

**Analysis and Discussion:**

**I. Why do we measure Effectiveness of HR in an Organization?**

It is very important that HR function's policies, processes and systems are aligned to Organization's vision, mission and business strategy. HRs effectiveness should therefore be measured so as understand:

- Is HR function providing services and achieving outcomes aligned to vision, mission and business strategy of the Organization?
- Is HR function effective in providing the type of services required by its internal and external customers?
- To find the areas of Training and Development for HR personnel within Organizations
- To optimize the structure of HR department within Organization
- To Benchmark the performance of HR function in Organization, locally and globally
- Make HR function leaner?

**II. How do we measure Effectiveness of HR in Organizations?**

Success of an Organization is linked to its HR Competencies, which is quantifiable and can be measured and analyzed by way of:

A. HR Personnel Competency
B. HR Department Competency
C. Organizations HR Competency
D. Benchmarking HR Processes
E. Internal and External Customer Satisfaction

**A. HR Personnel Competency:**

It is very important to measure competency of HR Personnel within an Organization, in order to gauge our internal HR talent pool, by way of various tools:

1. Competency Mapping of all HR roles within Organizations and Individual assessments over these Competencies (Annexure-1)
2. Performance and Potential Appraisal Process to evaluate performance over job and asses future potential for growth and learning
3. Review of performance on monthly / quarterly basis depending upon the level (Annexure-2)
4. Managing Point and Checking Point (MPCP) for all roles defined and frozen at the beginning of financial year (Annexure-3)
5. Key Result Areas (KRAs) also defined and frozen at the beginning of each financial year

**B. HR Department Competency:**

Also important is to measure the competency of HR Department, as a whole, to assess, deliverables, through various tools and matrixes:

1. Audit done on periodic basis, both through internal and external sources (Annexure-4)
2. Policy Deployment and its cascading for micro level implementation and to be tracked monthly, during reviews
3. Mid – Term Roll On Plan adherence tracking
4. Employee Satisfaction Survey (ESS) done to measure effectiveness of HR and take subsequent measures to improve effectiveness
5. Periodic Review at various organizational levels

6. X – Matrix process to link HR function activities with other functions activities (Annexure-5)
7. HR Policies and Practices (R 2 R) adherence

**C. Organizations HR Competency:**

A similar measure can be done with regards to overall Organizational strategy, so as to assess alignment of HR policies, practices and systems:

1. Corporate HR Function to define R2R policies and process
2. Matrix Organization structure with Strategic Business Units (SBUs) HR, reporting to Corporate HR function, for all R2R activities
3. Review done on periodic basis with regards to performance of HR function of all SBUs of the Organization
4. Lean HR concept to be used so that HR personnel and HR Department have more time for growth related activities of the Organization
5. Manpower Productivity Study to be done for all SBUs to assess the manpower no's
6. Audit both internal as well as external through local and global sources to be undertaken to identify gaps and take corrective actions
7. Expert advice and consultation taken for specific defined areas
8. Human Resource Information System (HRIS) to be used as a technology tool, not only to take various reports and outputs for development and growth, but also to handle various transactional level activities like leave, attendance etc.
9. Benchmarking done for Organization, SBU wise, locally and globally
10. Board Level interventions
11. HR Meets at periodic intervals so as to identify the areas of concern, growth and development

**D. Benchmarking (B/m):**

Benchmarking helps to re-engineer HR policies, processes and systems in order to align them with Organization's vision, mission and business strategies:

1. Cost of Competitor (Least) and Quality of Competitor (Best) to be the basis for all business strategies
2. Benchmarking to be done Locally and Globally keeping in mind the Organization and its business
3. HR Policies and Process (R2R) to be reviewed regularly
4. Manpower Cost to be B/m
5. Manpower Productivity to be B/m
6. Manpower Turnover to be B/m
7. Headcount to be B/m
8. Attrition Rate to be B/m
9. Manpower Cost / Sales Ratio to be B/m
10. Compensation and Benefits to be B/m
11. Best Practices to be B/m (Annexure-6)
12. Quality Systems, all activities to comply with it
13. Plan Do Check Act (PDCA) cycle to be deployed for all policies and processes

**E. Internal Customer Satisfaction:**

External customer or stakeholders can only be satisfied, if our internal customers are satisfied and can be measured, by way of:

1. Online and Manual ESS once in two years
2. Suggestion Boxes at all locations
3. Grievance Redressal Process for individuals, Department and SBUs
4. HR Survey done through feedback of HODs and above level
5. Steering Committee meeting once in a year to take stock of whole of Organizations HR Performance
6. Quality Systems to be used as a tool to track deviations
7. Weekly Review Meeting at local level
8. Monthly Meeting at SBU level

9. Periodic Review at Organizational level

**III. Value Addition to Organizations by Measuring Effectiveness of HR Function:**

By measuring effectiveness of the HR function and thereafter aligning HR policies, processes and systems to Organization vision, mission and business strategy, following tangible outcomes can be achieved by an Organization:

1. Organizations transforms itself from being a manufacturer of products or services to a solutions provider in its business
2. Helps Organization capture value across the complete business chain, with the following changes:
   - i. Lower Attrition Rate
   - ii. Manpower Cost / Sales ratio, less than the competitor
   - iii. Life Long Service Commitment of employees
   - iv. Exponential Growth of Organization
   - v. Quality Certifications
   - vi. Attracting Best Talent and Employer Branding
   - vii. Manage perception and promote good work of employees in Organization
   - viii. All HR activities operate in PDCA way in Organization
   - ix. People to process driven
   - x. Brings strategic thinking within Organization
   - xi. Demonstrates diverse contribution to growth and future of Organization
   - xii. Aligns HR with Vision, Mission and Business Strategy of Organization
   - xiii. Realign resources for future growth and expansion of Organization
   - xiv. Role based, Lean Organization

**Conclusion:**

It can be concluded that HR Practices can be measured objectively by way of various tools at individual; departmental and Organizational level within HR Function, in an Organization. Metrics like Competency Mapping can assess skill set of individuals with defined HR roles within an Organization. Performance Review Summary can track performance on monthly / quarterly basis of individuals at various levels. Managing Point and Checking Point (MPCP) for all roles can be defined to streamline performance. Audit of HR Department / Function can be undertaken on periodic basis to take corrective measures. Use of X – Matrix process can be used to link HR function activities with other functions activities. Effectiveness of various HR policies, processes and systems can be measured objectively by way of various tools and their effectiveness can be linked to the desired business outcomes. This will also help to measure and improve impact of HR practices on business results in an Organization.

**Annexures:**

**Annexure-1**

| **SECTION MANAGER (HUMAN RESOURCE)** | | | **Levels** | **1** | **2** | **3** |
|---|---|---|---|---|---|---|
| | | | | **100%** | **50%** | **25%** |
| **Competencies** | **Competencies required for job holder** | **Expected competencies for the position** | **Possessed Competency (%) assessed by the supervisor** | **Score (%)** | **Gap Identified (in %)** | **Training Level Identified** |
| **QUALIFICATION REQUIRED** | | | | | | |
| **KNOWLEDGE** | | | | | | |
| **SKILLS** | | | | | | |

| ATTRIBUTES | | | | |
|---|---|---|---|---|
| **Knowledge Level(s)** | **Rating Required for level(s)** | **Criterion** | **Training Assessment** | |
| **Complete / Partial / Basic** | **100% / 50% / 25%** | **Guide / Some Depth / Basic** | **95 - 100 %** | **No Training** |
| | | | **75 - 94 %** | **Fine Tuning** |
| | | | **50 - 74 %** | **Partial / Intensive Training** |
| | | | **Below 50%** | **Complete Training** |

**PERFORMANCE REVIEW**

**SUMMARY (Year)** - **Annexure-2**

**Department:** **Incumbent:**
**Designation:** - -

| S.No. | Accountabilities / objectives | Actual (Year) | Target (Year) | Rating Scale | | | 1st Qtr | 2nd Qtr | 3rd Qtr | 4th Qtr | Remarks | Weightage | Rating | Weight * rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | | | | | | | | |
| 1 | | | | | | | | | | | | | | |
| | | | | | | | | | | | Total | | | |

| | | | FY: | Annexure-3 Date : |
|---|---|---|---|---|
| Name: | | Department: HR | Designation: Department Head | |

| S.No. | Accountability | Managing Points | | | | | | Checking points | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | M.P. | UOM | Target | VCS Ref. | Freq. | No. | C.P. | UOM | Target | VCS Ref | Freq. |
| 1 | Employee Development and Involvement | M1 | Compliance to company wide training schedule | % | 90% | | Monthly | C1 | Number of training programs not organized as per schedule | Nos. | 5 | | Monthly |
| | | M2 | Adherence to community development project schedule | - | As per schedule | | Annual | C2 | Number of community development projects (Plan vs actual) | Nos. | 5 | | Monthly |
| | | M3 | Compliance to Policy Deployment schedule | - | As per schedule | | Monthly | C3 | Number of times PMD review not completed as per | Nos. | Nil | | Monthly |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M4 | Compliance to provision schedule of employees welfare & fringe benifits | - | As per service regulations | | Annual / Monthly | C4<br>C5<br>C6<br>C7<br>C8 | schedule<br>Uniform distribution<br>Annual gifts<br>Annual sports<br>Transportation facilities<br>Food committee meeting | - | As per schedule<br>-Do-<br>-do-<br>-do-<br>-do- | | Annual<br>Annual<br>Annual<br>Monthly<br>Monthly |

**HRD AUDIT QUESTIONNAIRE** **Annexure-4**

**A number of statements dealing with various aspects of Human Resources Development in your company are given below. Please assess the extent to which each statement describes your organization using the following 5 point rating scale**

**5 = Means it is very much true (90 to 100%)**
**4 = Means it is mostly true (75%)**
**3 = Means it is sometimes true and sometimes not (50%)**
**2 = Means it is not true most of the time (25%)**
**1 = Means it is not at all true & its opposite is true (0 to 10%)**
**NA= Not Applicable**

| S. No. | Item Description | Rating |
|---|---|---|
| 1 | Manpower requirements of each department/work units are identified well in advance | |
| 2 | Etc.. | |
| | **STRENGTHS, WEAKNESSES AND SUGGESTIONS**<br>**What do you consider strengths of the organization in terms of employee development (or HRD including competence building, motivation, development and culture building)** | |
| 1 | Top Management have very positive & aggressive for their employees & organization development as a whole | |
| 2 | Etc.. | |
| | **What are the areas where this organization needs to improve to do more for ensuring the continuous development of employees and building a strong culture.** | |
| 1 | Inter personal & Inter departmental relations | |
| 2 | | |
| | **Give below any specific suggestions or ideas you have to strengthen HRD in this function.** | |
| 1 | Polite and respectable behavior for all category of employee | |
| 2 | Etc.. | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Annexure- 5 | | | | |
| | | | | Company Guidelines | | | | | | | | | |
| | | | | Technology improvement | | | | | | | | | |
| | | | | Use of information systems | | | | | | | | | |
| Company Objectives | | | | X - MATRIX (YEAR) HR Department | | | | | Department Action Plans | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Customer satisfaction** | **Cost** | **Manpower** | | | | | | **As per schedule** | **Continuous** | **As per schedule** |
| **CSA Score > 90 %** | **Cost reduction by Rs.** | **Cost / net sales : %** | **Productivity - Sq.Mtrs / person** | | | | | **Monthly safety meeting and safety audit** | **Training calendar** | **Manpower recruitment plan** |
| | | | | **Dept. Objectives** | **From** | **To** | **Goal (L)** | | | |
| | | | | **Reduction in number of accidents (a) Mondays loss injury (b) first aid injury Number of Mondays loss (a) On a/c of Mondays loss injury (b) On a/c of first aid injury** | | | **Zero** | | | |
| | | | | **Compliance to companywide training schedule** | | | **As per schedule** | | | |
| | | | | **Timely recruitment of manpower** | | | **As per schedule** | | | |
| | | | | **Manpower reduction** | | | **As per schedule** | | | |
| | | | | **Reduction in extra working hours beyond normal working hours** | | | **<=4 Hrs. / day** | | | |
| | | | | **Completion of Community Development Project** | | | **4** | | | |

**Annexure-6**

| **Top Attraction Drivers: Asia** | | | | **Top Retention Drivers: Asia** | | | |
|---|---|---|---|---|---|---|---|
| **India** | **China** | **South Korea** | **Japan** | **India** | **China** | **South Korea** | **Japan** |
| **Reputation of the organization as a good employer** | **Training / learning opportunities** | **Fringe benefits** | **Challenging work** | **Satisfaction with organization's business decisions** | **Satisfaction with organization's people decisions** | **Training / learning opportunities** | **Organization provides clear benefit information** |
| **Career advancement opportunities** | **Competitive base salary** | **Work/life balance** | **Competitive base salary** | **Low- or no-stress work environment** | **Senior management makes an effort to be accessible to employees** | **Fringe benefits** | **Low- or no-stress work environment** |
| **Challenging work** | **Career development opportunities** | **Retirement benefits** | **Work / life balance** | **Retirement benefits that meet my needs** | **Low- or no-stress work environment** | **Work/life balance** | **Senior management acts to ensure organization's long-term success** |

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# ENGINEERING ETHICS- A MATTER TO RECONSIDER

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**Abstract**
Engineering Ethics should be given highest priority by practicing engineers. Most of the engineering undergraduates and practicing engineers focus on application of technical knowledge with lesser adherence to Engineering Ethics. Unfortunately, unethical decisions and behaviors of engineers can lead to disastrous situations. Engineering undergraduates pursue their trainings in different engineering firms under senior engineers. If senior engineers are involved in unethical activities, the trainees may adopt these practices, because the respective senior engineers are considered as their professional role models. It is clear when referring existing research literature, less attention has been focused on this matter by engineering researchers. Therefore, this qualitative research was conducted with the main objective of identifying major engineering ethical violations observed by engineering trainees in their training places by getting answers to a structured questionnaire from 200 final year engineering undergraduates of a state university in Sri Lanka. The interpretive analysis of the data shows that senior engineers have predominantly violated two major clauses of Engineering Code of Ethics. Those clauses are "Engineers shall hold paramount safety, health and welfare of the public" and "Engineers shall continue their professional development & shall actively assist & encourage engineers under their direction to advance their knowledge and experience". The findings of the study are very important for any practicing engineer to get rid of their unethical acts in order to develop ethical awareness of their trainees and junior engineers. Further research can investigate deeply about these issues from the perspectives of the senior engineers in order to support the development of ethics and moral practice within the conduct of engineers.

***Key Words: Engineering Ethics, Ethical Violations, Senior Engineers, Undergraduates***

## Introduction

A professional engineer should have balance knowledge on both technical matters and Engineering Ethics. Engineers who work neglecting ethics create additional problems to society. There are lot of examples of engineering works related tragedies happened as a result of neglecting Engineering Ethics by engineers in their decision making process. Hyatt Regency Hotel walkway collapse, Challenger disaster and Union Carbide accident in Bhopal are the most suitable examples for that (Khulief, 2008). Therefore, engineers should practice, starting from their undergraduate period to behave ethically and make ethical decisions in their professional activities. Engineering undergraduates who do not have much knowledge about Engineering Ethics can question that whether they should need ethics? (Harris, Pritchard, & Rabins, 2009). But, they should know that only technical knowledge is not enough to improve the welfare of the society by their engineering works. However, final year engineering undergraduates in Sri Lanka are having a positive perception towards Engineering Ethics (Wijesinghe & Jayawardane, 2018). So when a person 'thinks ethically' they are giving at least some thought to something beyond themselves (Bbc, 2015). In order to meet this requirement, accredited engineering degree programs should provide students a sufficient

knowledge on ethics ("Criteria for Accrediting Engineering Programs, 2016 – 2017 | ABET," 2018). Nowadays, there are Engineering Ethics modules incorporated into undergraduate engineering curricula as stand-alone courses in Sri Lanka and also in other countries. But, teaching Engineering Ethics is not an easy task and it is challenging (Dyrud, 2004). Students should incorporate those concepts in to their lives. At the time of passing out from universities, engineering students should have developed their skills to identify and resolve moral problems associated with their professional works (Shuman, Mitcham, & Wolfe, 2003). O'Neill-Carrillo et al. (2008) have identified that ethics across the engineering curriculum is more effective for teaching Engineering Ethics. But, in Sri Lanka, stand-alone courses like Professional Ethics or Engineering Ethics courses have the sole responsibility to convert engineering students to ethical engineers in future.

The Institution of Engineers Sri Lanka (IESL) has introduced Code of Engineering Ethics for professional engineers in Sri Lanka ("The Institution of Engineers Sri Lanka - Code of Ethics," 2013). In state universities of Sri Lanka, engineering undergraduates are taught Engineering Ethics based on this IESL Code of Ethics. That is not enough to develop engineering students' moral conduct. They learn lot of engineering related matters when they pursue industrial training during their undergraduate period. Not only technical aspects, but also they learn professional conduct from senior engineers working in those engineering firms. If senior engineers involve in unethical acts, subordinates like engineering trainees or junior engineers who work under them will adopt those unethical acts. So, Engineering Ethics should not be limited to books and lectures. Therefor senior engineers should adhere to code of ethics always in their professional works. They have to reconsider the ethics, as many junior engineers learn ethics and moral conduct from them. If engineering trainees or junior engineers have sufficient knowledge to determine the acts of their senior engineers are ethical or unethical, they can adopt only ethical acts. In such a situation, there is a strong research requirement to identify the predominantly violated clauses of Engineering Ethics as per the observations of engineering undergraduates in their respective training places. So, in this research paper, it gives the details of a research conducted in Sri Lanka with the objective of identifying the above research requirement. The results of this research work will be useful for senior engineers to reconsider about Engineering Ethics in their professional works to improve their moral conduct while eradicating their unethical behaviors in front of engineering trainees or junior engineers for the betterment of society.

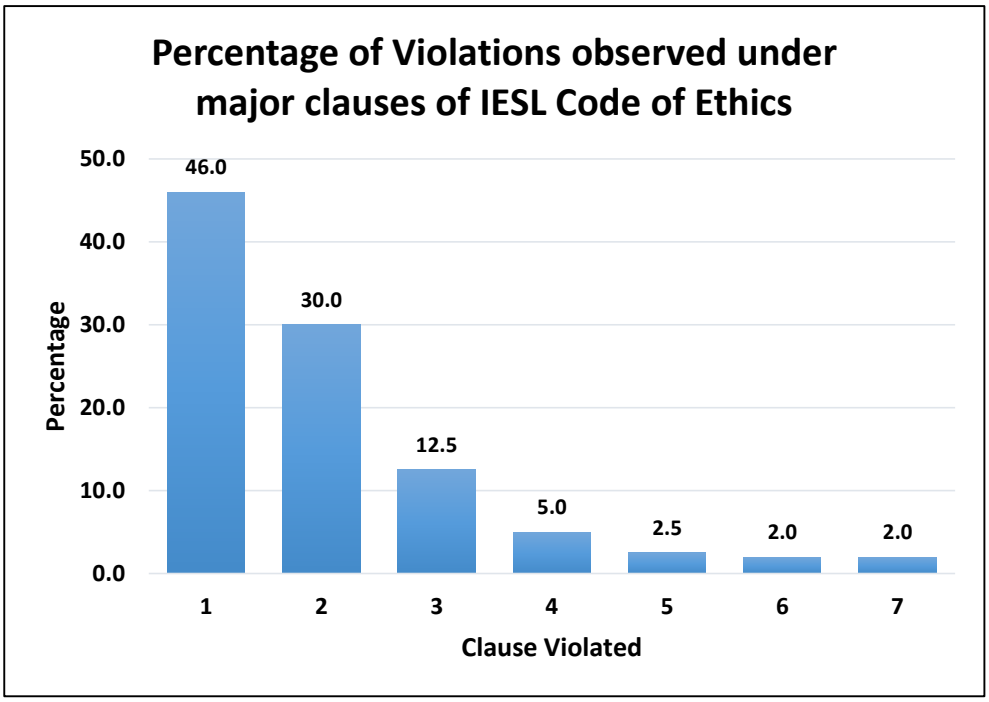
**Methodology**

This study was conducted in an engineering faculty in a state university of Sri Lanka. 200 final year engineering undergraduates irrespective of their field of study were participated for this research work. They were studying in Civil, Electrical and Mechanical disciplines and having 6-month industrial exposure as trainee engineers in Sri Lankan engineering firms. At the time of collecting data, they had completed the Engineering Ethics module in their curriculum. So, they were the perfect group of students to conduct this research as they have industrial knowledge and Engineering Ethics knowledge. A structured questionnaire was given to 200 students to answer for a question prepared aiming the research issue being investigated. The question which was given for students to respond was "Briefly describe the major engineering ethical violation observed by you in your training place". Students were further advised to anonymously respond for that question without revealing the names of their respective training firms. But, they were asked to mention their engineering discipline for better understanding of the situation.

Interpretive analysis was used to analyze the responses of engineering undergraduates and to identify the major clause of Engineering Ethics violated by senior engineers or other responsible personnel in their training firms according to students' responses. 8 major clauses of Code of Engineering Ethics introduced by IESL were considered for this study. In cases where more number of clauses got violated, those cases were categorized under violation of most relevant clause of code of Engineering Ethics. Then, graphical analysis was used to identify clauses of Engineering Ethics which were predominantly violated by senior engineers worked in engineering students' training firms.

**Results & Discussion**

Following graph shows the percentage of ethical violations as observed by engineering undergraduates under each clause of Code of Engineering Ethics in their training places. No any respond found for the violation of clause of IESL code of ethics "Engineers shall be committed to the need for sustainable management of the planet's resources". Therefore it is not included in the graph.




Clauses denoted by 1-7 numbers are as follows.

1. Engineers shall hold paramount health, safety & welfare of the public and proper utilization of funds & other resources
2. Engineers shall continue their professional development & shall actively assist & encourage engineers under their direction to advance their knowledge and experience
3. Engineers shall apply their skills & knowledge in the interest of their employer or client for whom shall act, in professional matters, as faithful agents or trustees
4. Engineers shall always act in such a manner so as to uphold and enhance the honor, integrity & dignity of the profession
5. Engineers shall give evidence, express opinions or make statements in an objective and truthful manner
6. Engineers shall build their reputation on merit & shall not compete unfairly
7. Engineers shall perform professional services only in the areas of their competence

Out of 200 final year engineering students, 46.0% students have reported about violation of "Engineers shall hold paramount health, safety & welfare of the public and proper utilization of funds & other resources" clause and 30.0% students have reported about violation of "Engineers shall continue their professional development & shall actively assist & encourage engineers under their direction to advance their knowledge and experience" clause. So, these two clauses were violated predominantly by senior engineers in their training firms. 12.5% of students have identified cases dealing with the violation of clause "Engineers shall apply their skills & knowledge in the interest of their employer or client for whom shall act, in professional matters, as faithful agents or trustees" as the 3rd major ethical violation observed in their training firms. When analyzing the responses of students on their observed ethical violations, senior engineers in their training firms were responsible

for most of the identified ethical violations. Unfortunately, it is a bad lesson for trainee engineers as they were learning many practical aspects of engineering and professional conduct from their senior engineers. Following narratives extracted from students' responses will give a more insight for the research issue being investigated.

"*In my training place, there I could saw spread of cement dust to the environment. Cement dust spreaded heavily from that place to the nearby houses. It caused bad effects like occurrence of respiratory diseases. Senior Engineers did not pay their attention to mitigate this problem for a long period of time*"

This case was about the violation of clause "Engineers shall hold paramount health, safety & welfare of the public and proper utilization of funds & other resources". Spread of cement dust to nearby houses had caused health issues for nearby society. Senior engineers have a more responsibility to ensure health and safety within and around his or her workplace. They had neglected that issue for a long period of time. Actually, it is bad experience for the particular student who has undergone training in that firm.

*"Due to less supervision on engineers, Site in charge Engineer used to leave the site before the works were completed. When he was not available, other engineers also tend to spend time in the site office. But, one day, a laborer was met with an accident by falling a bundle of reinforcement bars onto his leg and his leg was severely injured"*

Engineers are the people who have a thorough knowledge about safety impacts of their workers. They should continuously educate and supervise their fellow workers to avoid accidents and tragedies. Normally, shop floor employees do not have much knowledge and awareness on safety aspects due to less education level and experiences. So, professional engineers should always adhere to most important and essential clause of engineering Ethics called "Engineers shall hold paramount the health, safety and welfare of the public". It includes the health, safety and welfare of their subordinates and workers. If site engineers had paid more attention on that matter, that laborer will not be injured.

*"A high rank member of the company had an unethical practice of using site laborers and materials to build his own house during working time. Sometimes, site works had to be stopped due to lack of laborers."*

This is a clear violation of a part of clause 01 "Engineers shall properly utilize funds and other resources". Those resources were not their private properties to utilize for their personal benefits. This high rank person was not a faithful agent or a trustee for his company. Actually, such senior professionals are not suitable to become professional role models of trainee engineers.

*"Some Senior Engineers in my training organization did not encourage us to advance our knowledge and experience. They were always searching for mistakes of trainees. Although they had enough free time, they did not give us a time slot to discuss with them. Some Engineers discriminate us based on the University"*

Trainee engineers need the support and guidance of senior engineers to advance their knowledge and experience. That is why engineering undergraduates pursue their industrial training in different engineering firms. According to IESL code of Ethics, senior engineers should guide subordinates of his or her workplace to improve engineering knowledge and experiences. If senior engineers are not doing that, they are not professional ethical engineers. According to above narrative, this engineering student couldn't complete his or her training period in useful manner. In most professions, unethical senior professionals always try to find and highlight mistakes of trainees. Actually, trainees may do lot of mistakes due to lack of experience. It is the responsibility of senior professionals and engineers to correct them and guide them in proper manner. Senior engineers should try to allocate sufficient

time to train undergraduates though they are having busy working schedule. It is their social responsibility to develop the future engineering generation.

*"Senior Engineer, who was responsible for the training program, was not interested to train us. Instead of doing that, he used us to do day today office paper works like photo copying which had no connection to the training program"*

It is not ethical to assign unnecessary or unrelated works for trainee engineers. They should be given engineering related tasks to complete while allowing them to get familiar with practical engineering problems. Operating a photocopy machine is not a duty of a future engineer. In this case, particular senior engineer has wasted the valuable time of the trainee engineers by assigning them a totally unnecessary task. Senior engineers should not forget their ethical responsibility to develop the future generation.

*"The case I observed in my training place was assigning the civil engineering works to an electrical engineer by the engineering manager of the factory."*

According to Engineering Code of Ethics, engineers shall perform professional services only in the areas of their competence. In this case, Engineering Manager has assigned civil engineering works to an electrical engineer. Is electrical engineer competent enough to carry out the civil engineering works? What does an electrical engineer know about civil engineering? Actually electrical engineers do not have sufficient knowledge on civil engineering aspects. Performing professional services only in their specialized field ensure the safety of the society. Mistakes can be happened from electrical engineer in large scale as he or she hasn't got sufficient knowledge in civil engineering.

*"One day in my training establishment, I and few workers were taken for a job in another factory by the senior engineer. That factory belongs to the cousin of our senior engineer. We repaired a broken machine there. Resources to repair that machine were taken from our training establishment."*

Every professional engineer should work honestly for his or her work place. This fact is highly emphasized in most of the codes of Engineering Ethics. In this case, a senior engineer has misused the resources of his workplace to serve his relative. And also, he has misused his professional powers to handle subordinates for an outside work during the working time of the factory. It is not an ethical behavior suitable for a senior engineer.

Actually, when referring engineering students' responses, they have the competency of identifying ethical and unethical acts and behaviors of their superiors. But, there is a possibility of doing same unethical act by engineering students in their future professional matters claiming that their senior engineers had done the same thing earlier. So, it does not make any good to the society. Therefore, senior engineers should focus on developing ethics in their trainees and junior engineers for a better society

**Conclusions & Future Recommendations**

"Engineers shall hold paramount health, safety & welfare of the public and proper utilization of funds & other resources" and "Engineers shall continue their professional development & shall actively assist & encourage engineers under their direction to advance their knowledge and experience" were the two clauses found in Code of Engineering Ethics predominantly violated by senior engineers and other responsible personnel in different engineering training establishments in Sri Lanka as per the observations of undergraduate engineering trainees. The unethical acts of senior engineers may be adopted by junior engineers or trainees because most of them consider their senior engineers as their professional role models. Further research can investigate deeply about these issues from the perspectives of the senior engineers to identify the reasons for their unethical acts in order to support the development of ethics and moral practice within the conduct of engineers.

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# ENVIRONMENTAL PRACTICES AND ECONOMIC SUCCESS A STUDY ON SMALL AND MEDIUM-SIZED ENTERPRISES REPRESENTED IN HIGH POLLUTING INDUSTRIES IN SRI LANKA

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## Abstract

Today environmentalism grows rapidly and it helps to make the world a better place. This concept paper is designed to investigate the impact of environmental practices on economic success of the Small and Medium-sized Enterprises (SMEs) represented in high polluting industries in the Western Province, Sri Lanka. It also identifies the most effective environmental practice/method that can be economically benefitted for the development of the country. The link between environmental practices and economic success has been widely debated in the literature during the past decade. One view is that environmental practices mainly causes extra costs and thus negatively affect the performance of a business while, the opposite has been argued that the environmental practices would improve the performance of a business. Both views have not been generalized so far. The empirical studies done on environmental practices of the SMEs are very limited in the context of Sri Lanka, thus the proposed study will make an effort to fill that void. This research involves quantitative approach. A total of 180 small and medium entrepreneurs represented in high polluting industries will be selected from the Western Province of Sri Lanka and the environmental practices of those SMEs will be examined against the financial performance on a year-over-year (YOY) basis. The findings will help to identify, whether the environmental practices affect the economic success of the SMEs represented in high polluting industries in the Western Province of Sri Lanka.

***Keywords: Environmental Practices, Economic success, Small and Medium-sized Enterprises***

## 1. Introduction

Municipal solid waste is the most complex solid waste stream, resulting from industrial or agricultural activities (Wang and Nie, 2001). When comparing with other South Asian countries, Sri Lankans have a greater concern to conserve the environment. However, limited commitment from the public has created serious environmental threats in recent years (Alagan, 2009). Environmental pollution and continuous increase of garbage are major issues in Sri Lanka (Alagan, 2009; Ileperuma, 2010). Most of the municipalities face difficulties owing to lack of proper dumping sites or recycling methods. Therefore, scattered garbage is common in most of the urbanized areas in the country (Alagan, 2009). Waterways of Sri Lanka are getting increasingly polluted by human sewage which has a direct impact on human health (Ileperuma, 2010). Air pollution is one of the serious environmental problems in Sri Lanka's major cities such as Colombo and Kandy.

Accordingly, it has revealed that the emissions of motor vehicles are the main cause of the air pollution as the fleet size has almost doubled during the past period (Ileperuma, 2010). Rapid industrialization, water pollution, air pollution, groundwater pollution, acidification of soil, climatic changes and accumulation of none biodegradable municipal waste etc. are the main causes of environmental degradation in Sri Lanka (Annual Report –CEA, 2014-2016; Zubair, 2001). Therefore, the government of Sri Lanka has imposed several regulatory measures for the prevention and control

of the pollution connected with different entities. The main legal tool implemented by the Central Environmental Authority (CEA) to control industrial discharges and emissions is the Environmental Protection Licensing (EPL) scheme. The Environmental Protection License (EPL) is a regulatory/legal tool implemented under the provisions of the National Environmental Act No: 47 of 1980. Industries and activities which required an EPL are listed in the Gazette Notification No 1533/16 issued on 25.01.2008. Industries are classified under three categories i.e., "A", "B" and "C" depending on their level of pollution. Category "A" comprises of 80 significantly high polluting industrial activities and Category "B" comprises of 33 numbers of medium level polluting industrial activities. EPL for the industries in "A" and "B" categories have to be obtained from the Central Environmental Authority. Category "C" comprises of 25 numbers of low level polluting activities. EPL for industries in "C" category has to be obtained from the respective Local Authorities (CEA, 2017).

### *1.1 Problem statement:*

Assessing whether the SMEs represented in high polluting industries in the Western Province, could enhance its financial performance after adopting green practices, on a year over year (YOY) basis?

The Western Province is the most densely populated province in Sri Lanka. The Western Province consists of three administrative districts namely: Colombo, Gampaha, and Kalutara. According to the Central Bank Report of Sri Lanka (CBSL), the Western Province is the major contributor to Sri Lanka's economic growth and it provides the highest contribution to Gross Domestic Product (GDP) of the country (Central Bank Report, 2017). According to the statistics published by the CEA, the highest number of "A" Category EPL holders are located within the Western Province of Sri Lanka, which had reported as 5,544 by the 31st Dec. 2017 (CEA, 2017). Apart from that, the highest number of complaints (44%), on environmental issues has mainly received from the districts belongs to the Western province (CEA, 2017). Out of the total 'A' category industries, food and leisure industry could be considered as the most prominent and important industries in the Western Province. **The food processing industry is one of the profitable and emerging industries in Sri Lanka and** vital for overall growth of the economy. Apart from that, the food processing industry is identified as one of the fastest growing sectors in the economy and recorded 5.2 % of growth rate in the 1st quarter of 2018 (DCS, 2018). At present, the leisure industry contributes 2% to the national GDP and the government expects the leisure industry to increase its GDP to 4% - 5% by 2020. According to the records of the Sri Lanka Tourism Development Authority, the leisure industry has increased remarkably during the 1st quarter of 2018, when compared to the year 2017 (DCS Quarterly reports, 2018). While considering the importance of these two sectors, small and medium enterprises belongs to the food and leisure industry has selected for the study.

### *1.2 Significance of Study*

In Sri Lanka, entrepreneurial businesses heavily contribute to the economic growth of the country. Hence, failure of the entrepreneurial sector is an economic cost to the entire development of the country. It was revealed that several quantitative studies (Hamilton, 1995; Melnyk et al., 2003; Gilley et al., 2000) have tested the relationship between green practices and financial performance under different socio cultural contexts. The results had been varied according to the researched context. However, under the Sri Lankan context, it has noticed that limited researches have done on green practices. The scholars (Judge and Douglas, 1998; Sharma and Vredenburg, 1998; Melnyk et al., 2003) have empirically proved that the green practices have positive impact on financial performance while some scholars argue (Wagner et al., 2002; Hamilton, 1995; Gilley et al., 2000) that the green practices have negative effect on financial performance. Both views have not been generalized so far (Molina-Azorín et al., 2009). This study will explore, whether an entrepreneur could increase the business performance by adhering to the eco-friendly practices under the context of Sri Lanka. This research may help the new entrepreneurs; to go with green. Apart from that, the investors will be benefitted when choosing the most appropriate company to invest.

### *1.3 Research Questions*

**Q1:** Whether the green practices, impact on the financial performance of the small and medium-sized enterprises represented in high polluting industries in the Western province, Sri Lanka?

**Q2:** What is the most effective green practice/method, adopted by the small and medium-sized enterprises represented in high polluting industries that economically benefitted for the development of the country?

### *1.4 Research Objectives*

Two objectives are derived from the research questions.

- To identify whether the green practices, impact on the financial performance of the small and medium-sized enterprises representing in the high polluting industries in the Western province, Sri Lanka?

- To identify the most effective green practice/method (adopted by the small and medium-sized enterprises representing in the high polluting industries in the Western province, Sri Lanka) that could be economically benefitted for the development of the country.

## 2. Methodology

### *2.1 Sample frame*

The researcher will be used the deductive approach to explain the theoretical underpinning and the related insights of the selected enterprises. As of December 31, 2017, there were 48,103 registered industries in Sri Lanka. Altogether there were 13,119 "A" Category enterprises represented in high polluting industries in Sri Lanka. Then the area sampling has done to identify the provincial wise distribution. Accordingly, it was identified that there were 5,544 high polluting enterprises located within the Western province as at Dec. 31, 2017, and that amount was reported as the highest number when compared to the other provinces. Apart from that, the highest number of complaints on environmental issues had mainly received from the districts belongs to the Western province (CEA, 2017). In addition, the Western Province recorded the highest contribution to the Provincial GDP (Central Bank Report, 2017). Thus, the Western province has selected for further research, through judgmental sampling.

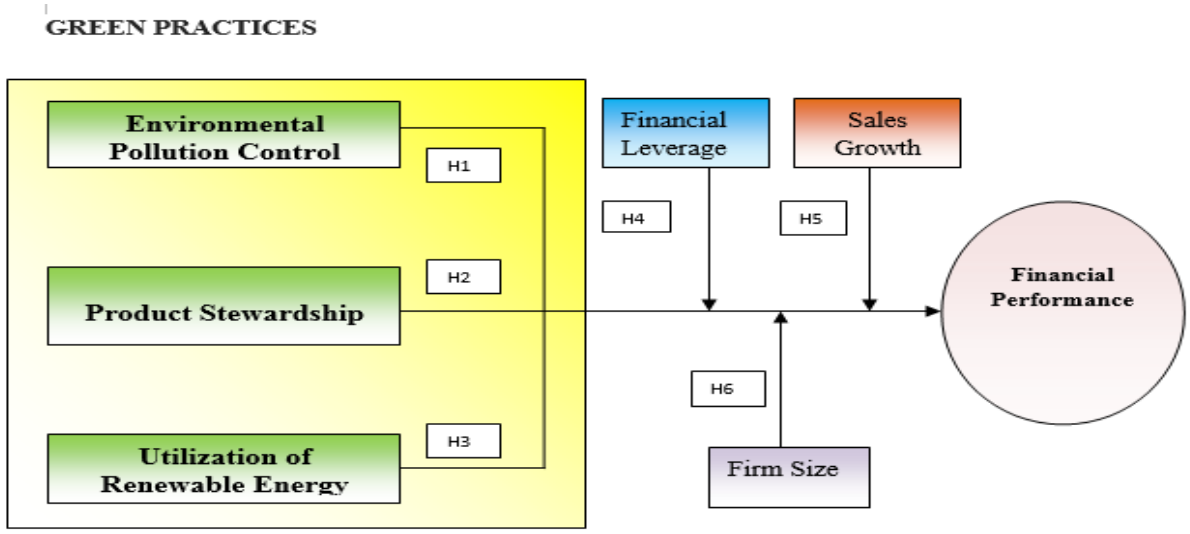
Micro-level enterprises are not fallen into "A" category as they are not high polluting enterprises. The enterprises that were fallen into the 'Large' category has been removed (186 Nos.) from the sample by considering the number of persons engaged in the business (*Economic Census 2013/2014, Department of Census and Statistics*). Thus, the study population of the SMEs has remained as 5,358. This study has mainly focused on the "A" category high polluting food and leisure related small and medium-sized enterprises in the Western Province Sri Lanka. Out of which, small and medium-sized 'A' category enterprises related to the food processing (A-66) and leisure industry (A-32) has been selected as the study sample. Therefore, the study sample has been remained as 180 small and medium-sized enterprises in the food and leisure industry.

### *2.2 Conceptual Framework*

A conceptual framework has developed (Figure 1) to identify the impact of the green practices on the financial performance of the high polluting small and medium-sized enterprises in the Western province of Sri Lanka, by using the literature findings and the GRI Standards 301, 302 and 306 (Global Reporting Initiatives, 2016). Two well-established theories namely, Ecological Modernization Theory (Spaargaren and Mol, 1992) and Economic Development theory (Schumpeter, 1934) have been used to depict the impact of green practices on financial performance. The Ecological Modernization Theory is used to develop the construct of 'environmental pollution control'. The Economic Development theory is used to develop the constructs related to 'product stewardship' and 'utilization of renewable energy'. Aforementioned constructs are hypothesized to have a direct influence on 'financial performance' with a positive effect. Accordingly, environmental pollution

control, product stewardship and utilization of renewable energy will act as the independent variables of this study and the impact of those independent variables will be tested against the dependent variable which is represented by the Return on Assets (RoA) and Return on Equity (RoE). Table 1 has shown the previous studies adopted by several scholars.

**Figure 1 : Conceptual Framework**




*Source: Researcher's construction, 2018*

**Table 1: Previous studies adopted**

| Dimension | | Authors |
|---|---|---|
| **Independent variables** | **GRI Standards** | |
| Environmental Pollution Control (EPC) | GRI 306 | Christmann (2000), Jasch (2000), Filbeck and Goman (2004), Yakhou and Dorweiler (2004), Rao and Holt (2005) |
| Product Stewardship (PS) | GRI 301 | Jasch (2000), Pujari et al (2003), Lewis (2005), Pujari (2006), Lee (2009), Lee & Kim (2011), Marques et. al (2014), Masilamani et al (2017) |
| Utilization of Renewable Energy (URE) | GRI 302 | Yue et al (2001), Tsoutsos and Stamboulis (2005),Stefan and Paul (2008), Shen et al (2010), Wüstenhagen and Menichetti (2012) |
| **Dependent variables** | | |
| RoA *(The ratio of net profit after tax to total assets)* | | Nakao et al (2007), Gonzalez-Benito and Gonzalez-Benito (2006), Waton (2004), King and Lenox (2001), Ameer & Othman (2012), Lo et al (2012) |
| RoE *(The return on owner's equity)* | | Wagner et al (2002), Wagner (2005), Aragon-Correa and Rubio-Lopez (2007), Nakao et al. (2007) |
| **Control variables** | | |
| Financial Leverage *(Total debt to assets)* | | McKelvie and Wennberg (2013), Delmar el al (2013) , Miroshnychenko et. al (2017) |
| Sales Growth *(Deference of net sales for firm i between time t & t-1)* | | Menguc and Ozanne (2005), Montabon et al (2007), Miroshnychenko et. al (2017) |
| Firm size | | Sarkis & Cordeiro (2001), Jermias (2008), Ramaswami et al (2009),Yang et al (2011) |

*Source: Researcher's constructions, 2018*

***2.3 Formulation of Hypotheses***

The proposed framework suggests the following hypotheses.

H1 - Environmental pollution control practices have a positive impact on financial performance of an entrepreneurial business.
H2 - Product stewardship practices have a positive impact on financial performance of an entrepreneurial business.
H3 - Utilization of renewable energy has a positive impact on financial performance of an entrepreneurial business.
H4 - Financial leverage has a moderating effect in-between green practices and financial Performance of an entrepreneurial business.
H5 - Sales Growth has a moderating effect in-between green practices and financial performance of an entrepreneurial business.
H6 - Firm Size has a moderating effect in-between green practices and financial performance of an entrepreneurial business.

### *2.4 Research Model*

The regression model is selected as the most appropriate model for this study. Multiple regression method will be used to test the hypotheses formulated and discussed under the conceptualization. Two separate regressions will run for RoA and RoE. The data will be analyzed through the E-Views statistical package. The conclusions and the recommendations would be formed based on the results of the proposed analysis.

$$FP_t = \beta_0 + \beta_1 (EPC_{t-1}) + \beta_2 (PS_{t-1}) + \beta_3 (ERE_{t-1}) + \beta_4 (Controls_{t-1}) + d_t + \varepsilon_t$$

| | | |
|---|---|---|
| $FP_t$ | - | Proxy of Financial Performance (RoA or RoE) |
| $\beta_0$ | - | Intercept of the straight line in the population |
| $\beta_1$ | - | Coefficient of Environmental Pollution Control |
| $\beta_2$ | - | Coefficient of Product Stewardship |
| $\beta_3$ | - | Coefficient of Exploitation of Renewable Energy |
| $\beta_4$ | - | Coefficient of Control variables |
| $EPC_{t-1}$ | - | Proxy for a firm's Environmental Pollution Control |
| $PS_{t-1}$ | - | Proxy for a firm's Product Stewardship |
| $ERE_{t-1}$ | - | Proxy for a firm's Renewable Energy Exploitation practices |
| $Controls_{t-1}$ | - | Vector of control variables that include Financial Leverage, Sales Growth and Firm Size |
| $d_t$ | - | Time |
| $\varepsilon_t$ | - | Random Error |

## 3. Expected Output

According to Rivera (2002), green practices can help entrepreneurs to reach a win-win situation. The enterprises that adopt green practices could benefit from premium pricing as they can differentiate their products from their competitors. Thus, the findings will aware the entrepreneurs, whether the real commitment to green practices could influence the financial performance of their business. If an

entrepreneur is able to increase its financial performance by adopting green practices, then they will, become an example for other entrepreneurs to follow. In addition, the findings will motivate the newcomers to go with eco-entrepreneurship.

### *3.1 Tentative Research Plan*

**Table 2 : Action Plan**

| Task | Time Period ( 2 Years ) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3rd Q 2017 | 4th Q 2017 | 1st Q 2018 | 2nd Q 2018 | 3rd Q 2018 | 4th Q 2018 | 1st Q 2019 | 2nd Q 2019 |
| Proposal writing | ✓ | ✓ | ✓ | | | | | |
| Proposal Presentation | | | ✓ | | | | | |
| Proposal Revision | | | ✓ | | | | | |
| Instrument Development | | | ✓ | | | | | |
| Writing Chapter 1,2,3,4,5,6 (Background, Research Problem, Purpose, Objectives, Significance, Literature Review) | | ✓ | ✓ | ✓ | | | | |
| Instrument Testing & Revision (Pilot survey) | | | ✓ | | | | | |
| Data Collection & Tabulation | | | ✓ | ✓ | | | | |
| Data Analysis | | | | ✓ | ✓ | | | |
| Writing Chapter 7,8,9,10 (Research Methodology, Analysis, Conclusion, Recommendation) | | | | ✓ | ✓ | ✓ | | |
| Dissertation submission | | | | | | | ✓ | |
| Dissertation Revision | | | | | | | ✓ | |
| Final Report | | | | | | | | ✓ |

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# DEVELOPMENT AND EVALUATION OF A PARTICULATE MATTER DISPERSION MODEL FOR POWER PLANTS BASED ON THE GEOGRAPHICAL SIGNIFICANCES

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**Abstract**

Particulate Matter (PM) in the troposphere is a complex mixture of inorganic and organic components with particle aerodynamic diameters ranging from a few nanometers to tens of micrometers. PM has been linked to multiple detrimental public health outcomes and plays important roles in climatic processes including cloud formation, precipitation, and the solar radiation budget. PM 10 and PM 2.5 are the most health damaging considered to other pollutant in atmosphere thus people with heart or lung diseases are the most likely to be affected. This paper elaborates the protracted modeling of well-known Gaussian Plume Dispersion model used in forecasting of dispersion and behavior patterns of PM emitted from Sri Lankan power plants emphasizing the significant functioning in urban and rural areas. Adiabatic and environmental lapse rates are analyzed specifically in identifying the atmospheric stability conditions based on geographical and topographical conditions. The type of the plume buoyant or momentum is initially detected in analyzing the PM dispersion. The PM emission rate is modified with particle interaction coefficient of 0.002 and the effective stack height is modified by adding the distance travelled by particles due to drift velocity. Stack tip downwash, dimensional and spatial coordination of the plume, building downwash & multiple stack effect are integrated in the model to characterize PM in both urban and rural areas. The model is validated with refinery emission data where the results depict that stable atmospheric condition is the most challenging. The model momentously highlights the significant differences in urban and rural PM dispersion reflecting the concentration contour lines, spatial point PM concentrations, PM dispersion pattern during emergency situations and the minimum ground level concentration with the relevant ground level distance through graphical representations and numerical figures.

***Keywords: Particulate matter, Dispersion, Model, Gaussian plume***

## 1 Introduction

Particular matter (PM) are complexes of both solid and liquid matters dispersed in air. These are created either from organic and inorganic solid particles and liquid droplets and many of them are hazardous to both human population and environment. PM consist of dust, soot, dirt and smoke which can sometimes be visible to the naked eye. The work on this research is based on the PM emitted from thermal power plants in Sri Lanka and their effect on urban and rural areas in the vicinity.

The primary products of complete combustion of diesel generators are carbon dioxide, nitrogen and water. However, the incomplete combustion with insufficient oxygen supply causes generation of particulate pollutants. PM generated from incomplete diesel combustion is comprised of carbon, water, hydrocarbon and Sulphur hydrides, which are visible as a hazy dark smoke. Approximately, 0.045% of total emission of diesel exhaust consist of PM. However, this value varies along with the performance of the diesel generator used (Huy and Kim Oanh, 2017).

Inhalation of PM causes health damages to human population. According to World Health Organization (WHO) reports, PM have been considered as the most health damaging substance among all other air pollutants. The particulates with a diameter of 10 microns or less (PM10) have been considered as the most health damaging particulates because they can penetrate easily into the lungs. Long-term exposure to particulate pollutants increase the risk of respiratory and cardiovascular diseases along with the lung cancer(Harrison *et al.*, 2017).

In this research work a model is developed to demonstrate the PM dispersion in atmosphere. Distribution of PM in urban and rural areas are then compared by using the model developed.

### 1.1 Modeling of Dispersion of Particulate Matter

The model that is used in this research work to demonstrate the particulate dispersion in atmosphere is Gaussian plume dispersion model. A dispersion model is a tool to predict the concentrations of pollutants emitted from the point or site of generation to a site/point of deposition considering the data on emission characteristics, meteorology and topography of the terrain.

The Gaussian model is based on assumptions of a release from a stationary point source dispersing with a homogenous, steady-state flow form the time of the emission until the release reaches the receptor. That is for each time period the concentrations are calculated the meteorological conditions are assumed to be same throughout the considered entire time period.

PMs emitted from thermal power plants are released to the atmosphere from stacks mixed with other gaseous pollutants. Those PMs which are mixed with other gaseous pollutants possesses a momentum when they enter to the atmosphere. PMs emitted from stacks are in heated form and thus in higher temperatures than the rest of substances in atmosphere. That makes them less dense making a plume pollutant (Brusca *et al.*, 2016). The factors that largely affect the rise of the plume of pollutants are wind profile, emission temperature and ambient temperature. Gaussian plume model equation includes both atmospheric and plant specific characteristics. In order to modify the equation to adapt to the behavior of PMs PM emission rate is modified with particle interaction coefficient of 0.002.

$$C(x,y,z) = \frac{Q}{2\pi\sigma_y \sigma_z U_s} e^{\frac{-y^2}{2\sigma y^2}} \left(e^{\frac{-(Z+H)^2}{2\sigma_z{}^2}} + e^{\frac{-(Z-H)^2}{2\sigma_z{}^2}}\right) \qquad (18)$$

The Gaussian equation has been developed in order to demonstrate the dispersion of gaseous pollutants emitted from a point source (Alemayehu and Hackett, 2015). The purpose of the research is to modify the Gaussian plume model to model the dispersion pattern of particulate matter emitted from thermal power plants in Sri Lanka. Following modifications are done in the Gaussian plume model to convert the equation to adapt to demonstrate the particulate matter dispersion apart from the gaseous dispersion in atmosphere.

The effective stack height (H) is the summation of actual stack height and the plume rise. But as this model demonstrate the dispersion of particulate matter; the effective height is affected by the force exerted by gravity upon the particulate matter. This gravity force is insignificant on the gaseous. But for particulate matter, the gravity force upon the matter should be considered when calculating the effective stack height. And also once the wind speed is much larger than the flue gas emission rate, the plume begins not from the mouth of the physical stack height, but a smaller distance below to the mouth, well known stack-tip downwash concept. Thus accurate value for plume rise can be obtained by replacing H by H(x) as follows,

$$H(x) = H - x*(vt/ Us) \qquad (15)$$

Many of secondary particulate matter undergoes thermodynamic equilibrium chemical reactions which are called as the gas-to-particle conversion -GTPC processes. One such method of particulate matter generation is nucleation, in which particulates are formed from gaseous phase substances. The particulates formed from nucleation has small contribution to the total mass of soot at the emission point, but has a great influence when the plume tend to continue adding a considerable generation of mass because they provide active sites for the surface growth. This process leads to the generation of

large number of small size particles. The other major method of PM generation by chemical interactions is the process of nucleation. Nucleation is the process of formation of particulates from aerosols by nucleating condensable species to form a new particle. GTPC process tends to reside in the accumulation mode particulate matter range (normally 0.1 to 2.5 μm). It is found that the ammonia and acid gases in the atmosphere are major inorganic atmospheric aerosol precursor sources which control composition of PM in the atmosphere through the GTPC process (Mohankumar and Senthilkumar, 2017). Both Condensation and Nucleation under GTPC process effect for an increment in PM emission rate as follows with a term called

$\boldsymbol{\alpha}$ – particle interaction coefficient (0.002).

$$Qtot = \alpha Q + Q \quad (2)$$

## 2 Methodology

The basis of the model is the straight-line, steady-state Gaussian plume equation, which is used with above modifications to model simple point source emissions from stacks, that experience the effects of aerodynamic downwash due to nearby buildings, isolated vents, multiple vents and so on. Here wind exponent power factor and building downwash concepts have been integrated in characterizing different geographical conditions. The following methodology was used in building the model successfully using MATLAB interface. Sapugaskanda oil refinery data were analyzed during validation of the model.

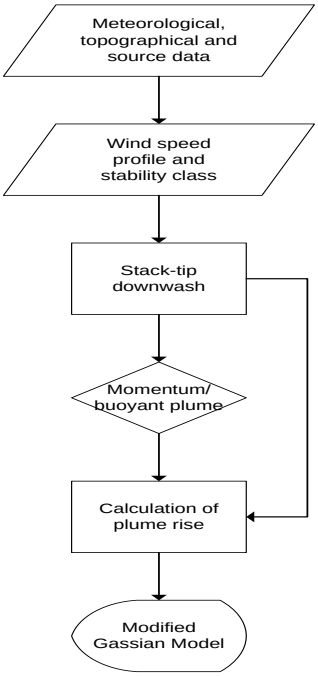



*Fig 1. Flow chart of the proposed model*

### 2.1 Effect of wind speed

The wind power law is used to adjust the observed wind speed, from a reference measurement height, to the stack or release height. The stack height wind speed, is obtained as follows.

$$U_s = U_{ref} \left(\frac{h_s}{Z_{ref}}\right)^p \quad (1)$$

Where p is the wind profile exponent. Values of p are automatically taken by the model as a function of stability category and wind speed. The stack height wind speed, Us, is not allowed to be less than 1.0 m/s. The demographic condition around the vicinity of the power plant can be taken into account through the selection of correct exponent factor rural or urban and the default values are as follows.

Table 1. Wind power exponent factor table

| Stability category | Rural exponent | Urban exponent |
|---|---|---|
| A | 0.07 | 0.15 |
| B | 0.07 | 0.15 |
| C | 0.1 | 0.2 |
| D | 0.15 | 0.25 |
| E | 0.35 | 0.3 |
| F | 0.55 | 0.3 |

### 2.2 Identification of Atmospheric stability classes

The tendency of the atmosphere to resist or enhance vertical motion and the turbulences termed the **stability**. Stability is related to both the change of temperature with height (the lapse rate) given by the boundary layer energy budget, and wind speed together with surface characteristics (roughness). Stability classes are defined for different meteorological situations, characterized by wind speed and solar radiation (during the day) and cloud cover during the night. Dispersion estimates include six stability classes A – Very unstable, B – Unstable, C – Slightly unstable, D – Neutral, E – Stable, F – Very stable(Modi *et al.*, 2013). The stability class determination factors are all taken by analyzing the lapse rate and inversion effects. The model is developed such that once the user enters the time period of his interest, the relevant stability class is displaced.

Table 2. Atmospheric stability class table

| Surface wind speed (m/s) (Us) | Day | | | Night cloud cover (6pm-6am) | |
|---|---|---|---|---|---|
| | 10am-3pm | 3pm-6pm | 6am-10am | Cloudy | Clear |
| <2 | A | A | B | E | F |
| 2-3 | B | B | C | E | F |
| 3-5 | B | B | C | D | E |
| 5-6 | C | C | D | D | D |
| >6 | C | D | D | D | D |

### 2.3 Determination of Buoyancy and Momentum

Many sources of air pollution release material in the atmosphere with some initial momentum and positive buoyancy which make the puff or plume rise gradually while dispersing under the influence of both the source generated and naturally occurring turbulence(Air and Concentrations, no date). For most plume rise situations, the value of the Briggs buoyancy flux parameter, Fb (m4/s3) and momentum flux parameter Fm are needed in determining the type of the plume. We developed the model such that effective plume height alters depending on the type of the plume and atmospheric stability condition.

$$F_b = \frac{g \times V_s \times d_s^2 \times \Delta T}{4T_s} \qquad F_m = \frac{T_a}{T_s} V_s^2 \frac{d_s^2}{4} \qquad (4,5)$$

After the selection of plume type momentum or buoyant, the model is integrated such that it calculates the suitable plume height based on the prevailing atmospheric condition. Then the plume height is adjusted such that the distance travelled from drift velocity is reduced from the plume height.

### 2.4 Concept of Building downwash

The presence of buildings causes in formation of eddies and wakes which significantly alters the dispersion of pollutants. The building downwash always require the calculation of a distance dependent momentum plume rise. This model stimulates the equations described below to calculate a distance dependent momentum plume rise at a distance of two building heights downwind from the leeward edge of the building (Christensen, 1997). For buoyancy plumes in unstable, neutral, or stable conditions the plume rise will be as follows

$$h_e = h_s^1 + 1.6 \frac{F_b^{1/3} x^{2/3}}{U_s} \quad (19)$$

For momentum dominated unstable and stable conditions, the following equations are used to calculate a distance dependent momentum plume rise respectively:

$$h_e = h_s^1 + \left(\frac{3 F_m x}{B_j^2 U_s^2}\right)^{1/3} \quad (20)$$

$$h_e = h_s^1 + \left(\frac{3 F_m \sin\left(\frac{x\sqrt{s}}{u_s}\right)}{B_j^2 U_s^2}\right)^{1/3} \quad (21)$$

### 2.5 Dispersion parameters

Equations that approximately fit the Pasquill-Gifford curves are used to calculate $\sigma$y and $\sigma$z (in meters) in the model(United States Environmental Protection Agency (USEPA), 1995). These 2 coefficients depend largely on atmospheric conditions and crosswind distance from plume center.

$\sigma_y$(m) = 465.1128 $x$(km) Tan (TH) (16)

TH = 0.017453293[c – d ln(x)]

$\sigma_z$(meters) = $ax^b$ (x in kilometers) (17)

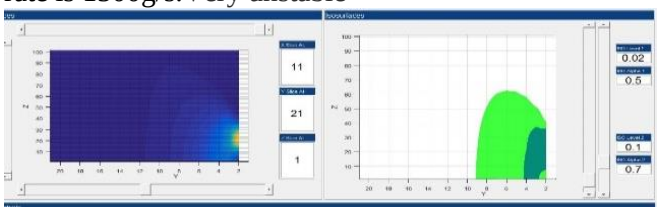
Table 3. Constant values in determining dispersion parameters

| Stability category | c | d |
|---|---|---|
| A | 24.1670 | 2.5334 |
| B | 18.3330 | 1.8096 |
| C | 12.5000 | 1.0857 |
| D | 8.3330 | 0.72382 |
| E | 6.2500 | 0.54287 |
| F | 4.1667 | 0.36191 |

## 3 Results

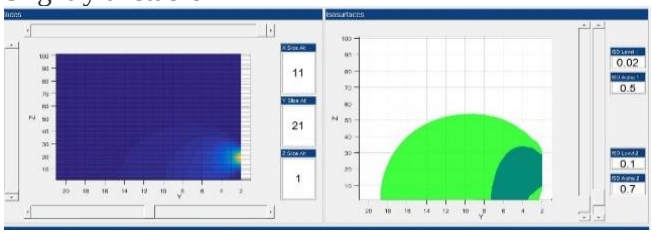
This model can be used in identifying the concentration contour lines, spatial point PM concentrations, PM dispersion pattern during emergency situations and the minimum ground level concentration with the relevant ground level distance through graphical representations with numerical figures momentously for urban and rural areas. Following graph series elaborate the

significant results obtained for 6 different stability classes in urban area under ordinary emission conditions. The considered stack height is 13m, emission temperature is 500K and the PM emission rate is 1500g/s.Very unstable

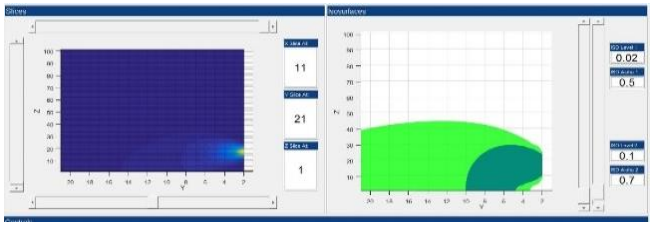


Unstable

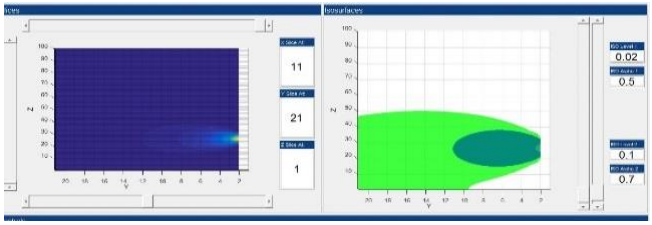
Slightly unstable



Neutral



Stable



Very stable

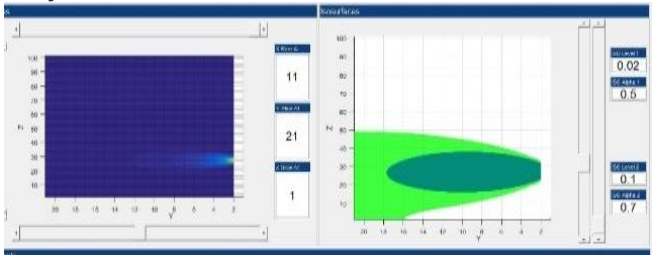


*Figure 2. Urban PM dispersion for stability classes under normal conditions*

According to the above 6 graphical representations PM with higher concentrations are tend to stay agglomerated in a large area during stable atmospheric classes while they are distributed away and not even touch the ground during unstable conditions. In neutral atmospheric condition the plume spreads alike in the vertical and horizontal as it propagates downstream, forming a coning plume. It generally forms in sunny days. This condition is comparatively good than the stable condition once health and

safety effects are considered. Compared to unstable conditions, the particulates with lesser concentrations fall on ground level much near to the stack.

Further the model can be used in analyzing the predictive plume dispersion pattern once accidental releases (Q= 170,000 g/s) happen in both urban and rural areas.

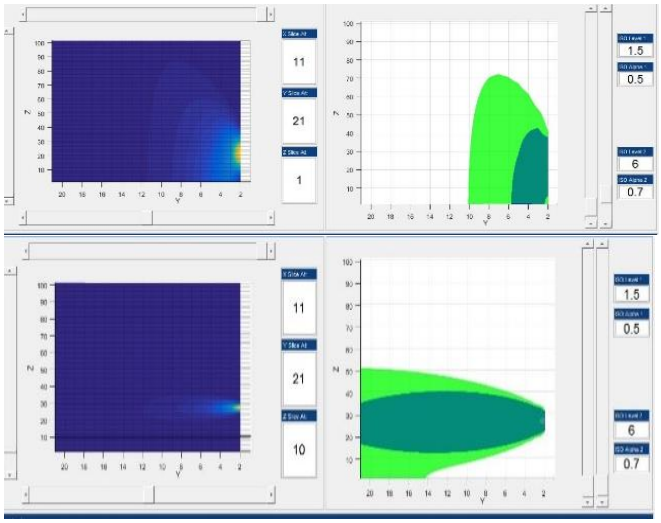



*Figure 3. Urban PM dispersion for very unstable and very stable under accidental releases*

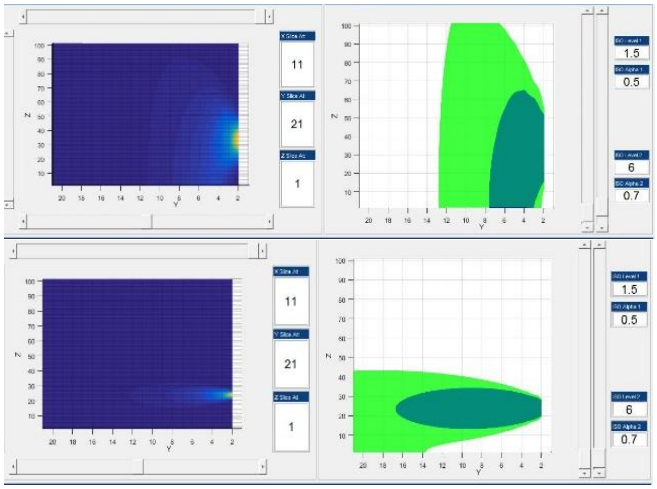



*Figure 4. Rural PM dispersion for very unstable and very stable under accidental releases.*

Huge amount of PM agglomerate and reach ground within considerable distances from stack during very stable condition irrespective of geographical location. In unstable condition within rural areas the plume center being raised well above the stack and it is well mixed and dispersed in the upper atmosphere compared with rural areas.

## 4 Discussion

The developed model can be used to analyze PM dispersion patterns through several significant aspects to identify the most appropriate emission type in minimizing adverse health effects in both urban and rural areas. The below graph elaborates the variation of maximum distance taken by a PM of concentration 0.05g/s to hit the ground under an emission rate of 1500g/s in the six atmospheric stability classes in both urban and rural areas. The critical PM concentration level and emission rate were taken after analyzing refinery data.

According to this graph, the maximum distance taken by PM to hit the ground along the plume center line in urban situation has gradually increased once stability class goes from unstable to stable. This clearly elaborates that the degree of PM with higher concentrations agglomerating or falling to ground covering a large terrain increases once stability class is stable. Since there is a significant scale of dispersion barriers like tall buildings, bridges, stacks and less atmospheric turbulences in urban area, the dilution of PM is hindered and they try to stay concentrated. It can be seen that the maximum ground level distance is given by Neutral atmospheric condition in rural areas. Since the plume tends to disperse alike in both vertical and horizontal directions and no significant barriers are found the maximum ground level distance is high in this atmospheric condition causing more PM to touch the ground.

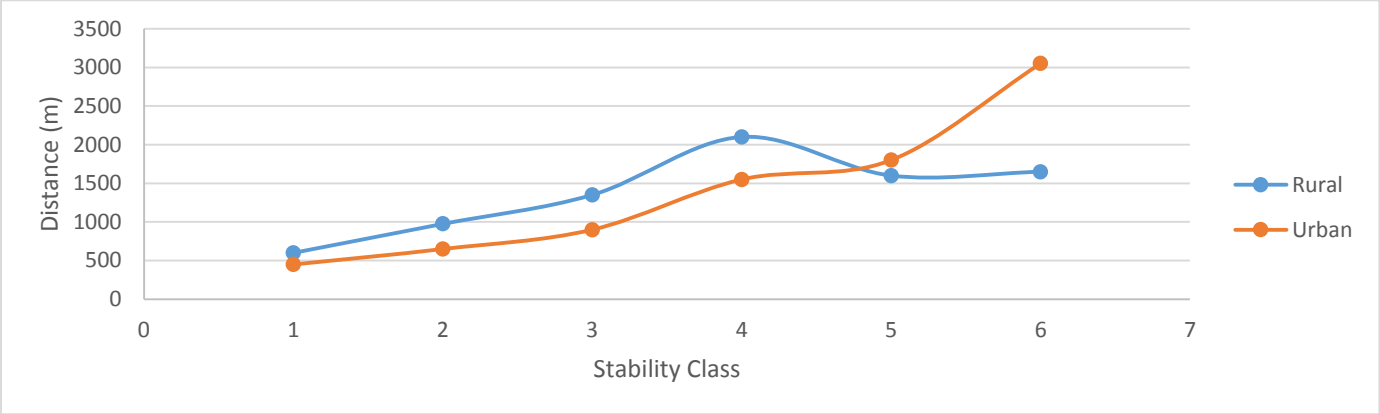



Fig 5. Graph of maximum ground level distance vs stability classes for urban and rural areas under normal operating conditions

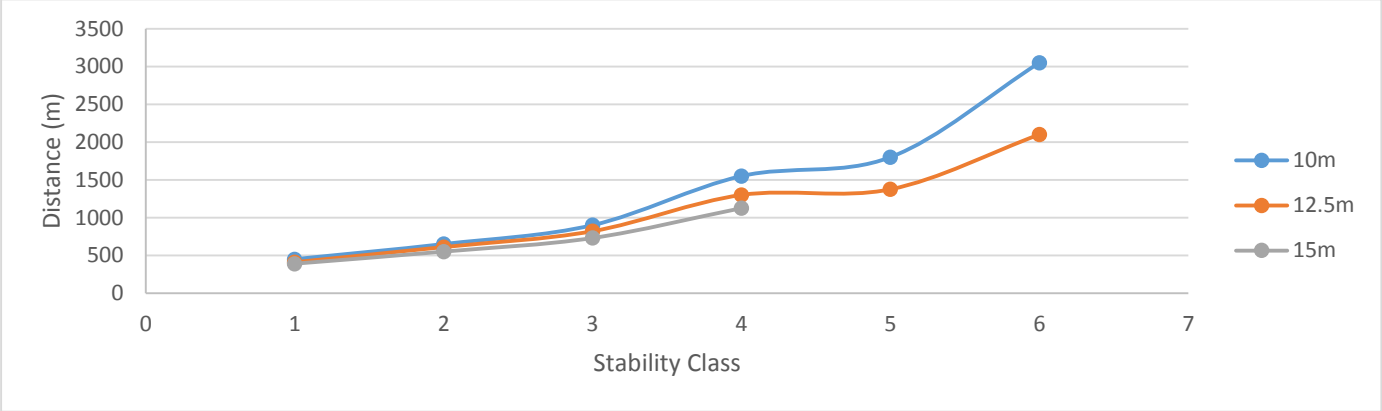
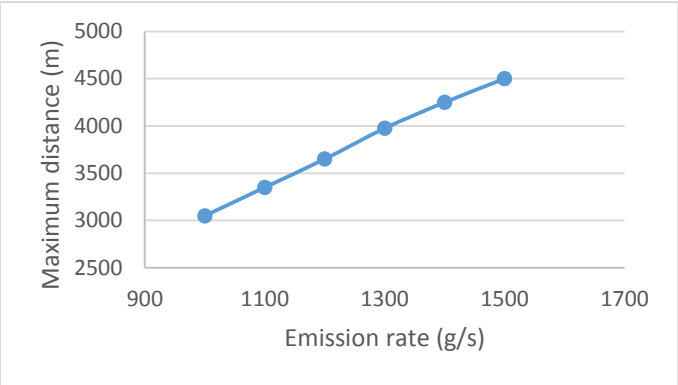



Fig 6. Graph of maximum ground level distance vs stack height in urban area for all stability classes.

This graph describes how maximum ground level distance (MGLD) varies with different stack heights in all atmospheric classes in urban area under normal emission rates. MGLD does not show any significant variation with stack height under unstable atmospheric conditions. Since PM are well diluted and dispersed in atmosphere, no considerable amount touches the ground in unstable conditions. But the MGLD shows a decrease when stack height increase up to 12.5m within stable conditions. PM emitted from stacks with heights above 15m under stable atmospheric conditions does not tend to touch the ground rather stay agglomerated in upper sky causing PM smog formations. Thus it is better to have stacks with heights around 15m-20m if the plant is located in a terrain feeling frequent stable atmospheric conditions such that no adverse PM dispersions are felt.




The above figure is analyzed in depicting out how the MGLD varies with different PM emission rates for the most worst case, stable atmospheric condition within urban areas. It clearly images that the MGLD gradually increases with increasing PM emission rate. The prominent reason is that due to emission of large quantity of PM and less atmospheric mixing considerable amounts of high concentrated PM stay

Fig 7. Graph of maximum ground level distance vs various emission rates for stable stability class in urban areas.

agglomerated and fall to ground covering a large area causing more damage. Once the PM emission rate increases adversely habitats even within 10km of the plant should be evacuated. Thus this predictive model assists operators to take the most necessary safety measurements once an accidental release happens and to identify up to which radii from plant habitats should be safely evacuated.

## 5 Conclusion

This paper is imperative on the implementation of a Gaussian Plume Model to analyze and study dispersion of PM in thermal power plants of Sri Lanka significantly based on geographical conditions. Once the model was developed, Sapugaskanda oil refinery source and geographical data were analyzed in validating the model. Results revealed that performances of the model were quite sturdy. The near real-time nature of this model makes it a good predictive tool for regulatory purposes and identifying the optimum emission conditions based on the geographical location of the power plant.

The model is useful in obtaining a fair value for a GEP stack height by considering the proposed plant source terms and its topographical variations. Model gives the most suitable distance from the stack where habitats should be placed considering all effecting conditions and elaborates how source terms should be altered such that no adverse PM dispersions happen.

The results of this controlled environment could be extended to real scale phenomena by making a deeper analysis of meteorological in order to find solution for adverse weather and topographical conditions. Further this model could be easily used in optimization of algorithms to identify behaviors of all industrial pollutants sources.

## Acknowledgement

The authors would like to thank University of Moratuwa for providing support to this project.

## 6 Appendix

| | |
|---|---|
| ds | Stack inside diameter (m) |
| Fb | Buoyancy flux parameter ($m^4/s^3$) |
| Fm | Momentum flux parameter ($m^4/s^3$) |
| g | Acceleration due to gravity (9.8 $m/s^2$) |
| $h_b$ | Building height (m) |
| $h_e$ | Plume (or effective stack) height (m) |
| hs | Physical stack height (m) |
| hs´ | Release height modified for stack-tip downwash (m) |
| H | Effective stack height (m) |
| P | Wind speed power law exponent |

| | |
|---|---|
| Qs | Pollutant emission rate (g/s) |
| Ta | Ambient temperature (K) |
| Ts | Stack gas exit temperature (K) |
| $U_{ref}$ | Wind speed at reference height (m/s) |
| $\sigma_y$ | Dispersion coefficient in wind direc |
| $\sigma_z$ | Dispersion coefficient in vertical direc |
| S | Stability parameter |

$$U_s = U_{ref} \left(\frac{h_s}{Z_{ref}}\right)^p \quad (1)$$

$$Q_{tot} = \alpha\, Q + Q \quad (2)$$

$$h_s^1 = h_s + 2d_s \left(\frac{V_s}{U_s} - 1.5\right) \quad (3)$$

$$F_b = \frac{g\, V_s\, d_s^2\, \Delta T}{4 T_s} \quad (4)$$

$$F_m = \frac{T_a}{T_s} V_s^2\, \frac{d_s^2}{4} \quad (5)$$

$$\Delta T_c = 0.0297 \times T_s \times \frac{V_s^{1/3}}{d_s^{2/3}} \quad (6)$$

$$\Delta T_c = 0.00575 \times T_s \times \frac{V_s^{2/3}}{d_s^{1/3}} \quad (7)$$

$$\Delta T_c = 0.00575 \times T_s \times V_s \sqrt{s}$$

$$s = 0.0298\, \frac{g}{T_a} \quad (8)$$

$$h_e = 21.425\, \frac{F_b^{3/4}}{U_s} \quad (9)$$

$$h_e = 38.71\, \frac{F_b^{3/5}}{U_s} \quad (10)$$

$$h_e = 2.6 \left(\frac{F_b}{s \times U_s}\right)^{1/3} \quad (11)$$

$$h_e = \frac{3\, d\, V_s}{U_s} \quad (12)$$

$$h_e = 1.5 \left(\frac{F_m}{\sqrt{s} \times U_s}\right)^{1/3} \quad (13)$$

$$h_e = \frac{3\, d\, V_s}{U_s} \quad (14)$$

$$H = h_s^1 + h_e - (x V_t / U_s) \quad (15)$$

PM concentration at ground level (Z = 0)

$$C(x,y,0) = \frac{Q}{2\pi \sigma_y\, \sigma_z\, U_s}\, e^{\frac{-y^2}{2\sigma_y^2}}\, e^{\frac{-H^2}{2\sigma_z^2}} \quad (16)$$

PM concentration at ground level along the plume centerline(y=0, z=0)

$$C(x,0,0) = \frac{Q}{2\pi \sigma_y\, \sigma_z\, U_s}\, e^{\frac{-H^2}{2\sigma_z^2}} \quad (17)$$

Contaminant concentration at ground level along the plume centerline when the emission source is at ground level

$$C(x,0,0) = \frac{Q}{2\pi\sigma_y \sigma_z U_s} \quad (22)$$

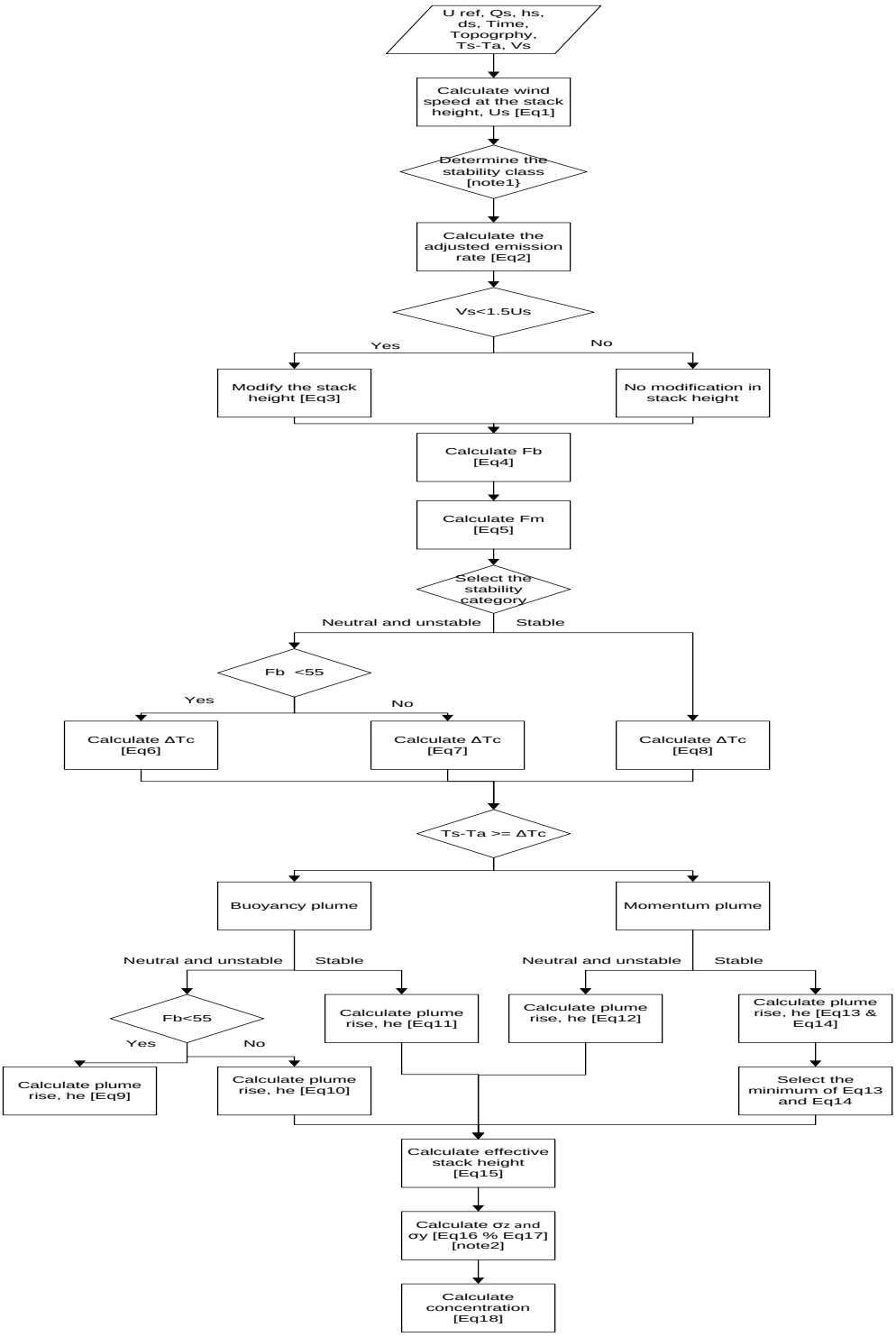



Fig 8. Complete flow diagram of the model

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# THE IMPACT OF EMPLOYER - EMPLOYEE RELATIONSHIP AND PRACTICE OF EFFECTIVE GOAL SETTING ON THE PERFORMANCE OF MILLENNIAL EMPLOYEES IN SMALL AND MEDIUM SCALE IT ORGANISATIONS IN SRI LANKA

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**Abstract**

Employee performance is a major contributing factor of organisational performance. Since there are many factors that affect employee performance, it is important to explore the contribution of each factor. IT industry is a booming industry in Sri Lanka where the majority of the workforce is considered to be millennials. It is evident that the behaviour of millennials is significantly different from the behaviour of other generations. Most of the studies that have been conducted on millennial employees are on their difference from other generations and behaviour at the workplace. Organizational Goal setting involves the development of an action plan designed to motivate and guide a person or group towards a goal. According to the literature, the specificity of goals leads to improvements in both employee and organizational performance. The relationship between an employer and an employee is a key deciding factor as it is vital to establish mutual trust. There is no sufficient research conducted on Sri Lankan small and medium scale IT organisations in order to explore the impact of the practice of effective goal setting and employer-employee relationship on employee performance. Hence, this research study has been conducted to investigate the impact of the practice of effective goal setting and employer- employee relationship on the performance of millennial employees, both collectively and individually, through a systematic review of literature. Also this study opens the path for further research on human research management practices of IT industry as well.

***Keywords: employee performance, practice of goal setting, employer-employee relationship, millennials, IT organisations***

## Introduction

Human Resource Management (HRM) is a one of the major factors for an organisation because employees or the human capital is the core asset and a source for sustained competitive advantage(Rana and Malik, 2017). According to Ho (2008), "employees" are no longer considered as "labourers" who only contribute their manpower. Therefore, for the modern employees in current organisations, further attention and management practices are needed. HRM helps to improve employee performance, in order to improve organisational performance.

This research focuses on how some identified important factors impact on performance of employees in Information Technology (IT) organisations in Sri Lanka. Since 2003, Sri Lankan IT workforce is growing rapidly and there were 15586 IT employees in 2003 and in 2014 the figure was 82,854 employees in the IT workforce. Currently there are above 90,000 IT employees who are hired as IT professionals in IT organisations, non- IT organisations and government organisations. Sri Lankan IT industry is not very mature. But there was significant improvement in recent years. IT workforce in Sri Lanka is relatively young, with workforce with 67% of employees having five or less number of years of experience (National ICT Workforce Survey Report, 2013). IT sector in Sri Lanka offers a wide range of employment opportunities for skilled workforce trained on IT. According to the findings of previous ICT Workforce Surveys, number of employees recruited by IT, BPO and non-IT companies and government organisations in IT jobs has increased steadily from 15,000 in 2003 to

50,000 in 2010. This indicates the remarkable capacity of the IT sector for creation of jobs for Sri Lankans. Currently higher proportion of IT workforce is belong to generation X or millennial category.

**Research problem and justification**

According to "Great Place to Work" Sri Lankan rankings 2015, there were six IT organisations among top 20 companies. But in 2018, there are only two IT organisations among top 20 companies. This implies that the attention for employees has decreased over past years in IT organisations in Sri Lanka. Therefore they should focus more on employees and understand them in order to satisfy them effectively. Employee satisfaction has significant positive effect on employee performance as well as organisational performance. Among the factors that affect employee performance, practice of effective goal setting and employer-employee relationship have identified as major factors. Since lager scale IT organisations are already practicing these practices, this research has tried to identify the impact of practice of effective goal setting and employer-employee relationship on employee performance in small and medium scale IT organisations in Sri Lanka through literature review.

This study has tried to identify the impact of practice of effective goal setting and employer-employee relationship on employee performance among millennials in small and medium scale IT organisations in Sri Lanka, through a literature review. The main and most important objective of this research is to increase the awareness of researchers about the HRM practices Sri Lankan IT industry through the literature review. Since there are very limited number of researches done covering these areas we believe that there is information gap that needed to be filled.

**Methodology**

This systematic review of literature is based on the content analysis to gather the state of knowledge in employee performance, practice of effective goal setting, employer- employee relationship, millennials and HRM practices in small and medium scale IT organisations in Sri Lanka. As the initial step, 50 articles were selected depending on the relevance to the major areas of study. Among them, 30 articles were selected for further study through screening based on relevance from titles and abstracts. The selected articles were scrutinized in deep to eliminate the irrelevant articles from the study. After a deep comprehensive study, 20 articles were identified as relevant for the research area and selected for the analysis. The reference section of this paper contains all the articles studied.

**Results and Discussion**

## Definition of SMEs in Sri Lanka

SMEs are defined differently by different countries based on different parameters such as number of employees, business turnover, capital investment and energy consumption etc. In Sri Lankan context, SMEs have been defined in terms of either value of annual turnover, the size of employment or a combination of both. According to National Policy Framework for SME development definition of SME is organisations which employ less than 300 employees and which have an annual turnover not exceeding Rs.750 Million. Using the size of capital and the number of employees as the criteria, the Industrial Development Board (IDB) defines a small industry as an establishment whose capital investment in plant and machinery does not exceed Rs. 4 million and the total number of regular employees does not exceed 50 employees (Central Bank of Sri Lanka, 1998). The Department of Small Industries defines SMEs as those with a capital investment of less than Rs. 5 Million, and which employ less than 50 employees. The National Development Bank defines SMEs as those with a capital investment of less than Rs. 20 Million excluding land and buildings. The Export Development Board (EDB) defines SMEs as those with a capital investment of less than Rs. 20 Million in plant, machinery and equipment excluding land and buildings and an annual export turnover not exceeding Rs. 40 Million and total annual turnover not exceeding Rs. 100 Million (white paper, 2002).

In accordance with above said definitions, it is the fact that there are no unique criteria or a unique definition for the small medium enterprises in Sri Lanka like other countries. In other words, there is no universally accepted definition of SMEs. Apart from the different criteria, various types of definition were adopted by different official agencies for administrative and statistical purposes.

## Definition of Millennials

According to PWC report millennials were born between the years 1980 and 2000 (Sayers, 2007; Hurst and Good, 2009) although some sources argue that those born in the mid-2000s are also part of this generation. Millennials are the most educated generation of all time (David,2015), attaining a higher-rate of both high-school and college educations than previous generations. Millennials are the first generation to be heavily influenced by technology. In their lifetime they have been introduced to computers, mobile devices, the internet, social media, music streaming and other information and communication technologies, according to Mark Prensky they are defined as "digital native(s)". The millennials are different from previous generations from various aspects. They are more civic and globally minded than previous generations because grown up in an environment where information is abundant and immediate. Millennials expect instant gratification and they are feeling special because their parents have been highly involved in their lives. For most of the millennials work-life balance shapes every part of their professional life and influences everything from job offers to the execution of their daily work. Millennials prefer a team approach and a collaborative environment since they are highly involved with continuous social engagement through social media (Caraher, 2014; DeVaney, 2015; Pew Research Center's Social & Demographic Trends Project). Since millennials are now the largest generation in the workforce and companies need to understand what motivates millennials to truly appreciate the way that they work. Millennials have grown up very differently than previous generations because they have grown up with the technology evolution. Therefore, technology is no longer a separate object, but rather, an embedded way of life for them. Therefore it important to study how they behave at the workplace and their perception towards the current HRM practices.

## Employee performance

According to Rivai (2004), Performance is the overall outcome or success of a person during certain periods, compared to standard work that has been agreed. Performance does not stand alone but is related to job satisfaction and compensation, influenced by the skills, abilities and individual traits (Pawirosumarto *et al.*, 2017). Also performance is one of the ways to measure the effectiveness of organisations as well as individuals (Pang and Lu, 2018). Personnel and psychological literature a common assumption predominates employee attitudes bear a significant relationship to employee performance (Brayfield & Crockett, 1955). Al- khori have identified there major performance dimensions, namely; ability; motivation; and opportunity (Al-khouri, 2010). Pawirosumarto *et al*.(2017) suggested that there is a positive and significant influence partially between leadership style, employee motivation and discipline on employee performance. Discipline is the variable of the most powerful influence on employee performance, so it needs special attention. Antoncic and Antoncic (2011) explain that employee satisfaction has a positive influence on four dimensions of work which are general satisfaction with work; employee relationships; remuneration, benefits and organizational culture; and employee loyalty. Hence, this impact has a positive influence on employee performance as well as organisational growth (Siengthai & Pila-Ngarm, 2016). Perera et al. (2014) have found that job satisfaction has a significant positive effect on job performance. As identified in the literature review motivation have a significant, positive effect on employee performance. Understanding motivation of each and every individual give better opportunity to further improve their behaviours and performance (Al-khouri, 2010). To measure performance of employee there should be clearly identified process as well as standard or identified performance for a certain period of time, having some expectations or benefit motivate employees to perform well. Most organisations use practice of goal setting as a technique to define and decompose goals in order to measure performance as well as to achieve objectives of the organisation effectively and efficiently. Above literature have identified that understanding each individual is important to address through recognised dimensions in order to improve performance of the employees. To gain that understanding there is a need for internal

relationship between employer and employee. Therefore, employer – employee relationship also is a critical factor which directly or indirectly affects which influence employee performance.

## Employee performance in SMEs in Sri Lanka

Gamage and Takayuki have identified that that enhancing HRM practices in SMEs in Sri Lanka have contributed to improve operational performance of the organisations. They have studied HRM practices under three dimensions namely, skill, motivation and opportunity. From the proposed HRM proposed model they have concluded that increased ability, motivation and opportunity to perform will make a direct impact on operational performance and indirect impact on financial performance through operational performance (Gamage & Takayuki, 2013). According to the research conducted in Rathnapura district, in Sri Lanka, it is identified that a number of management deficiencies contributed for the poor growth of SMEs. The growth has been increased with the number of employees in the organisation and management processes. Lack of better planning in small industrial sector is also identified as another important deficiency and therefore most of the SMEs fail to achieve expected objectives of Entrepreneurs. It is also identified that most of SMEs did not function efficiently due to the delay of decision-making process and at the same time poor controlling and directing have also been observed (Priyanath, 2010). There are very limited number of studies conducted on HRM practices and employee performance in small and medium scale IT organisations in Sri Lanka. Therefore the purpose of this research is to fill that information gap. The above literature also have identified that there is a need for effective HRM practices for Sri Lankan SMEs.

## Mi**llennial employee performance**

A study was conducted in an organisation in Sri Lanka in order to examine the factors influencing the employee engagement in case of Generation Y employees. It was statistically found that career growth, supervisor behaviour, work content and work life balance have a positive relationship with the employee engagement of Generation Y employees. It has also concluded that career growth and supervisor behaviour are the most significant predictors of employee engagement of Generation Y employees. (Liyanage and Gamage, 2017). In Hong kong, millennials in general perceived their employers positively and embraced good work ethic. It is also identified that perception and work ethic are significantly related. The study also revealed that millennials in Hong Kong hold peculiar interpretations of work and leisure, and of work and success. It was suggested that parenting, educational system, and modern working environments might have caused these interpretation (Kwong, 2013). The above literature have explained the importance of identifying the millennial employee behaviour and focus on managerial patterns which will be most suitable for millennials because the millennial workforce of every industry is growing. Therefore, the organisations which do not take corrective managerial actions will have to face critical issues with managing employees and it will cause the decrease in the performance of the employees as well as the performance and organisations.

## Practice of effective goal setting and employee performance

A goal is what an individual is trying to accomplish; it is the object or aim of an action. Goal include performance standard (a measurement for evaluating performance), quota (a minimum amount of work or production), work norm (a standard of acceptable behaviour defined by a work group), task (a piece of work to be accomplished), objective (the ultimate aim of an action or series of actions), deadline (a time limit for completing a task), and budget (a spending goal or limit) (Locke *et al.*, 1981). Goals are important to the organisation for many reasons. Goals provide guidance to the direction of efforts of individuals and groups within the organisation. As the size and number of departments grow within an organisation, it is essential that upper management keeps these departments moving in a common direction. The goals also provide a closer cooperation, coordination, and improved communication between departments (Cochran *et al.*, 2015). The goal-setting theory is based on the simple evidence that conscious goals affect action and motivation

(Ryan, 1970). Over the last five decades, seminal work was realized, notably by Locke and Latham (1975, 1990, 2002), who identified the principal conditions under which conscious goals are the most efficient in raising an individual's motivation toward a certain task. These effects of goals are seen in teams as well as individuals (Nahrgang et al., 2013). In the small and medium scale organisations, the major approach was to involve all the staff in the strategy process. These companies ran off site away days for all their staff, in which, as a minimum, the strategy for the coming year was presented and discussed in open (Bourne *et al.*, 2013). The practice of goal setting seems to be more effective among small and medium scale organisations in this case because employees and management are more interactive.

In the practice of effective goals setting, there should be recursive and collaborative process which will sustain in the long run. The practices can be different from organisation to organisation but management should focus on the relevance of the practices with the position, performance and need of the organisation(Bourne *et al.*, 2013).

Vroom's theory also referred to as Valence-Instrumentality- Expectancy Theory, explains why people choose a particular behaviour to satisfy their needs. It states that before choosing a behaviour, an individual will evaluate various possibilities on the basis of how much work is involved and what the reward is. Motivation is a function of how badly individuals want something and how likely they think they are to get it. It occurs in direct proportion to perceived or expected rewards. Through that motivation employees are influenced to perform well (Al-khouri, 2010). The relationship between goals and performance has connected through organisational rewards. To offer rewards for outstanding performance of employees' organisation should follow an effective and up to date practice of goal setting which measures performance of each employee in the organisation. It implies that generally there is a positive relationship between practice of effective goal setting and employee performance.

Brayfield and Crokett (1955) has identified that employees are motivated toward the goal of quality, may be highly satisfied with his job while turning out a very limited number of finished pieces per unit of time. If he is forced to increase productivity and lower in some measure the quality, that expect his satisfaction to decrease and cause decease in performance as well. This study implies that employees are more motivated and satisfied with decomposed goals and it contributes towards employee performance as well.

In summary, the goal-setting theory has been applied and studied in management for a long time. When the theory is applied outside of the laboratory in complex situations, many examples of problematic behaviour can occur (Ordóñez et al., 2009; Pollitt, 2013). It quickly becomes unclear whether goal setting should lead to a positive cycle (Latham et al., 2002) or to depletion and poor performance (Welsh and Ordóñez, 2014). From above studies following preposition has been developed for the millennial employees in small and medium scale IT organisations in Sri Lanka.

$P_1^+$: There is a significant positive effect of employer-employee relationship on Employee performance.

## Employer- employee relationship and employee performance

In current corporate world there are some needs/factors request by the employees who are working in an organisation other than the compensation for the work they have done in the organisation. Employer- employee relationship is one factor most of the employees require in order to sustain with the organisation and improve the individual and organisational performance. In this study the employer can be the organisation itself, owner of the company, managers or immediate supervisors. Rosenbluth and McFerrin Peters (1992, 1998) state that the firm-employee relationship is the "first" relationship of the firm and must be strong before the firm can successfully develop any other relationships. Very successful firms identified by Freiberg and Freiberg (1998), Carlzon (1987) and Pollard (1996), have stated that a competitive advantage has been gained by developing strong

relationships with their employees. The general viewpoint is that looking after employees is good for business (Herington, Scott, & Johnson, 2005). Hon and Grunig (1999) has identified that trust, control mutuality, relational satisfaction, and relational commitment as the indicators for a quality relationship (Waters, Bortree, & Tindall, 2014). These factors can be taken into account when it comes to employer-employee relationship as well. Seven key elements indicate the depth and magnitude of a relationship; that is cooperation, balanced power, communication, attachment, shared goals and values, trust and absence of damaging conflict (Herington *et al.*, 2009).

Based on the literature review conducted, Chen, Tsui and Farh had proposed broaden the construct with five dimensions (to capture the domain of this construct) of loyalty to supervisor to include both the relative strength of a subordinate's identification with the supervisor and his or her attachment and dedication to the particular supervisor(Chen et. al., Farh, 2002). When above literature explains the dedication to employer-employee relationship in employee perception, Ehrlich have identified employers who are desired to maintain effective employer-employee relationships should be given priority (Ehrlich, 1994).

A supervisor can closely interact with subordinates, perceive their behaviours and respond accordingly. Employee with a strong degree of loyalty to the supervisor may be more motivated to perform well because of the employee's belief that the supervisor will observe and reward his or her good performance (Chen et. al., 2002). It is identified that employee dissatisfaction and disappointment may result in lower productivity (Ehrlich, 1994).

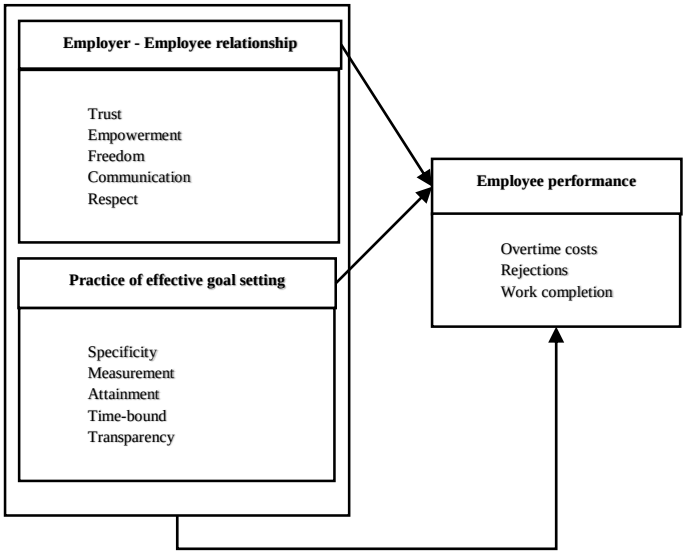
Maslow's hierarchy of needs is a one of the earliest and well known theory of individual motivation. From that theory Maslow hypothesised that within every individual there is a hierarchy of needs. An effective employer- employee relationship can be satisfy three levels from the hierarchy, namely; safety needs, socials needs and esteem about some extend with the organisation. It is identified that above literature, motivation is a major factor which influence employee performance. Therefore it can be said employer – employee relationship also influences the employee performance.

Findings suggest that the degree of freedom afforded to employees to use their own ability to make their own decisions and methods could improve customer satisfaction, service quality and employee productivity (Pang & Lu, 2018). In workplace to an individual employee, freedom to use their own ability can only give under the supervision of the immediate supervisor. And also if there is strong employer- employee relationship, most of the time employers let employees to work on their own. Today's leaders need to recognise their own feelings and those of others to motivate themselves and effectively manage relationships, increase morale and motivation, improve productivity, promote greater cooperation and team work and increase retention of top talent (Al-khouri, 2010). Therefore the employer has to play a major role in building strong relationships with their employees. Since there is very limited studied done to identify the connection between employer- employee relationship and employee performance, through this research it has attempted to test the effect of employer-employee relationship on employee performance, in the context of Sri Lankan IT sector.

$P_2^+$: There is a significant positive effect of effective practice of goal setting on Employee performance.

**Conceptual framework**

Following framework was developed using identified prepositions and dimensions under each factor.




1. Proposition$^{+}_{1}$: There is a significant positive effect of employer-employee relationship on Employee performance
2. Proposition$^{+}_{2}$: There is a significant positive effect of effective practice of goal setting on Employee performance
3. Proposition$^{+}_{3}$: There is a significant positive effect between employer-employee relationships, effective practice of goal setting on employee performance simultaneously

Since there are very limited number of studies done in Sri Lankan IT sector, from the literature we have identified, foreign researchers that have been conducted under related HRM practices confirms our argument and they can be applied to millennials who are working in small and medium scale organisations in Sri Lanka as well. The findings of this study also highlighted that there is a need for more studies for HRM practices in IT sector in Sri Lanka.

**Conclusions and Future Recommendations**

**From the literature review conducted we can conclude that practice of effective goal setting and employer- employee relationship positively effect on employee performance of millennial employees who are working in small and medium scale IT organisations in Sri Lanka.**

**We recommend future researchers to do more studies under Sri Lankan IT industry and applicability of current HRM practices on modern employees in IT sector. Future researchers can test the applicability of this research and validate the results under a more controlled environment.**

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# IMPROVING DOWNSTREAM LOGISTICS PERFORMANCE OF AGRICULTURAL SUPPLY CHAINS THROUGH COLLABORATIVE DIGITAL LOGISTICS

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## Abstract

Global agricultural production is barely sufficient to appease the hunger of the world population. Greater part of agricultural production gets spoiled on the way to the consumer. Agricultural logistics ensures that the agricultural products reach the consumer with the right quality at the right cost. Hence, the availability of properly managed storage and transport facilities, real time access to information on: demand, supply, weather conditions, price fluctuations, surplus handling and value added production capabilities are crucial. Consequently, the need for redesigning the agricultural logistics networks by deploying information technology has emerged. Although digital logistics is important to enhance the performance of agricultural supply chains (ASC), it is difficult for small scale stakeholders to invest on the new-fangled technologies. It is established that collaboration is a strategic decision which aids in gaining logistics performance excellence. Accordingly, this study focuses on the effect of supply chain collaboration in implementing digital logistics in less sophisticated supply chains such as agricultural supply chain, in improving downstream logistics performance. This scrutiny presents the findings of a comprehensive and systematic review of literature in the areas of collaboration, digital logistics and downstream logistics efficiency of agricultural supply chains and subsequently presents a conceptual framework of factors involved in collaboration and integrating digital logistics in improving downstream logistics performance of agricultural supply chains.

***Keywords: Agricultural supply chains, Collaboration, Digital Logistics, Downstream Logistics Performance***

## Introduction

Agriculture is the prime way of appeasing the hunger of humans. It is estimated that approximately one-third (i.e. around 1.3 billion tons per year) of the food produced annually for human consumption is lost or wasted globally. Furthermore, more than 40 per cent of the food losses occur at the post-harvest or processing level in many developing economies. (Gunasekera, et al., 2017; Gustavsson, et al., 2011). The logistics of agricultural products has always faced several problems, including large losses, low efficiency and high cost, all of which have drawn much attention from all sectors of society. Therefore, methods of increasing logistic efficiency, shortening transportation time, and cutting down losses of ASCs should be studied (Yan , et al., 2014).

Nowadays whole fabric of business is changing through developments in digital technology (Pollitt, 1999). Most of the supply chains are focusing on digitizing their supply chain processes including logistics. Digitization of logistics activities refers to the application of information technology to enhance the performance of logistics activities (Ngai, et al., 2008; Lai, et al., 2010).

Many researchers have emphasized collaboration as a strategic decision to achieve successful and efficient supply chains. Supply chain collaboration enables firms to achieve better performance in terms of cost reductions, revenue enhancements and flexibility in dealing with supply and demand

uncertainties (Simatupang & Sridharan, 2002). Thus, this scrutiny analyses how digital logistics and collaboration intercept with each other in the context of downstream ASCs.

There are various approaches and models developed to enhance the logistics performance of supply chains. This study meticulously and systematically analyzes the published literature with the objective of identifying the issues of downstream logistics in ASCs and explores the applicability of two concepts, "Digital logistics" and "Collaboration" to resolve those logistics issues thus, to improve the logistics performance of downstream ASCs. These findings would be of immense importance for ASC stakeholders to accomplish their goal to maximize the profits while providing a superior service to the consumers.

The remnants of the paper are structured as follows: the methodology of this study, the results of the systematic literature review, cessation of the paper by giving conclusions and offering some perceptions on future research.

## Methodology

The approach adopted to scrutinize the state of knowledge in the assorted area is the content analysis; which is based upon an explicit sequence of steps with which to systematically organize elements of text so as to enable an investigator to meaningfully interpret and make inferences about the patterns in the content of the overall body (Bowen & Bowen, 2008). The foremost step of the analysis was to search for articles related to the study. There were number of studies that have been conducted by considering various aspects of logistics efficiency, digital logistics and collaboration. This search resulted in altogether forty eight articles. These articles were further screened based on the title and the abstract in the next phase and selected twenty nine articles. Full text of each of these articles was reviewed and eliminated the articles which are not pertinent to the scope of the study. Thus, in total fifteen articles were included in the study. The selection process is shown in the Figure 1. All the articles that were reviewed are listed on this paper under the list of references. It is believed that the papers selected and reviewed were a considerable representation of the exhaustive body of the research work being accomplished in this area of study.

A comprehensive literature review was done with the intention of finding the way of improving downstream effect of trust and collaboration on the downstream logistics efficiency of ASCs and revealing the research gap in the area. Only contemporary articles which were published within the years of 1997 and 2018 were chosen for the review with the intention of enhancing the relevance to the current context.

The content of the articles was categorized under the factors on which the researches were carried on and profound content analysis has been conducted.

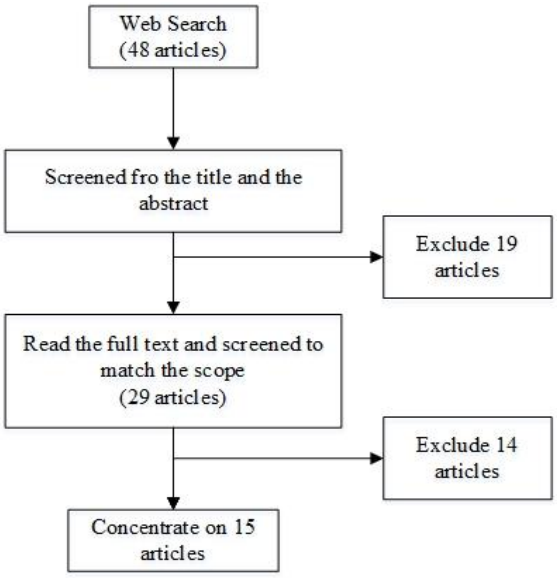


Figure 5: Literature Screening for the Meta Analysis

**Main Results of the Reviewed Studies**

**Downstream Logistics issues of ASCs**

Consistent with the reviewed studies, there are numerous numbers of inefficiencies and issues that diminishes the performance of the downstream ASCs.

A study conducted in 2015 on "Study on Countermeasures of the Logistics Efficiency of Fresh Agricultural Products in China" has identified some logistical concerns in ASCs of China. As stated by this study, the wastage of agro products are high due to the low processing ability and logistics cost and time are high due to the underdeveloped or old infrastructure. The authors have proposed that developing the cold chain logistics, gaining service of third party logistics providers and developing the logistics technologies will aid to solve these logistical issues. (Zhang, 2015)

(Gunasekera, et al., 2017), has identified post harvesting loss as a major ASC issue during grading, sorting, packaging, storing and transportation in developing economies. Limited access to vital farm inputs and credit, poor infrastructure and lack of technical and market information are some of the critical challenges confronting many downstream agricultural stake holders. As stated by this study, remedial measures to address the post-harvest losses would require substantial market-led investment in agricultural infrastructure, upgrading technical and managerial skills along the food supply chain and improvements in knowledge dissemination, as well as improved storage, transport and distribution facilities. According to the authors, these measures require specific initiatives such as post-harvest technologies, farmer education, storage facilities and cooling chains.

(Chandrasekaran & Ranganathan, 2017) has identified post harvesting loss is high in Indian ASCs due to the respiration and continuous emission of CO2 during transportation, packaging and storage of agro products due to the fact that not having proper infrastructure to transport and monitor the quality of the products.

**Digital Logistics in Downstream ASCs**

(Chang, et al., 2016), has introduced an IoT (Internet of Things) application model for ASCs which can control the safety and quality of agricultural products. As stated by the study, information sharing in the supply chains of agricultural products based on IoT aims to solve the problem of insufficient sharing of information, inefficiency, and poor quality of transmission of information in agricultural supply chains. IoT can help the operators of agricultural products establish a system of inspection and delivery that enables them to trace the flow of the products and manage production problems efficiently to guarantee the security of the circulation of agricultural products.

(Nukala, et al., 2016), states the applicability of IoT technologies such as RFID (Radio Frequency Identification) , WSN ( wireless Sensor Networks), Cloud Computing and Data Analytics in agricultural downstream logistics. According to the findings, temperature sensors integrated with RFID can be used for environment monitoring and traceability of products to aid in increasing product efficiency and integrity. In cold chain, WSN's are used to monitor real-time temperature conditions of perishables. IoT is used in warehouses for capacity sensing, planning, reporting, energy management and inventory management. Intelligent cloud based information systems are used for delivering real-time monitoring and data processing in transporting and delivering of agricultural products.

( Ruiz-Garcia & Lunadei, 2011), descriptively explains the role of RFID in agriculture, its applications, limitations and challenges. The study has identified the significance of RFID in logistics. They enable tracing and tracking of agro products during the logistics activities and monitoring light, temperature and humidity during the cold chain logistics. This ensures the safety and the quality of the perishable agro products along the downstream logistics.
A conceptual model for fleet management was proposed by C.G Sørensen and D.D Bochtis which can be used for decision making concerning, for example, resource allocation, scheduling, routing, and real-time monitoring of vehicles and materials. (Sørensen & Bochtis, 2010)

A study conducted in 2010 on "A model and prototype implementation for tracking and tracing agricultural batch products along the food chain", presented an architectural proposal which enables advanced traceability management in any company of the food sector. If these systems can be coupled to real time data acquisition and management systems in the future, this information can be used for processing improvements in food logistics like packing, product movement and cold chain management. (Ruiz-Garcia, et al., 2010)

(Jedermann, et al., 2014), summarizes the key findings of research study results from around the world to promote intelligent food logistics. This study discusses the applicability of wireless sensor and communication system for remote quality supervision and gas sensors to detect ethylene as an indicator of unwanted ripening and volatile components to indicate mould infections in maintaining the quality of the agro products during logistics.

**Supply Chain Collaboration in improving Downstream Agro Logistics**

(Cadilhon, et al., 2005), stated the importance of the supply chain collaboration in downstream ASCs. Findings of a case study based on a traditional ASC of Ho Chi Minh City of Vietnam indicated the significant loss of wastage of fresh agricultural products due to the knowledge and training given to suppliers by a wholesaler regarding processing, packaging and transporting of fresh agricultural products. This scrutiny emphasizes the significance of collaborative information and knowledge sharing in improving performance of ASCs.

In line with the findings of (Aggarwal & Srivastava, 2016), information sharing between buyers and suppliers regarding the inventory, stocks held, forecasts, etc., helps to avoid spoilage and wastage. In traditional ASCs, there is a lot of spoilage and wastage in agricultural products, because of poor supply chain infrastructure. In collaborative supply chains, if timely information flow happens between the two parties, it can lead to reduction of wastage and supply chain becomes more efficient

with optimum levels of inventory, cost of transportation, timely delivery and reduced wastage. Interdependence of supply chain partners leads to joint planning and information sharing, resource pools and equipment sharing.

Supply chain collaboration concept is of significant importance for the agri-food industry however, some constraints arise due to the nature of industry's products, and the specific structure of the sector. Subsequently, collaboration in the supply chain is often limited to operational issues and to logistics-related activities, such as transportation. Collaboration in logistics results in improved asset utilization, lowered stock holdings, faster and flexible delivery, improved product availability and dwindled lead time. (Matopoulos, et al., 2007)

**Supply Chain Collaboration and Digital Logistics**

Through advanced technology such as RFID, supply chain collaboration can be established to interchange real-time logistics information flawlessly. Therefore, the supply chain partners can be correctly aggregated, managed, accessed and routed. By incorporating mobile technology, real-time logistics information for transportation tracking and management, and food quality traceability along the agro supply chain can be shared. ( Kuo & Chen, 2010)

Technologies related to IoT, Cloud Computing, GPS/GPRS and RFID for positioning, identification, communication, tracking and data sharing is significant for a better collaboration and interoperability enhancement in logistics. (Gnimpieba , et al., 2015)

Consistent with (Kayikci, 2018), collaborative actions such as shared warehouse and transport capacities, through digitization has the potential to improve the efficiency and reliability of the logistics process. This creates special needs for inter organizational information exchange, data integration and an architecture to support virtual logistics clusters. The virtual service providers assemble several partners into strategic alliances that allow sharing of their physical facilities to achieve utilization of logistics service

Collaborative resource sharing enhance the productivity and efficiency of logistics in agri supply chains as it is difficult for small stakeholders to invest in new technology, equipment and infrastructure (Aggarwal & Srivastava, 2016).

**Discussion**

Table 4: Downstream logistics issues

| Study | Logistics issues | | | | |
|---|---|---|---|---|---|
| | Product wastage | Cost | Lack of infrastructure | High lead time | Lack of information |
| (Zhang, 2015) | * | * | * | * | |
| (Gunasekera, et al., 2017) | * | | * | | * |
| (Chandrasekaran & Ranganathan, 2017) | * | | * | | |

Table- 1 indicates all the downstream logistics issues discussed through the reviewed literature. The issues identified through the literature are interrelated, thus, one issue leads to other in downstream ASCs.

Almost all the studies have identified post harvesting loss as a major issue in downstream logistics ASCs. Post harvesting loss occurs mainly due to deteriorating the quality of the products during transportation, storage and handling (Gunasekera, et al., 2017). The loss during transportation and storage can be reduced through proper infrastructure and technologies. Digital technologies like RFID

and sensor based technologies can be used for temperature controlling and monitoring which is crucial in cold chain logistics for maintaining quality of the perishable agro products. These technologies can be used for tracing and tracking of agro products throughout the logistics in ASCs. Thus, the real time information obtained through these technologies improve the supply chain visibility and full time transparency along the supply chain (Kayikci, 2018) and shared information pave the way for supply chain collaboration and high logistics performance.

Having sophisticated infrastructure for maintaining quality and safety of the perishable agro products for boosting customer satisfaction is crucial in agro logistics. Temperature monitoring and control are essential mechanisms in cold chain logistics, although they are costly for small scale ASC stakeholders ( Kuo & Chen, 2010). In collaborative supply chains, partners can share the cost for these infrastructures. Some stakeholders are not aware of these technologies and also they do not have the understanding to use these technologies and infrastructure. In collaborative supply chains, partners can help each other by sharing their knowledge and skills with each other. Then everyone will get the privilege of using these infrastructure designed with cutting edge technologies to advance the performance of the logistics of downstream ASCs. Digital platforms will enable the virtual clusters of agro supply chain partners to share their infrastructure such as warehouses and transport capacities with each other (Kayikci, 2018). This sharing of resources will results in reduced logistics cost for the partners involved in that collaborative relationship while enhancing the logistics performance of the supply chain.

For the intention of improving the logistics performance of downstream ASCs, the access to real time and precise information regarding the demand and supply, customer expectations etc. is vital. Information sharing will help to reduce the lead time of the downstream agricultural logistics and will aid in managing and planning the logistics operations (Kayikci, 2018). Through digital platforms such as cloud based information management systems, supply chain partners can share the information with each other (Nukala, et al., 2016). Virtual clusters of agricultural supply chain stakeholders can share their information and knowledge, which leads to a highly collaborative and highly performing downstream agricultural supply chain.

## Conclusion

Collaborative digital logistics is very significant in downstream agricultural supply chains in improving efficiency, reducing wastage and satisfying customers. Logistical performance of the downstream ASCs can be considerably enhanced by incorporating digital technologies such as RFID, WSN, IoT, Cloud computing etc., with routine logistics processes. In consistence with the reviewed literature, collaboration has a two way relationship with the digital logistics. Collaboration supports digital logistics implementation as well as the digital logistics supports to establish supply chain collaboration. Supply chain collaboration also has the capability to boost the downstream logistics performance of ASCs. Figure-2 indicates the conceptual framework designed for improving logistics performance.

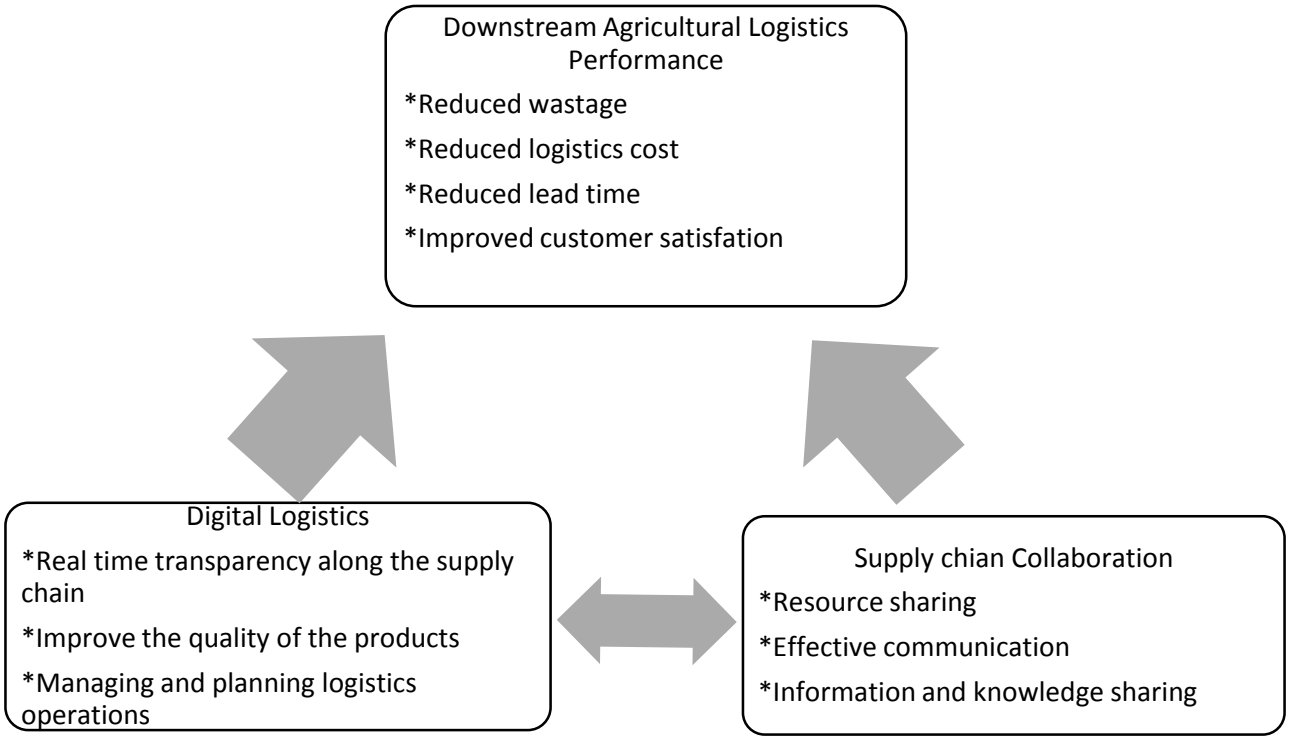


Figure 6: Conceptual framework for improving downstream logistics performance

In the recent past, research interest and the importance of logistics efficiency of ASCs have made an enormous contribution on this topic. Based on the review, classification and analysis of the articles, some broad suggestions for future research can be put forth. Although there are numerous number of studies conducted on digital logistics, there are limited literature conducted on the integration of collaboration, digital technologies and the ASCs. Therefore more researches should be carried on these areas and how these technologies and practices can be used innovatively in improving downstream logistics of ASCs. This study has focused only on downstream agricultural supply chains and in future, researchers should concentrate their attention on improving performance of the whole agricultural supply chain.

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# IMPROVING STUDENTS' ORAL SKILLS THROUGH A COOPERATIVE LEARNING APPROACH

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**1. Abstract**

It is obvious that the need for English in the Sri Lankan society is growing in a variety of different directions every day. Yet, although English is regularly taught in all schools from the nursery to the tertiary levels, the learners suffer from a great lack of fluency in their oral communication. They are generally competent in their cognitive skills but weak in their communicative skills. In that context, this paper deals with issues and problems faced by secondary level students in mastering the oral skills in English and to investigate the effectiveness of Cooperative Learning (CL) strategy. The main aim of the study was to determine how cooperative learning is an effective approach to develop and enhance the speaking skills. In order to analyze the hypotheses developed in this concern, a quantitative survey and a qualitative survey are used along with a questionnaire as an instrument for obtaining data from a group of 50 students from five schools of the Kahatagasdigiliya Educational Division. According to the results, it was discovered that the majority of the students cannot speak English properly, as they suffer from a sense of insecurity caused by several language deficiencies. But through cooperative learning, students interact and express themselves more to their peers or classmates. The approach served also as a venue for reluctant and fearful students which enable to intensify their self-esteem. Therefore, in conclusion, the paper suggests a cooperative learning strategy to promote oral skills.

## 2. Introduction

In Sri Lanka, English language is being taught from nursery to tertiary level of education. But the problems remain growing as students are unable to communicate properly in English. The importance of this study springs out of the fact that Cooperate Language strategy plays a major role in language learning contexts.

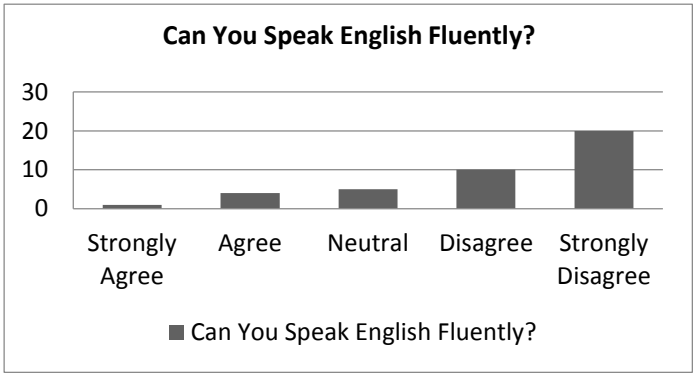
(Current research seems to validate this view that cooperative learning increases the social interaction among students and consequently). It leads to improving communication skills among them. English language classroom should no longer be dominated by the teacher but should be more student-oriented with the teacher adopting the role of facilitator. By doing so, it adds variety to teaching and learning context and making it fun for the students to improve their speaking skills. The objective of this thesis is to review cooperative learning approach with a special focus on students' oral production and quality of spoken English.

## 3. Method and Materials

Data used when conducting this study consists of two investigating tools. The first one was a questionnaire that was administered among 50 secondary level students of Kahatagasdigiliya division. The second method was interviews with the English language teachers of those schools. Primary data consisted of questionnaire surveys, class room observation, and direct interviews with classroom teachers, and secondary data comprised early research reports, newspapers, magazines, and websites.

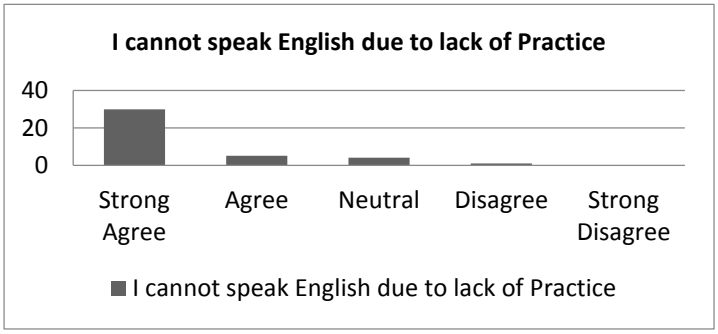
The population of the study consisted of fifty students at secondary levels selected from the five schools of Kahatagasdigiliya division in the North Central Province of Sri Lanka. 50 students are selected from the below mentioned schools.

1. Kahatagasdigiliya Central College
2. Pandulagama Maha Vidyalaya
3. Koonwewa Maha Vidyalaya
4. Rathmalgahawewa Maha Vidyalaya
5. Ranpathvila Maha Vidyalaya

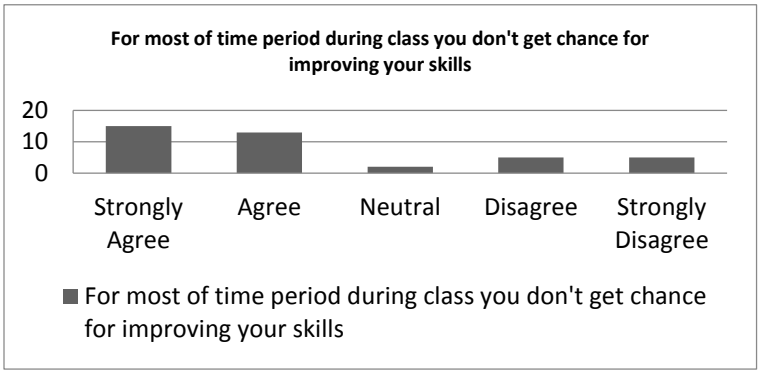



Data Analysis

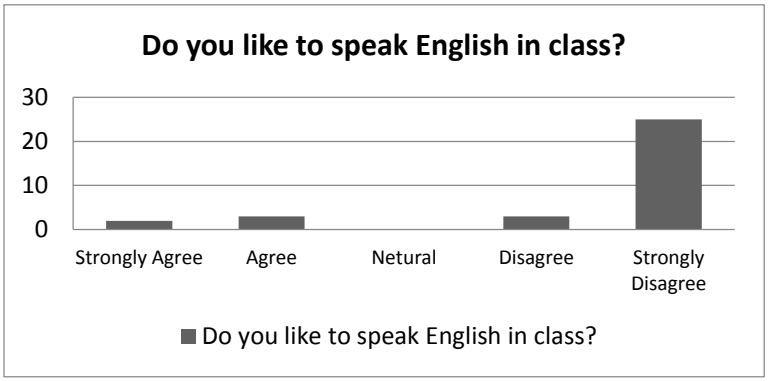
In above figure, there is one block which reflects the majority of students are failed to speak English fluently.




The results of above figures reveal that majority of students agreed upon this point that they do not get chance for practice or improving their speaking skills. Teachers do not provide them chance for improving English speaking skills during class time.

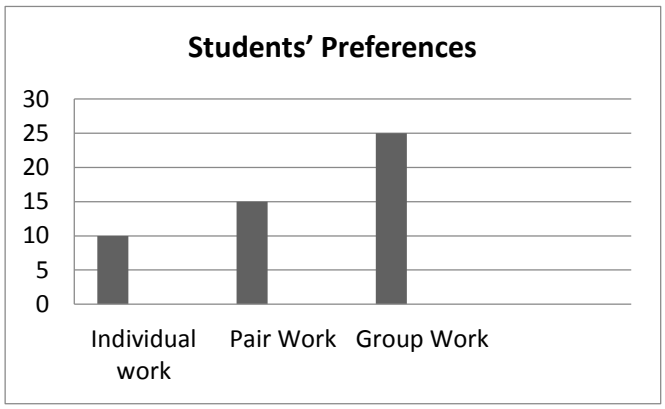



The results of above figures tell that most of students do not like to speak English in class. There may be two possible reasons for this. Either they have lack of confidence and feel hesitation while speaking or they do not know how to speak English.




The result of these figures reveals that reason of failure in speaking English of majority of students is lack of practice. They do not have sufficient practice in speaking skill. Because, they do not have such an environment in which they make practice.


Most students feel hesitate for participating in speaking. It can also be predicted that students actually have fallen a victim of anxiety disorders. As a result, the performance of most students is disturbed. So, they do not participate in speaking activities as result of the above figure reveals. Lack of confidence also becomes a cause of hesitation. Therefore, students find it difficult to participate in discussion or any speaking activities. Results suggest that practice develops confidence-because majority of students have lack of practice as results of above figure tells. So, they are facing lack of confidence.




Results of this figure shows that group work is the most enjoyable. Because students are motivated when they work together in small groups.

**4. Results**

The findings of the research results illustrated that there were a variety of factors that affect the students' speaking performance.

**Anxiety:** Speaking a Second/Foreign language in public, especially in front of native speakers often leads to anxiety. Sometimes, extreme anxiety results in the learners being tongue-tied or lost for words in an unexpected situation leading to discouragement and a general sense of failure in the learners. Unlike children, adults are very cautious about making errors in whatever they say. For them, making errors would be a public display of ignorance which would be an obvious occasion of losing face. This is one of the major factors for the inability to speak in English.

**Strong and quick learner's domination in the class:** A large and mixed ability class is another factor affecting the language acquisition process. In these classes we have both strong and weak learners, where the strong and quick learners are often seen to be dominating and overtaking the slow and weak learners. The weak learners don't get opportunity in the presence of the strong ones, which results in the shrinking of the weak learners.

**Lack of proper orientation:** Even though some learners have learnt the language at their school levels, they are unable to produce even a single sentence without grammatical error. The basic reason for this is, learning the subjects from the examination point of view.

**Building confidence:** The next important aspect is to build confidence in the learners. Once the teacher establishes a good rapport with the learners, it is important to build their confidence. This can be done by starting with simple and easy tasks. This will encourage the slow learners to participate in the activity and boost their morale. Gradually increasing the difficulty level will sharpen their knowledge thereby improving the learners. Minimizing teacher talk time and maximizing learner talk

time will also encourage the learners. Instead of correcting the mistakes, the teacher can go for peer correction which would encourage them to come out of inhibition. The teacher should be a guide, mentor and facilitator.

**Improved teaching facilities:** The teacher should ensure to get proper teaching aids and facilities which would create a proper learning ambiance for the learner.

## 5. Discussion

Richards (2006) groups the phases of English language teaching into 3: traditional approaches, classic communicative language teaching and current communicative language teaching. Traditional approaches (up to 1960s) focuses on grammatical competence as the basis of language proficiency. Such methods fell out of fashion. Attention shifted from grammatical competence to the knowledge and skills using grammar and other aspects of language for different communicative purposes. It was argued that communicative competence should be the goal of language teaching. Communicative Language Teaching emerged to be the solution of this situation.

To be good language learners, individuals have to become skilled at these four language skills: listening, speaking, reading, and writing. Brown (2001) states that all four skills are treated as linked skills. They have to be taught in an integrated curriculum rather than in a single segment.
Developing the communicative competence of the learners is one of the major goals for English teaching. There are even views that "the essence of English teaching is communication", and that "communicative competence is the initial and ultimate goal of English teaching".

The important role of the teacher within the classroom is to create effective class condition for learning. According to Harmer (2001), in learner-centered lessons, a teacher's role is best performed as a facilitator. This includes the roles as a controller, an organizer, an assessor, a prompter, a participant, a resource, a tutor and an observer. While the roles of the teachers above are all important in teaching English in the classroom, in speaking activities there are three roles that are relevant to be adopted in order to enhance students to speak fluently.

Slavin (1995) proposes that cooperative learning refers to a teaching methods in which students work in small groups to learn academic content. The concept is that the members are discussing, arguing, and helping each other to accomplish a certain goal; higher-level students will help lower level ones to improve their understanding of the subject. The idea of cooperative learning is that by giving a reward to a group rather than individual, the students will be motivated to help one another to master the materials. Each member of a team is responsible not only for learning the materials but also for helping teammates to understand the materials and complete the task given.

## 6. Conclusion and Recommendations

The obtained results confirmed our study that there is a positive relationship between cooperative group work and oral proficiency. So it led me to suggest these recommendations for improving EFL learner's oral proficiency.

**Classroom environment**-The teachers expressed that the foremost aspect one must consider before any oral communication can take place is the classroom environment. That is, without a classroom environment that allows a student to feel safe enough to make mistakes, learning will not happen. Furthermore, the classroom environment must be a space where the student feels that his or her thoughts are valued. It is vital that the classroom environment is a positive space for the students to develop their oral skills without the fear of doing 'wrong'.

**Variety of teaching materials-** Use of a variety of games/ role plays/ simulations any other forms of classroom activity that reinforces target language communication in the classroom.

**Pupil-centered Approach-** Traditionally, a teacher's role was to provide correct models of language and corrective feedback. It would rather effective to shift teacher centered approach to pupil centered approach to promote the speaking skill. Hence it is expected that the students would be allowed to take an active role in the language classroom. A teacher is expected to be willing to put his/her students' learning needs ahead of his/her own behavior.

**Assessing** - Teachers need to better understand meaningful ways of assessing students' oral production. It is suggested that negative evaluation might inhibit students' future participation.

**Motivation-** Some students may be motivated to learn English; they feel afraid to speak and to communicate with their classmates because they fear to make mistakes in pronunciation or grammar, or fear of teachers' negative feedback. So here, teachers should encourage the students to talk in the classroom.

**Rewarding -** Teachers should praise individual performances of the group works. It will encourage students' future participation.

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**Web links-**

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- https://en.wikipedia.org/wiki/EF_**English_Proficiency**_Index
- www.groundviews.org/2009/07/.../**english**
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- www.slageconr.net/slsnet/9thicsls/fullpapers/fullp019.pdf

# WHY DO MARINE FISHERS BREAK RULES? EVIDENCE FROM SOUTHERN SRI LANKA

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**Abstract**

Fisheries management in Sri Lanka has failed to achieve the sustainability of the marine resources due to rule breaking by marine fishers. Number of evidences has shown significant negative impacts of rule breaking by marine fishers on fish stock and fish harvest which directly affects the wellbeing of the rule breakers as well as the other fishers. This study was conducted with the objective of identifying the prevailing legal systems in the fishing community, the rules breached by the marine fishers and the reasons for breaching the aforementioned rules. The study was conducted in Rekawa of Southern Sri Lanka with a sample of 63 marine fishers selected through random proportionate sampling. The data were collected through two focus group discussions and a pre-tested questionnaire survey; and data were analyzed descriptively. As per the study findings, there were two types of legal systems governing coastal resource use namely; community legal system and state legal system. Community laws were unwritten and consisted of norms, traditions, values mainly focusing on wellbeing of the people while state laws were written in the spheres of resource access, resource appropriation and resource conservation. The study has found that the level of awareness about state laws among marine fishers was very low; and also the number of state laws breached by the marine fishers was higher than the number of community laws. The study has identified that poverty as the main reason for breaching of community laws while poverty, incompatibility with interests, lack of awareness on fisheries regulations were the main reasons for breaching state laws. Therefore, it is important to understand the reasons for compliance and non- compliance with fishing laws in devising laws and policies with the consultation and engagement of stakeholders in all the levels.

***Keywords: Marine fishers, Break, Rules, Southern Sri Lanka***

## Introduction

Rule breaking by marine fishers has become a common explanation for failure of fisheries management to achieve its sustainability and conservation globally. A considerable amount of evidences have shown that rule breaking by marine fishers has caused negative impacts on fish harvest, fish stock, national economy (Sumaila, Alder, Keith; 2006). Therefore, understanding the perceptions and reasons for the decisions made by fishers to break rules is vital to achieve the sustainable fish stock management (Sutinen and Kuperan, 1999). Understanding and incorporating the reasons for rule breaking into management measures will address the prevailing conflicts rather than complexion them.

Studies conducted all over the world have attempted to describe justification for rule breaking in terms of fishers reasoned decisions to comply or not or in terms of moral objections. According to Jagers, Berlin, Jentoft (2012), rule breaking is morally acceptable due to essential needs of the fishers; for example, fishers must catch fish by any mode in order to feed their families and ensure survival. Marine fishers also break rules assuming that rules are unfair, illogical and clash with their aspirations. Rules set by government authorities are breached by fishers since they do not respect or

accept the particular authorities as ruling entities which implies weaknesses in the governance mechanism (Jentoft and Mikalsen, 2004). Further, rule breaking incidents are accelerated by implementing complex laws with heavy punishments due to resentment, confusion, loss of respect for rules. Also, generally, fishermen are unlikely to inform about their rule- breaking colleagues which implies the existence of lack of self-enforcement of fishing rules.

Referring to Sri Lankan context, today there is evidence of rule breaking and conflicts in coastal areas, indicating the failure of present legal pattern to successfully deal with the issues of resource use. During the past decades, a decline in governance institutions has been observed due to the vague boundaries between the government and civil society that undermine effective law enforcement (Sri Lanka National Strategy and Action Plan, 2009). Unfortunately, various state laws have been formulated by the scientific community and fisheries administrators with little consultation of the actual stakeholders on the beach; the fishermen. This leads to the formulation of certain rules, regulation and laws that seriously clash with human development concerns, leading to rule breaking and conflicts. Sri Lanka is one of the countries, where politics has infiltrated into all spheres of activities that have become a fact of life (Amarasinghe, 2006). Due to the highly uncertain and fragile political situation of the country, it is extremely difficult to design and implement a long term fisheries development plans.

Being located in the southernmost tip of Sri Lanka, Rekawa is a bio- diversity hot spot which has been categorized under one of the 29 bio- diversity areas and 11 scenic and recreational areas in Hambantota District (Amarasinghe, 2004). Evidence from Rekawa has revealed (Amarasinghe, 2004) incidents of rule- breaking such as increasing fishing effort, use of environmentally unfriendly gears (eg: dynamite, monofilament nets), felling of mangroves, coral mining etc. Therefore, it is important to identify the reasons for rule- breaking by marine fishers. This study was conducted with the objective of identifying the prevailing legal systems in the fishing community, the rules breached by the marine fishers and the reasons for breaching the aforementioned rules.

**Methodology**

Rekawa coastal zone in the Hamantota District of Sri Lanka was purposively selected as the study area due to several reasons. It is one of the poorest communities in Sri Lanka who are highly dependent on the coastal zone for their survival. In respect of the objectives of the study, Rekawa was a good selection because past studies provide evidences of the existence of rule breaking incidents.

According to the Integrated Development Plan (2010), Rekawa is 4627 acres in extent (including seven Grama Niladhari divisions) with 2342 families and a total population of 6813 people. The highest population density of 2.1- 2.2 persons per acre is said to be found in Rekawa East, Rekawa West and Netolpitiya Grama Niladhari divisions, while the lowest density (0.9) is found in Medagama. The economically active population in the area is about 54%. Large diversity of employment categories are found in the area including fisheries, paddy cultivation, home gardening and tourism related activities.

The study was conducted with a sample of 63 marine fishers selected through random proportionate sampling. The primary data were collected through two focus group discussions and a pre- tested questionnaire survey. Focus group discussions and questionnaire survey attempted at eliciting information on the types of legal systems governing marine resources use, awareness and acceptance of laws, incidences of rule breaking and the reasons for rule breaking. The secondary data sources were annual reports issued by the Governmental Ministries related to coastal resources management and published information in journal articles, books, reports etc. The collected data were analyzed descriptively.

**Results**

Mainly, two types of legal systems governing coastal resources use were observed: community legal system and state legal system.

### 1. Community legal system

Community laws were unwritten, and they often consisted of customary practices, traditions, norms, values and even working rules. Community laws were generally based on the principles of the peasantry, which were diverse, but most importantly included the principles of equality, social harmony, reciprocity and wellbeing.

Six community laws were mentioned by the respondents as those applicable to resource use and social interaction of marine fishers. One of the important community laws mentioned by the respondents was the traditional barriers of entry into fisheries by not allowing outsiders to anchor their crafts on the beach. A special feature of a traditional fishing village was its "village identity". Each village was separated from the other in relation to productive activities, and its links to the interior agricultural villages were few. The social distance maintained between villages had been able to serve the important function of controlling the entry into open access fisheries. The access to the waters bordering a certain village was limited to the inhabitants of the village and outsiders were not even allowed to anchor their crafts or fish in coastal waters. Such a social control of the entry seemed to have evolved out of the particular danger of over- fishing that could have resulted in an unregulated or open- access fishery.

Another community rule mentioned by the respondents was the "*Dal paya*". Fishers of a particular geographical area often exploited the same resource areas and therefore, they fished close to each other. However, when the first to reach the resource area identified shoals and laid his net (the laid net was called the "*Dal paya*"), others were not allowed to lay their net in a way that blocked movement of fish towards the formers net. Therefore, the institution of "*Dal paya*" prevented conflict among users of the common property coastal resources.

The practice of "*Raula kapanawa*" (Shaving off beard) was another very important practice that was closely associated with a number of social norms; equality, reciprocity, wellbeing. When a craft landed their fish, people gathered around the catch and some people took few fish for home consumption, for which the craft owners or the crew of the crafts did not object. Those who removed fish were usually the old, retired, disabled fishers or members of families whose breadwinner had died. The practice of "*Raula kapanawa*" was consistent with principles of "the right to subsistence" and "the norm of reciprocity".

No fishing was carried out during the *poya day* (there were 4 *poya days*: full moon, quarter moon, half moon, three quarter moon) which was a religious day for Buddhists. The Buddhist fishers in Hambantota generally attended religious ceremonies at the village temple during the *poya days*. It was also to be mentioned that killing of animals for flesh was an unacceptable occupation because the first of the five percepts which all Buddhists were expected to observe say "I refrain from killing living beings". Knowing very well that they were engaged in an occupation which was despised by Buddhists, the fishers made it a point to attend religious ceremonies, offer flowers and worship Lord Buddha and offer alms to clergy to compensate for the sins that they had committed.

Fishing communities in the South did not allow their women folk to go to the beach and get involved in fishing activities. As noted earlier, "fishing" is socially despised in Buddhist communities in the south of Sri Lanka. Although the "man" was engaged in this "sin", they wanted neither the women nor the children to take any hand in direct fishing related activities although the women were involved in post- harvest practices.

Another community rule mentioned by the respondents was that disputes on the land were confined only to land and they did not applicable to the sea. Therefore, if a fisher faced with an accident at the sea, other fishers at the sea helped him forgetting all the disputes they had with each other on the land.

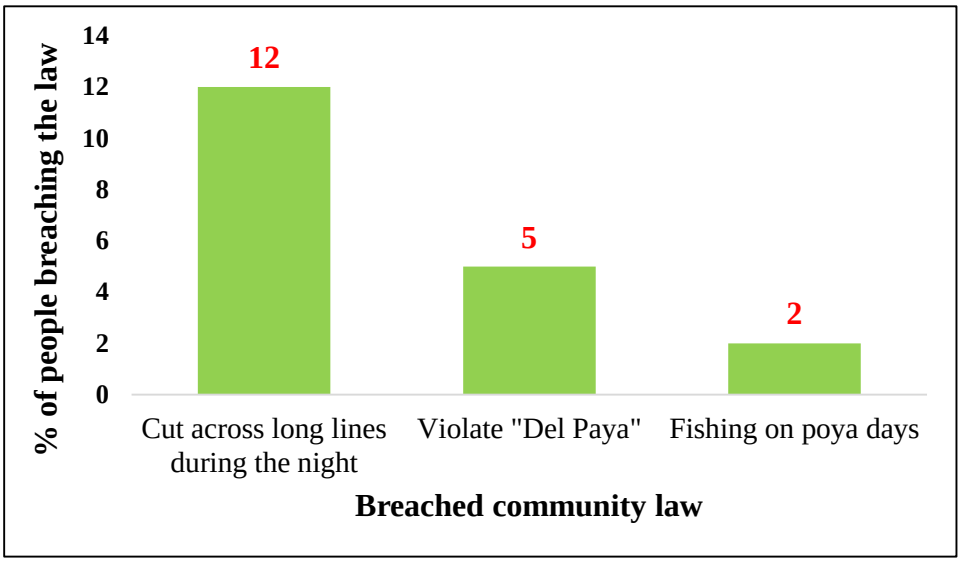


Figure 1- Community laws breached by marine fishers

From the six community laws, three (50%) were breached by the marine fishers as mentioned in Figure 1. Some fishers (12%) unintentionally cut across the long lines of other during the night for not seeing them. "*Del paya*" was violated by 5% of marine fishers due to insufficient space to lay nets and sometimes due to delays in reaching fishing grounds. Least number (2%) of marine fishers carried out fishing on poya days. The ultimate objective of breaching the community laws was to increase the fish catch and cash income in order to overcome the poverty which they were struggling with.

**2. State legal system**

Since the government was the custodian of a country's natural resources, state laws aimed at resource conservation and sustainable use of resources to meet the needs of present and future generations. State laws were mainly categorized into two; as conservation rules and access rules.

Referring to the awareness about state laws among marine fishers, 79% of them had low awareness while 21% of them had very low awareness which implied a worse situation about the relationship between resource users and the government officials.

Six state laws were mentioned by the respondents including four conservation rules and two access rules. Marine fishers were not allowed to harvest lobsters during February, September, October in each year since it was the breeding season of the lobsters and lobster harvesting during this period would kill the egg- laying lobsters reducing the offspring. Bottom- set gill nets, monofilament nets and scuba diving for chanks without permits were also banned for marine fishers due to their adverse impact on life at the sea bottom. Moreover, the use of poisons and explosives (dynamite) was also banned because they destroyed all marine life. Apart from banning such destructive fishing techniques, marine fishers were also required to license their boats, obtain fishing permit for each type of fishing operation in order to avoid illegal fishing operations. Of course, this law could also be effectively used to control entry into fisheries.

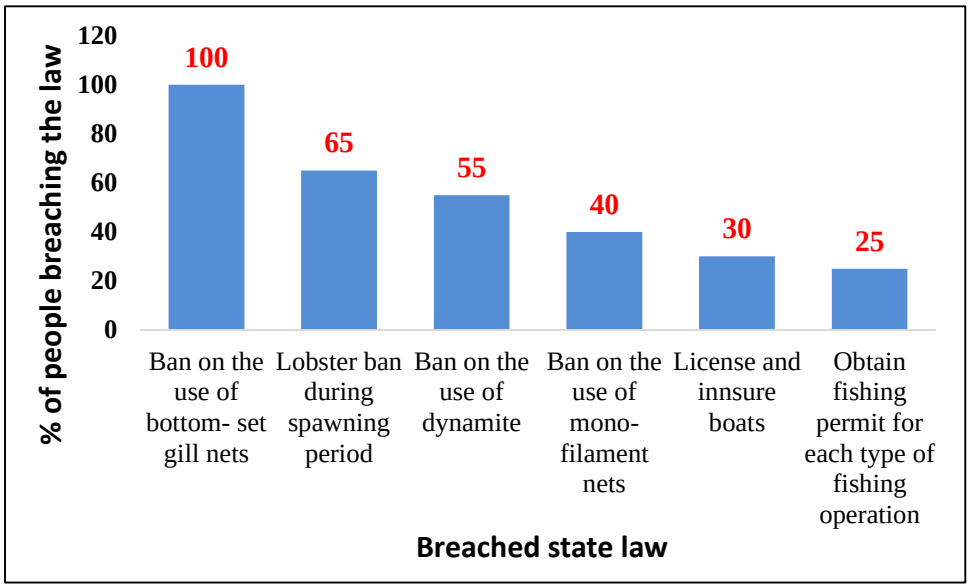


Figure 2- State laws breached by marine fishers

According to figure 2, nearly all the marine fishers used bottom- set gill nets to catch lobsters with the belief that it was the only technique which was available to catch lobsters.

65% of the marine fishers were engaged in catching lobsters during the lobster ban season during February, September and October, which coincide with the period of high availability of lobster resources. However, a more relevant reason given by the people was the lack of alternative employment for lobster fishers if they were to refrain from fishing during the lobster ban, revealing a presence of a livelihood issue. Fishers engaged in catching lobsters during the lobster ban season to earn cash incomes as a means of coping with poverty.

Some of the marine fishers (55%) used dynamite to catch fish for two reasons; to obtain a high fish catch during a short period of time and to earn cash incomes as a means of coping with poverty.

Fishers (30%) breached the law on the banning of monofilament net because it was considered by them as a very efficient fishing technique bringing in large catches.

Also marine fishers did not agree with the law on fisher insurance (which is made compulsory by the government) because they did not receive any indemnities for claims made against los of fishing equipment. Generally due to informational problems, fishing insurance was very unlikely to succeed, the reason why claims were not paid.

It appeared that the major reasons behind breaching state laws were earning higher cash incomes, coping with vulnerability and poverty, lack of awareness about state laws and incompatible with their interests.

**Discussion**

The findings of the study identified that number of laws and the percentage of marine fishers breaching the state laws were comparatively higher than the community laws. The importance of the community laws was the fact that they were socio- culturally constructed; laws that respects the particular social and cultural norms, values, customs, belief of the people. Therefore, they had the legitimacy within fishing communities. Although most of the laws were geared towards social harmony, equality, wellbeing; some of the community rules aiming at resource conservation were also evident such as not allowing the outsiders to anchor their crafts on the beach in order to control the

access to fishery. Since the community laws legitimacy with in the community, rule breakers were less. Community rules, to a great extent, ensured that conflicts were resolved either at sea or on the beach, without the involvement of an outside authority. They were self- reinforced without the involvement of an outside authority and thus involved low transaction costs. Following Bavinck (2005), this was what was called the "community legal system" which shaped the behavior of its community members.

All of the state laws that people were aware aim to ensure sustainable use of resources with little concern for the achievement of wellbeing aspirations of the people, ensuring equitable access to resources and equitable opportunities of earning incomes, dispute resolution and social harmony. Therefore, state laws did not have a high degree of legitimacy with in the fishing communities. The major reason for state laws to be concerned as "non- acceptable" by the marine fishers was because while protecting and conserving the resources, they tended to violate some of the wellbeing aspirations of the people. Certain laws like making insurance of fishing crafts and gear compulsory were "half- cooked" because indemnities were hardly paid against claims for damage and loss of fishing equipment because of informational issues. Thus, such laws had no use and people often break them.

Although marine fishers had been engaged in their occupations for quite a long time, their awareness about state laws remained at a very low level. This finding can be further supported by Amarasinghe (2006) stating that though Sri Lanka has a robust body of fisheries based on the Fisheries and Aquaculture Resources Act of 1996 and subsequent amendments, they have not been properly implemented. This implies a very sad state of affairs and one need to understand why people's knowledge of laws applicable to their own sector remains very low though they had been engaged in their occupations for quite a long time. It may also be of importance to devise means of improving their awareness and knowledge about state laws which not only controls their resource use patterns but also which offer them with opportunities of improved wellbeing.

The study showed that state laws pertaining to fisheries governance form specific set of laws based on particular resources, enforced by separate line agencies. Thus, resource use decisions seemed to be made in isolation, without any coordination or interaction among institutions or line ministries having interest in the resources of the same coastal zone. Such isolated process of decision making was a result of governing mechanism at the top, which too were characterized by isolated policy making processes, without understanding the fact that a particular set of policy prescriptions will have negative externalities on other policy prescriptions. This emerges from non- interactive forms of governance, which are non- inclusive and non- participatory.

**Conclusions and Future Recommendations**

This study revealed that mainly there were two legal systems governing marine resources use; community legal system and state legal system. The prime objective of community legal system was to assure wellbeing of the people while state legal system focused on resource access, appropriation and conservation. The level of awareness about state laws among marine fishers remained very low while higher numbers of state laws were breached than community laws which implied the lower legitimacy of state laws within fishing communities. Marine fishers breached community laws mainly due to poverty. But the reasons for breaching the state laws were poverty, lack of awareness on fisheries regulations and incompatibility with interests. Therefore, it is important to understand the reasons for compliance and non- compliance with marine fishing laws in formulating rules and regulations. The results of the study highlights the governance to be "interactive", a process bringing all relevant stakeholders on to a single platform, where they deliberate upon their knowledge, experience and aspirations and discuss policy instruments acceptable to all. Such a process will take into account concerns of all resource users, including state and non- state actors, the latter including marine fishers. Due to the presence of both state and marine fishing representatives in the platform, the prepared rules and regulations will get the legitimacy with in the fishing community minimizing

room for rule breaking and conflicts while ensuring sustainable resource use and improved wellbeing of people.

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# HYBRID OPTIMIZATION OF TWO-TIER LOGISTICS FRAMEWORK FOR COST-BENEFIT ANALYSIS – A SYSTEMATIC REVIEW OF LITERATURE ON MEGACITY LOGISTICS

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**ABSTRACT**

A megacity is a city over a population of ten million people that supports complex logistics functionalities each and every day. A common logistics framework related to megacity concept world-wide, is a two – tier transportation network structure that consolidates freight received from origins at a central hub location and then transports it to the destinations. In the context of megacity, consolidated hubs act as a hub-and-spoke structure to accumulate freight from different areas. Extensive literature on two-tier logistics framework optimizations suggests simulation-based mechanisms to analyse the operational feasibility. At the same time, there is ample literature in the context of mathematical optimization of logistics frameworks considering aspects of time, capacity and cost. Yet, a logistics framework in the megacity context needs to be subjected to a combinatory analysis of financial as well as operational feasibility for optimum outcome. Therefore, this study is conducted with the goal of identifying the capability of optimizing a two-tier logistics framework based on a hybrid approach (mathematical and simulation-based optimization) that can be utilized to analyse the cost-benefit trade-off of such a logistics structure while ensuring optimum operational feasibility. This scrutiny was conducted using multiple studies published in the area of megacity logistics, two-tier transportation framework, hybrid optimization and financial analysis by way of a systematic review of literature.

***Keywords – Megacity Logistics, Two-tier logistics framework, Hybrid Optimization, Simulation Optimization, Mathematical Optimization, Cost-Benefit Analysis***

## INTRODUCTION

The idea of city logistics is to develop urban logistics system that is effective and efficient as well as environmentally friendly (Saragih et al., 2015). In freight transportation, there are two main distribution strategies: direct shipping and multi-echelon distribution. In direct shipping, vehicles starting from a depot transport their freight directly to the customers, while in multi-echelon systems the freight is delivered from the origin to the customers through intermediate depots. In two-echelon distribution systems, freight is delivered to an intermediate depot and from this depot to customers. Thus, the transportation network is decomposed into two levels, the 1st level connecting the depot to the intermediate depots and the 2nd connecting the intermediate depots to the customers. The objective is to minimize the total transportation cost of the vehicles involved in both levels (Perboli, et al., 2011). The intermediate depots discussed by (Perboli, et al.,2011) shows a similar idea to the hub concept discussed by (Alumur & Kara, 2008), in which hubs are special facilities that serve as switching, transhipment and sorting points in many-to-many distribution systems. Instead of serving each origin–destination pair directly, hub facilities concentrate flows in order to take advantage of economies of scale.

The above explained theoretical framework can be observed in the proposed Megapolis megacity development initiative in Sri Lanka. According to (Anon., 2016), proposed Logistic corridor has identified three major clusters for logistic purposes; Cluster 01 – Ja Ela – Ekala Logistic Cluster, Cluster 02 - Welisara – Mabola Logistic Cluster and Cluster 03 –Peliyagoda logistic Cluster. It has identified that the concepts of inland port; logistic park can be applied in above mentioned areas. Logistics Park creates economies of agglomeration for freight activities thereby lowering operational costs.

Optimization is the methodologies for improving the quality and desirability of a product or product concept. It is the process of finding function extreme to solve problems and finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones (Danalakshmi & Kumar, 2010). Optimization of transport network can be conducted based on multiple optimization methodologies such as qualitative approach, mathematical approach, simulation or a modelling approach. (Nikolopoulou & Ierapetritou, 2012) propose a hybrid approach combining mathematical programming and simulation model to solve a logistics problem. This approach overcomes the computational complexity associated with solving the underlying large-scale problem and to provide a better representation of supply chain reality. Therefore, it is viable to apply the optimization methodology elaborated by (Nikolopoulou & Ierapetritou, 2012) in the context of cargo transportation network optimization.

Logistics management is a flow-oriented concept with the objective of integrating resources across a pipeline which extends from suppliers to final customers, it is desirable to have a mean whereby costs and performance of that pipeline flow can be assessed (Christoper,2011). Therefore, once an optimization-based model is developed for a logistics function, it can be analysed in the perspective of trade-off between cost and benefit that can be gained as a result of comparing it with different scenarios.

This study systematically and comprehensively scrutinizes the literature published in the concepts of megacity concept, optimization of two-tier logistics framework and cost-benefit analysis, with the objective of identifying knowledge gaps in the area of interest. The findings would be of strategic importance to any country moving towards a new phase of logistics development similar to the Megapolis megacity logistics initiative in Sri Lanka.

The remainder of the paper is organized as follows; applied methodology for the study, an overview of research approaches used in the examined articles, the results of the systematic literature review, closure of the paper by offering conclusions and an attempt to provide some perspectives on future research.

## METHODOLOGY

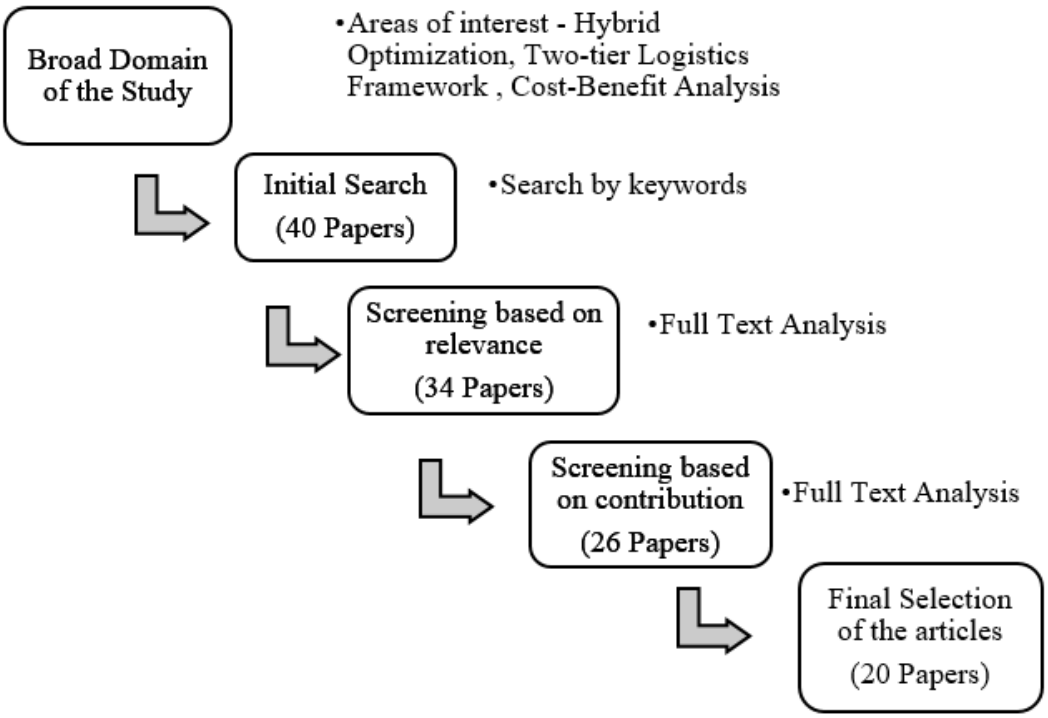


Figure 1: Screening process of the systematic review of literature

The systematic review of literature was based on content analysis as the approach to gather knowledge in the selected areas of two-tier megacity logistics, optimization approaches and cost-benefit analysis. The initial step was gathering literature related to the above mentioned areas and as a result forty articles were chosen based on title, abstract and keywords. Then the selected articles were further analyzed based on the full text to identify papers that are directly linked with the study area. Each paper was scrutinized in depth to eliminate irrelevant articles for the study. Dissimilarities caused in comparing the articles were discussed by the researchers and finally twenty articles were selected for the analysis. The selection procedure of the articles based on their relevancy is depicted in the figure 1 above. Reference section of this paper clearly states the articles reviewed in the scrutiny. This in-depth analysis is aimed to deliver the theoretical gap in literature uncovered by previous researches related to the study area. The paper cited was retrieved from publications related to logistics, operations management, transportation, optimization methodologies and financial analysis.

When considering the sources of reviewed literature, major journals contributed for the study covering 60% of the sources are mentioned in their descending order of contribution as follows: European Journal of Operations Research, Transportation Science, Journal of Industrial and Management Optimization, Transportation Research and Journal of Transport Geography.

## MAIN RESULTS OF THE REVIEWED STUDIES

The study by (Benjelloun & Crainin, 2009) titled “Trends, Challenges, and Perspectives in City Logistics” focuses on identifying new approaches in the aspect of city logistics based on available literature and practical scenarios such as project reports. The study elaborates on meaning and applications behind the term “City logistics”, planning issues occurred, trends, challenges and perspectives in that arena. Researchers have identified that the optimization and utilization of advanced information technologies components for City Logistics are not very developed.

A case study based research was conducted by (Cheong, et al., 2007) considering a third party logistics provider in Singapore in order to study the practical applicability of consolidation hubs that collect shipments from several suppliers, consolidate them and direct the consolidated shipments to the appropriate destination. The outcome was a decision model that decides impact based on varying shipping option and the inventory replenishment cycle for each component at each warehouse including cost aspect.

The paper titled "City Logistics for Mega City: A Conceptual Model (Case Study: DKI Jakarta)" by (Saragih et al., 2015) focuses on developing a city logistics system for the city of Jakartha. This case study focuses on the flow of materials, specifically fruits and vegetables in and out of the city in the form of a two-tier transportation structure and how it can be optimized to answer the situations of low availability of goods and traffic situations.

(Taniguchi, et al., 2014) investigated the trends and innovations in modelling city logistics. New techniques for modelling city logistics developed in the areas of emissions, healthcare and mega-cities are given a priority and presented in the paper as a systematic review of literature. This paper has described modelling approaches that can be used for designing and evaluating City logistics schemes for reducing the impacts of freight in cities.

In the study on "A geographer's analysis of hub-and spoke networks'" by (O'Kelly, 1998), He discusses about features of the hub-and-spoke system that make them different from basic facility location problems with a simulation exercise and a hypothetical network. The paper by (Crainic, et al., 2009) focuses on issues related to two-tier logistics structure and developed mathematical optimization methodologies supported by network diagrams to derive at optimized solutions. The study titled "Research on Optimization of Hub-and-Spoke Logistics Network Design with Impedance Effect" by (Li & Lindu, 2009) focuses on developing a function that can be applied in order to solve traffic congestion occurred due to impedance in the context of single allocation p-hub problem.
The study by (Chen, 2005) focuses on hybrid approach of heuristic based genetic algorithm and a simulated annealing method in solving the uncapacitated single allocation hub location problem (USAHLP). The computational results gained by applying the derived upper bound for the number of hubs is capable of obtaining optimal solutions for all small-scaled problems.

In the study by (Crainic & Laporte, 1997), the logistics network related issues of hub based transportation are addressed in strategic, tactic and operational level freight transportation planning and operations based on mathematical analysis. The study by (Cunha & Silva, 2007) is focused on developing a genetic algorithm to solve the problem of configuring hub-and-spoke networks for trucking companies that operate less-than-truckload (LTL) services in Brazil. It allows variable scale-reduction factors for the transportation costs according to the total amount of freight between hub terminals. (Groothedde, et al., 2005) have utilized a hybrid approach for optimization of the design and implementation of collaborative hub network for the distribution of fast moving consumer goods using a combination of trucking and inland barges. Economies of scale were derived as the outcome of the application. A simulation based approach is utilized by (Watada, et al.,2014) to investigate optimal decision methods under a cooperative situation in two-echelon logistic models based on three types of rival game behaviors: Stackelberg, Collusion, and Cournot, each of which provides the optimal decision for the duopolistic shippers and the oligopolistic forwarders in each scenario. From the study it was found out that among three scenarios, Stackelberg behaviour can carry out the maximum profit, and Collusion game can achieve the maximum profit for the shippers.

The study conducted by (Rodrı´guez, et al., 2007) to identify optimum hub location in a hub-spoke network was based on simulated annealing algorithm and the main factors concerned were cost of trans port between each origin/ destination pair; and the cost arising from not delivering the goods within the agreed time limit. (An, et al., 2011) have developed nonlinear mixed integer programming models and present linearized formulas in order to address reliable single and multiple allocation hub-and-spoke network design problems where disruptions at hubs and the resulting hub unavailability can be mitigated by backup hubs and alternative routes. A mathematical model was developed by

(ZaKpfel & Wasner, 2002) to decide whether a pure hub-and-spoke system where all quantities within the transportation network flow over the hub from or to the depots is suitable, or whether a hybrid hub-and-spoke network in which direct transports also take place is applicable for a particular scenario.

(Christoper, 2011) discusses about various cost and returns on logistics and how those aspects can be mathematically analysed based on financial ratios and financial calculations. (Cheong, et al., 2007) focuses on the network design problem to implement in supplier consolidation hubs and multiple shipment options, by deciding the number, location and operation of consolidation hubs so as to minimize the total logistics costs for the network. The paper by (Horner & O'Kelly, 2001) is focused on nonlinear costs associated with hub based transportation and developed a model in GIS environment to analyse the real world scenario in major cities in USA. In the study "Inbound Logistic Planning: Minimizing Transportation and Inventory Cost", the authors have considered the problem of selecting the appropriate distribution strategy for delivering a family of products from a set of suppliers to a set of plants so that the total transportation, pipeline inventory, and plant inventory costs are minimized. A mathematical model was developed as a result of this study. (Ya-ping, 2012) has studied on reverse logistics aspect and have construct a cost-benefit model of reverse logistics enabling precise computation of the total costs and ultimate benefit of reverse logistics to facilitate enterprises.

## DISCUSSION

The discussion of the articles summarized under main results of the reviewed studies is analyzed based on two aspects: Optimization Approaches for Two-tier Megacity Logistics Framework and Cost- Benefit Analysis of Two-tier Megacity Logistics Framework.

### Optimization Approaches for Two-tier Megacity Logistics Framework

The optimization approaches discussed in literature have utilized diverse methodologies in diverse aspects and they have resulted in logistics optimization in different angles. This discussion is on the similarities and differences observed by the authors with related to the different approaches used in optimization of two-tier logistics frameworks are as follows. The summary related to this analysis is available in Table 1.

Literature present in the context of two-tier hub and spoke based optimization focuses mainly on a common improvement parameter "cost", and followed by capacity constraints and time. At the same time there was one reference related to calculation of profit yet it was based on shipping industry. Even though hub and spoke based two-tier logistics optimization was extensively discussed in these papers, the priority given to megacity logistics is not very much observed. It is also observed that optimization approach used in solving this problem using traditional mathematical approach verses hybrid approach and simulation based analysis based on software have become equal. At the same time, the simulation integrated studies have been able to provide a better understanding into the developed and/or applied mathematical model in a practical scenario.

Table 1: Analysis of Optimization Approaches for Two-tier Megacity Logistics Framework

| Study | Optimization Approach | | | Factors Considered | | | Area applied | |
|---|---|---|---|---|---|---|---|---|
| | Mathematical | Simulation | Hybrid | Cost | Time | Other | Megacity Logistics | Other |
| (Cheong, et al., 2007) | * | | | * | * | | * | |
| (Crainic, et al., 2009) | * | | | * | | Capacity | * | |
| (Li & Lindu, 2009) | | | * | * | * | Capacity | * | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Chen, 2005) | | | * | * | | | | Generic |
| (Crainic & Laporte, 1997) | * | | | * | | Capacity | | Generic |
| (Cunha & Silva, 2007) | * | | | * | | | | Truck service providers |
| (Groothedde, et al., 2005) | | | * | * | | | | Fast Moving Consumer Goods Market |
| (Watada, et al., 2014) | | * | | * | | Profit, Quantity | | Shipping |
| (Rodrı´guez, et al., 2007) | | | * | * | | | | Generic |
| (An, et al., 2011) | | | * | * | * | Capacity | | Generic |
| (ZaKpfel & Wasner, 2002) | * | | | | | Capacity , Quantity | | Third-party Logistics Providers |

**Cost- Benefit Analysis of Two-tier Megacity Logistics Framework**

When considering the financial analysis of hub and spoke based two-tier logistics framework, the following outcomes are visible. The summary is available in Table 2.

Table 2: Cost- Benefit Analysis of Two-tier Megacity Logistics Framework

| Study | Financial Analysis Focused | | Explanation | Optimization method Integrated | Area Applied |
|---|---|---|---|---|---|
| | Cost | Benefit/Profit | | | |
| (Christoper, 2011) | * | * | Financial ratio analysis, Warehouse costing, Working capital analysis | No | Generic |
| (Cheong, et al., 2007) | * | * | Variable and fixed costs of warehousing and shipping | Yes | Generic |
| (Horner & O'Kelly, 2001) | * | | Transportation cost | Yes | Generic |
| (Berman & Wang, 2006) | * | | Transportation and Inventory Cost | Yes | Generic |
| (Ya-ping, 2012) | * | * | Cost and Revenue Analysis | No | Reverse Logistics |

Literature available in financial analysis of hub and spoke based two-tier logistics frameworks give much attention to cost minimization. It can be clearly seen according to Table 1 and table 2. Yet there is a void in the priority given for a firm financial analysis in megacity context. The one paper focused on two-tier hub and spoke based benefit analysis was in the field of reverse logistics. All the papers focused on logistics optimization according to table 1 and 2 focused on minimizing cost with the application of optimization yet there were no papers focused on analysis of quantifying financial benefits. Yet, we cannot blindly believe that minimizing cost means maximization of profit.

According to (Christoper, 2011), there are literature available in financial analysis of logistics that can be applied for analysis of financial benefits. Yet those theory based calculations were not applied in optimization models of two-tier hub and spoke based logistics framework in any sector including the megacity logistics.

## CONCLUSIONS AND FUTURE RECOMMENDATIONS

Based on the above discussion, it is evident that even though there are ample studies conducted on optimization of hub and spoke based two-tier logistic framework, the attention given to the context of megacity logistics needs to be improved. At the same time, the optimization methodology must be shifted from a complete mathematical analysis to a hybrid approach where a combinatory analysis of mathematical optimization enhanced by simulation can be utilized to improve clarity and reduce complexity in the optimization of two-tier hub and spoke based megacity logistics framework.

On the other hand megacity logistics is a major transformation for any city in the world and therefore its financial performance must be closely monitored not in one aspect but in two aspects, the cost as well as the benefit obtained by optimization. For that, literature available in the context of financial analysis can be integrated into the optimization methodology of two-tier hub and spoke based megacity logistics framework. From the above elaboration, It is evident that there exists a void in literature for a combinatory analysis of these three aspects; optimization of two-tier logistics framework, cost-benefit based financial analysis and megacity logistics. It can be demonstrated as follows.

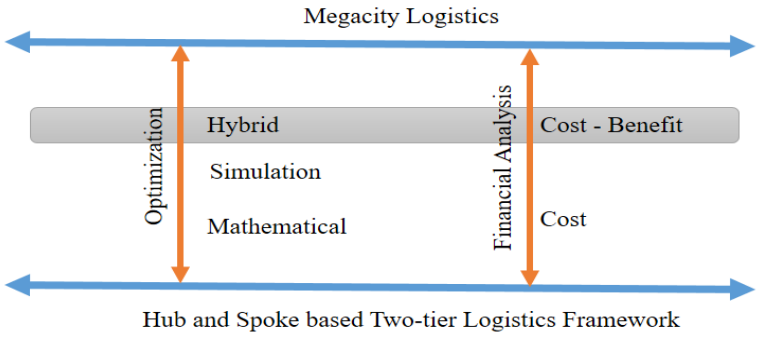


Figure 2: Conceptual Framework

Therefore, there exists an opportunity for future researches to concentrate on the overlapping study area to build up knowledge for hybrid optimization of two-tier logistics framework for cost-benefit analysis.

Furthermore, when considering the present Sri Lankan context, there exists research opportunities for practical analysis of the theoretical aspect highlighted in this paper by applying it to the logistics corridor development project of Megapolis megacity development.

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# EXPOSITION OF *RHODOMICROBIUM VANNIELII* USING GENERAL MORPHOLOGICAL AND BIOCHEMICAL FEATURES

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## ABSTRACT

The present work aimed to isolate purple non sulfur bacteria from enriched soil sample. The isolated bacterium was identified as *Rhodomicrobium vannielii* (RV) by morphological and biochemical tests.

The dominant photosynthetic pigment was bacteriochlorophyll *a* and carotenoids. The preferred growth medium of RV was simple electron donors and carbon sources. Pyruvate may be the best, but other substances such as acetate lactate, intermediates of citric acid cycle and malate also served as favored carbon sources and identification of tryptophanase and nitrate reductase formation was not reported previously.

Isolated RV utilized arabinose, cellobiose, galactose, glycogen, Inulin, maltose, melibiose, raffinose, rhamnose, ribose, salicin and trehalose and non-digestible carbohydrates of human such as arabinose, cellobiose, inulin; which was not identified previously. The findings of this study advance the knowledge on the efficacy of *Rhodomicrobium vannielii* by morphological and biochemical characteristics.

***Keywords;* *Rhodomicrobium vannielii*, Carbon sources, Non-digestible carbohydrates, Photosynthetic pigment**

## NTRODUCTION

Purple non sulfur bacteria (PNSB) are short rod shaped Gram negative organisms (Ainon H et al. 2006). They carry out anoxygenic photosynthesis, since they do not release $O_2$ from $H_2O$ during their photosynthesis. PNSB use $H_2S$ as the electron donor for photosynthetic electron transport chain. Therefore, $H_2S$ and adequate sun light are the main requirements for their phototrophic growth (McEwan 1994 ). They are common in water bodies below the layer of algae, aquatic plants and cyanobacteria (Soto-Feliciano et al. 2010) as well as in waste water ponds, sediments, moist soils, seawater pools, hyper saline environments and activated sludge (Poretsky 2003).

Most commonly isolated PNSB are *Rhodopseudomonas* (Socorro et al. 2013), *Rhodospirillum* (Soto-Feliciano et al. 2010), *Rhodomicrobium* (Ainon H et al. 2006). PNSB have been isolated, characterized and extensively employed to investigate principles of photosynthetic respiratory electron transport and gene expression in response to reduction-oxidation (redox) signals (Yaşa et al. 2006). PNSB have potential biotechnological application in bioremediation and production of single cell protein, and production of vitamins and ubiquinone Q10(Sasaki and Nagai 1979).

The genus *Rhodomicrobium* which is the focus of our current work, have ovoid cell shape, vegetative growth cycle and internal photosynthetic membrane.
*Rhodomicrobium* use bacterochlorophyll *a* and caretonoids of the spirilloxanthin series with rhodopin as the major caretonoids and with small amount of beta-caretonoids for photosynthesis. Cells grow under microaerobic to anaerobic condition with optimum growth temperature and pH of 30 $^{o}$C and 5.2 – 7.5 respectively.

This genus utilize substrates such as acetate, propionate, butyrate, valerate, caproate, caprylate, ethanol, propanol, butanol, lactate, pyruvate, malate, fumarate, succinate, and malonate as their energy source and carbon source but citrate, tartrate, fructose, glucose, mannose, mannitol, sorbitol, sorbitol, glycolate, oxalate, pelargonate, benzoate, aspartate, arginine and glutamate are not preferred. Our aim was to explicate genus *Rhodomicrobium* further using general morphological and biochemical features to identify the novel biochemical characteristic of genus *Rhodomicrobium.* These newly identified features collectively with known characteristics will be useful in identification and commercial application of genus *Rhodomicrobium* in future studies leading to more intensive studies on genus *Rhodomicrobium.*

## MATERIALS AND METHOD

### Source of sample

The Winogradsky's column was prepared with the use of a two-liter translucent plastic container filled with mud. The mud was enriched with 0.5 w/w $MgSO_4$, 0.25% w/w $CaCO_3$, 2% w/w cellulose and pond water to supply sulfur source, inorganic carbon source, organic carbon source and water respectively.

The column was incubated for 8 weeks in an environment that received bright indirect sun light (closer to window) at a room temperature 25°C-28°C (Benson 2002).

### Media

Glutamate-malate medium, Van Niel's Yeast Agar with Glutamate medium and Sodium sulfide solution were used.

Glutamate-malate medium (GMM); contained (per liter distilled water) Sodium-L-glutamate (2.0 g), DL-malic acid (3.0 g), $KH_2PO_4$ (0.5g), $K_2HPO_4$ (0.5 g), $(NH_4)_2HPO_4$ (1.0 g), $MgSO_4.7H_2O$ (0.2 g), $CaCl_2.2H_2O$ (0.6 g), $MnSO_4.5H_2O$ (1 mg/mL) (1.3 mL), $CoCl_2.6H_2O$ (1 mg/mL) (1.0 mL), Ferric citrate (10 mg/mL in 30% $NH_4OH$) (0.25 mL), Nicotinic acid (1 mg/mL)(1.0 mL), Thiamine-HCl (1 mg/mL) (1.0 mL), Biotin (100 µg/mL) (1.0 mL), Yeast extract(1.0g), pH=7.5 ± 0.2 at 25°C± 2°C was used for the isolation of PNSB (Ainon H et al. 2006).

Van Niel's Yeast Agar with Glutamate medium (VNYAG)(Atlas 2010.); contained (per liter distilled water) Agar (20.0g), Yeast extract (10.0g), $K_2HPO_4$ (1.0g), Glutamate (0.7g), $MgSO_4$ (0.5g) and pH 7.2± 0.2 at 25°C ± 2°C was used to obtain a pure culture.

Sodium sulfide solution (3.6% w/v): contained $Na_2S$ (0.36 g) in 10 mL of distilled water was used to detect the intracellular sulfur globules.

### Isolation and Characterization

One millilitre of sample of red colour area of the column (Fig. 2) was aseptically transferred to sterile tubes containing 10 mL of GMM. These test tubes were incubated in an anaerobic glass chamber for 3 weeks under florescent light at 25°C± 2°C temperature (development of red color in the medium confirmed the growth of PNSB) (Fig.3). Isolated colonies were obtained by subsequently streaking the inoculum from the test tubes on fresh VNYAG (Fig.4) plates. Inoculated culture plates were further incubated for three weeks under florescent light at 25°C± 2°C temperature. Then the pure cultures were inoculated in VNYAG in test tubes.

To identify the isolated PNSB, morphological, cultural, and physiological characterizations were conducted as described in the Bergey's Manual of Systematic Bacteriology; Volume 3(Staley et al. 1989). For morphological characterization, isolates were stained with Gram's staining. Cell shape,

motility and presence of endospores were determined by light microscope (Olympus CX21 Microscope) under 1000x magnification.

The isolated colonies on VNYAG medium were analyzed for cultural morphology including shape of the colony, colony pigmentation, elevation, margin and transparency.

**Biochemical tests**

Twenty (20) biochemical tests were carried out to determine the genus of isolated PNSB according to Ainon H et al 2006 and Bergey's manual of systematic bacteriology. Vol. 3, 1989 as follows,

**Detection of endocellular enzyme activity**

This was determined using catalase, oxidase, glucose fermentation, nitrate reduction, oxidative/fermentative, indole production, methyl red, voges-proskaur test, acid production from carbohydrates, $H_2S$ production from TSI and citrate utilization test.

**Detection of exocellular enzyme activity**

This was determined by gelatin hydrolysis, starch hydrolysis, lipid hydrolysis and lecithinase production test.

**Utilization of different sugars**

To detect the acid and gas production from carbohydrates, twenty one (21) different sugars (arabinose, cellobiose, fructose, galactose, glucose, glycogen, inulin, lactose, maltose, D- mannitol, mannose, melibiose, raffinose, rhamnose, ribose, salicin, sorbitol, starch, sucrose, trehalose and D-xylose.) were used. Sugars such as arabinose, cellobiose, galactose, glycogen, inulin, maltose, Mmelibiose, raffinose, rhamnose, ribose, salicin and trehalose have not been studied previously.

**Ability to live under different physiological conditions**

This was observed under aerobic and anaerobic environment.

- Growth at different temperatures

Test tubes containing GMM were inoculated with a loopful of isolated bacterial culture and incubated anaerobically under florescent light at 4ºC, 10ºC, 25ºC, 30ºC, 35ºC, 40ºC, 50ºC and 60ºC. Cell growth was determined by measuring the optical density at 600 nm (Thermo spetronic-Genesys 6) (Sharma et al. 2012).

- Growth at different pH

Test tubes containing GMM at varying pH of 3.0, 4.0, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0 and 9.0 was inoculated with a loopful of isolated bacterium and incubated anaerobically under florescent light at 25°C ± 2°C. The pH was adjusted using 1M HCl or 1M NaOH. Cell growth was determined by measuring the optical density at 600 nm (Ainon H et al. 2006).

**Presence of intracellular sulfur globules**

Presence of intracellular sulfur globules of the isolate was determined by incubating the cell suspension with neutral sodium sulfide solution (3.6% w/v) on a microscopic slide. The slides were irradiated with tungsten lamp for 20 minutes and the formation of intracellular sulfur globules were observed under light microscope (Olympus CX21 Microscope) (Truper and Pfenning 1981).

**Spectral analysis of chlorophyll and carotenoids**

Test tubes containing 10 mL of GMM were inoculated with a loopful of isolated bacterial culture and incubated anaerobically under florescent light at 25°C± 2°C for 48 hours. To determine the presence of photosynthetic pigments; bacteriochlorophyll *a* and *b*, and carotenoids pigments; the broth culture was centrifuged at 9000 rpm when the color of the broth turns bright red. The pellet was re suspended in 10 mL of 90% acetone followed by incubation in dark at 4 °C for 30 min. Then the mixture was centrifuged at 9000 rpm. The whole cell spectrum of supernatant was recorded at wavelength of 300-900 nm using 90% acetone as the reference in a spectrophotometer (Siefert et al. 1978).

**Thin Layer Chromatography (TLC) analysis of photosynthetic pigments**

TLC plate was prepared using Silica gel G as stationary phase which was pre heated to 60ºC for activation. A sample which was used for spectral analysis was spotted on the baseline of the TLC slide at 1.5 cm. The spot was allowed to dry at 25°C± 2°C temperature. TLC slide was placed in the pre saturated TL chamber which has mobile phase of two combination of solvent Acetone: Methanol at a ratio of (9:1). v/v and left for 10 minutes. The distance that moved by the spot in baseline and relative $R_f$ values were determined using following formula (Selvakumar and Dhevendran 2011)(Fig.9).

$$R_f = \frac{\text{Distance from the origin migrated by a compound}}{\text{Distance from origin migrated by solvent}}$$

**RESULTS**

PNSB were isolated from bright red/ purple colored patches of the Winogradsky's column (Fig. 1 and 2). Inoculation of the soil samples on the GMM resulted growth of red pigmented bloom of bacteria after three weeks of incubation in anaerobic chamber (Fig.3).

Fig. 1 Winogradsky's column - Whole

Fig. 2 Winogradsky's column - Lower section with purple colored patches

Fig. 3 RV in GMM test tubes

Consequent subculture of the VNYAG yielded a pure culture of PNSB. These organisms formed small, irregular, deep red colored colonies with entire margin, convex elevation and smooth surface on agar medium (Fig.4). Purified cultures were characterized based on the morphological, cultural, biochemical and physiological structures.

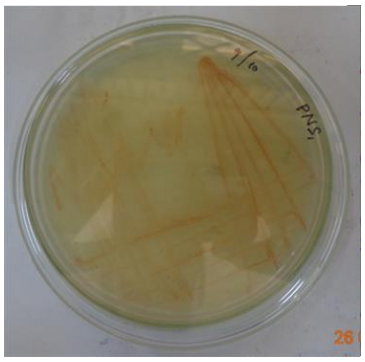

Fig. 4 RV on VNYAG agar plate

**Table 1** Cultural characteristics of genus *Rhodomicrobium*

| **Characteristics** | **Observations** |
|---|---|
| Colony shape | Irregular |
| Color | Deep red |
| Elevation | Convex |
| Margin | Entire |
| Transparency | Opaque |
| Surface | Smooth |
| Odour | No characteristic odour |

**Table 2** Morphological characteristics of genus *Rhodomicrobium*

| **Characteristics** | **Observations** |
|---|---|
| Gram staining | Negative |
| Cell shape | Short rod |
| Cell arrangement | Single |
| Motility | Motile |
| Endospores | Absent |

**Table 3** Endoenzyme activity of genus *Rhodomicrobium*

| Characteristics | Observations | Test/Method |
|---|---|---|
| Ability to grow in the presence of oxygen neutralizing toxic forms of oxygen metabolites; $H_2O_2$. | + | Test for presence of catalase enzyme in the bacterial cells |
| Presence of cytochrome C oxidase, an enzyme of the bacterial electron transport chain. | + | Test for oxidase detection |
| Ability to use glucose producing acid and gas. | – | Test for production of acid and gas from glucose fermentation |
| Ability to utilize carbohydrates aerobically (Oxidation) and/or anaerobically (Fermentation). | Fermentative | Oxidative/ fermentative test (Hugh and Leifson's' test) |
| Ability to split amino acid tryptophan to form the compound indole using tryptophanase enzyme. | + | Test for utilization of tryptone and production of indole ring |
| Ability to reduce nitrate ($NO_3^-$) to nitrite ($NO_2^-$) using the enzyme nitrate reductase | + | Test for detect nitrate reduction ability using nitrate broth |
| Ability to perform mixed acid fermentation using glucose | – | Test for detect mixed acid formation in glucose peptone medium |
| Ability to produce acetoin using glucose | – | Test for detect the acetoin production in glucose peptone medium |
| Ability to ferment sugars and to produce $H_2S$ | – | Test for detect $H_2S$ production using triple sugar iron agar |
| Ability to utilize citrate as the sole carbon source | – | Test for citrate metabolism using Simmon's citrate agar |

Symbols: +, Positive result for the test; -, Negative result for the test.

**Table 4** Exoenzyme activity of genus *Rhodomicrobium*

| Characteristics | Observations | Test/Method |
|---|---|---|
| Ability to hydrolyze gelatin. | – | Test for utilization of gelatin using the gelatin agar |
| Ability to hydrolyze starch. | – | Test for utilization of starch using the starch agar |
| Ability to hydrolyze lipids. | – | Test for utilization of lipids using the trybutrin agar |
| Ability to destroy animal tissues using lecithinase enzyme. | – | Test for production of lecithinase using the egg yolk agar |

Symbols: +, Positive result for the test; -, Negative result for the test.

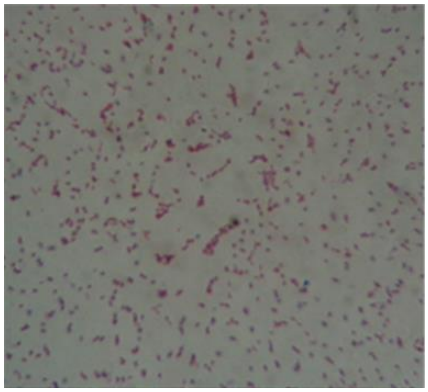

Fig.5 Light microscopic image of RV(10*100)

**Table 5** Ability to utilize different sugars by genus *Rhodomicrobium*

| Characteristics | Observations | Test/Method |
|---|---|---|
| Ability to utilize acid and gas from different sugars. | | Test for acid and gas production from carbohydrates. 0.5% (w/v) amounts sugar was added separately in to test tubes and detected the acid and gas production. |
| | + | Arabinose |
| | _ | Cellobiose |
| | _ | Fructose |
| | + | Galactose |
| | _ | Glucose |
| | _ | Glycogen |
| | _ | Inulin |
| | + | Lactose |
| | + | Maltose |
| | _ | Mannitol |
| | _ | Mannose |
| | + | Melibiose |
| | + | Raffinose |
| | + | Rhamnose |
| | + | Ribose |
| | + | Salicin |
| | _ | Sorbitol |
| | _ | Starch |
| | + | Sucrose |
| | + | Trehalose |
| | + | Xylose |

Symbols: +, Positive result for the test; -, Negative result for the test.

**Table 6** Ability to grow at different physiological conditions

| Characteristics | Observations | Test/Method |
|---|---|---|
| Ability to grow in anaerobic condition. | + | Growth in anaerobic jar using anaerobic agar |
| Ability to grow in aerobic condition. | + | Growth in aerobic condition |

Symbols: +, Positive result for the test; -, Negative result for the test.

**Table 9** Ability to utilize different carbon sources as the sole source of carbon

| Characteristics | Observations | Test/Method |
|---|---|---|
| Ability to utilize different organic acids as the sole source of carbon | | Test for utilization of different carbon source as the sole carbon source using Malate-yeast extract medium as the basal medium and 1% (w/v) each sugar separately in test tubes. |
| | + | Acetate |
| | _ | Benzoate |
| | _ | Citrate |
| | + | Lactate |
| | + | Malate |
| | + | Pyruvate |
| | + | Succinate |

Symbols: +, Positive result for the test; -, Negative result for the test.

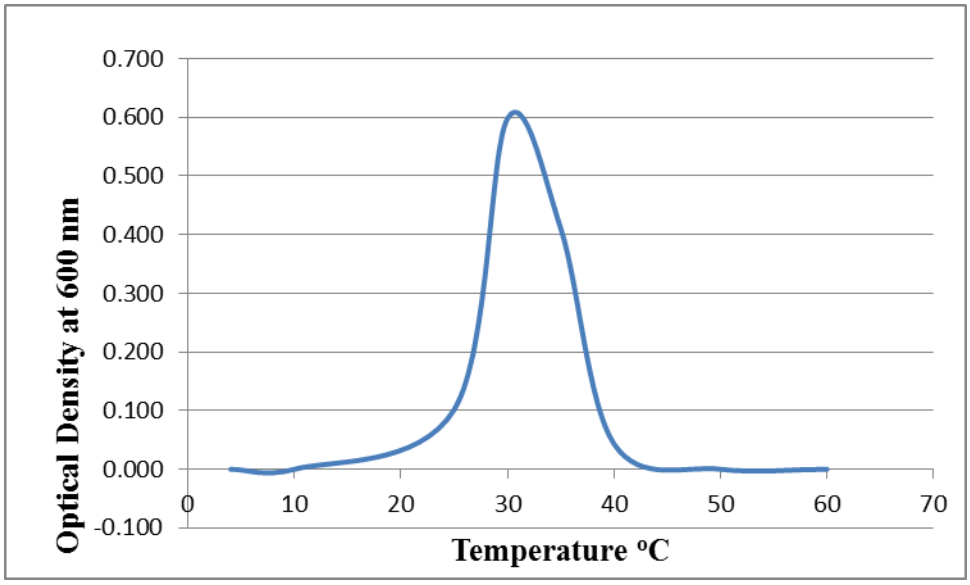


Fig.6 Growth of RV at different temperatures

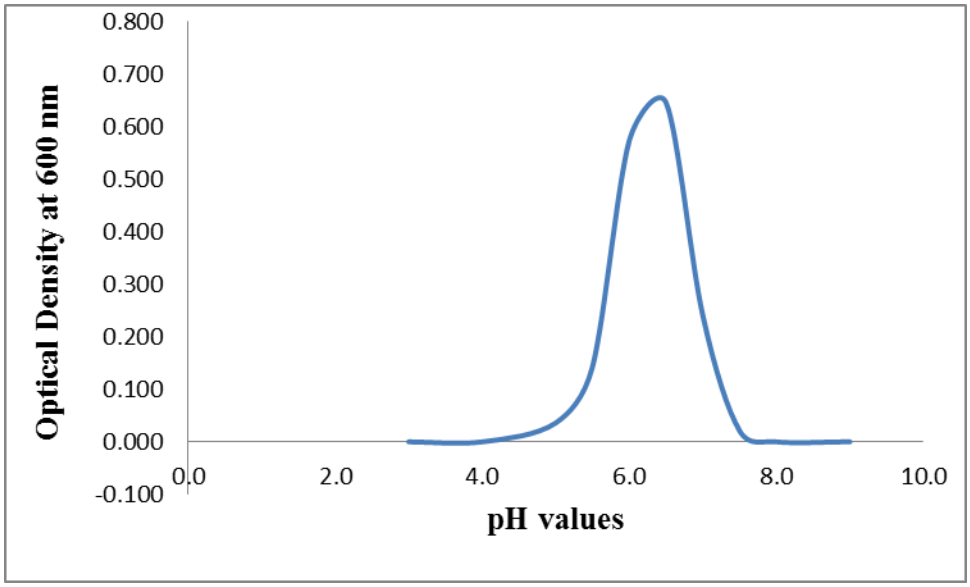


Fig.7 Growth of RV at different pH

**Presence of intracellular sulfur globules**

There was no formation of intracellular sulfur globules when PNSB was exposed to neutral sodium sulfide solution.

**Spectral analysis of chlorophyll and carotenoids**

The spectrophotometric analysis was done with acetone extract. Majority of the peaks exhibit maxima at 363, 476, 774 nm indicating the presence of bacteriochlorophyll and carotenoids (Fig. 8).

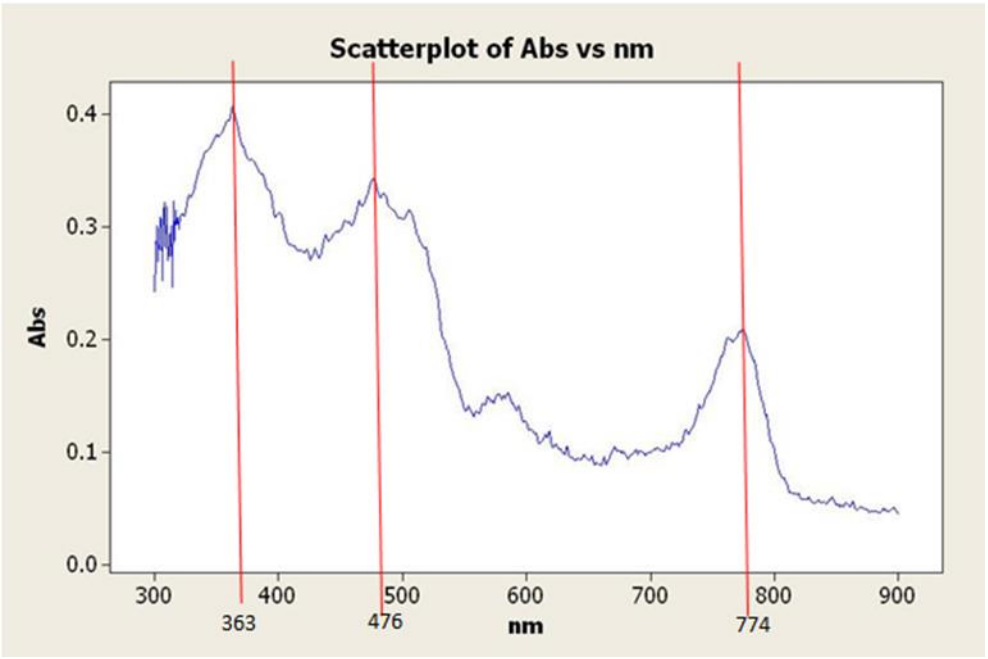


Fig. 8 Spectral analysis for Chlorophyll and Carotenoids of RV

**Thin Layer Chromatography (TLC) analysis of photosynthetic pigments**

Thin-layer chromatography was used to separate the pigments. Two clearly visible spots were identified after developing the Thin-layer chromatogram. One was in bright red color and was persistent after taking out from the TLC jar, while the other yellowish spot was invisible soon after taking from the jar (Fig. 9). $R_f$ values obtained were 0.40 and 0.85.

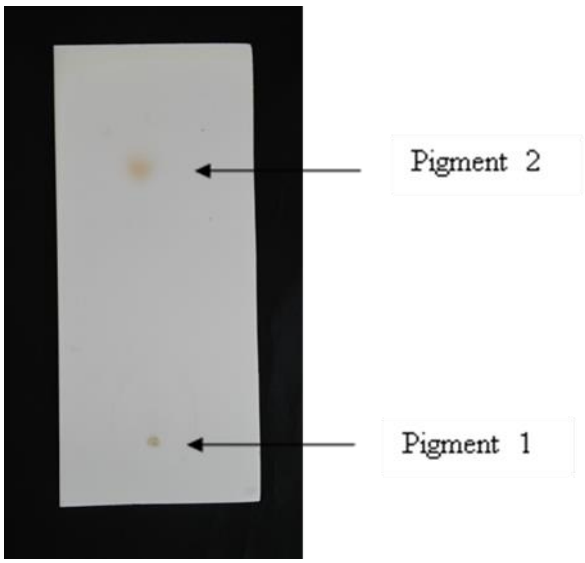


Fig.9 TLC analysis of photosynthetic pigments of Isolated PNSB

**Table 10** TLC analysis of photosynthetic pigments of isolated PNSB

| | |
|---|---|
| Distance from origin migrated by solvent | 7 cm |
| Distance from the origin migrated by a compound | |
| ○ Pigment 1 | 2.8 cm |
| ○ Pigment 2 | 6 cm |
| $R_f$ value for | |
| ○ Pigment 1 | 0.4 |
| ○ Pigment 2 | 0.85 |

## DISCUSSION

Main objective of this pilot study was to identify and characterize purple non sulfur bacterium – *Rhodomicrobium vannielii* by morphological and biochemical characteristics. Results of this study generated more information on the physiology and biochemical characterizations that are specific to this genius and species. The identification of this bacterium from the environment as a member of non-sulphur purple bacteria was based on its morphological, physiological, and biochemical analysis. The results suggested that isolate has similar characteristics of *Hyphomicrobiaceae* family (Staley et al. 1989).

PNSB are phototrophic, anaerobic, and also grow on citric acid cycle intermediates, especially malate, that differentiates them from other organisms ( Fig-?). Malate is the only organic carbon source that is utilized by non sulfur purple bacteria (Tayeht and Madigan 1987). GMM which is selectively

enriched for purple non sulphur bacteria contains malate. PNSB oxidize malate to oxalacetate using NAD-specific malate dehydrogenases (MDHs) enzyme.

Purple sulfur bacteria (PSB) such as *Chromatium* species lack MDH, but convert malate to oxalacetate through the combine activities of malic enzyme and pyruvate carboxylase (Tayeht and Madigan 1987). Having different enzymes for similar reactions clearly differentiates PSB from PNSB. The isolates of current work further confirmed using morphological characters as PNSB as they were Gram-negative rod-shaped non-endospore, motile, non-slimy, single bacterial cells without orderly arrangement and lack of intracellular sulphur globules. Formation of small, irregular, deep red colored colonies with entire margin and smooth surface on agar medium and with other morphological characters confirmed that isolates shares general characteristics with the genus *Rhodomicrobium (*Whittenbury and Dow 1977).

Since *Rhodomicrobium vannielii* (RV) is the sole species of *Rhodomicrobiu*m genus (Staley et al. 1989) and according to the morphological and biochemical characteristics, the isolated species was presumptively identified as the RV.

The isolated strain formed photosynthetic pigments when grown under anoxygenic phototrophic conditions which is a characteristic feature of this organism. Absorption spectra of cells had three major peaks at 363 nm, 476 nm, and 774, indicating the presence of bacteriochlorophyll *a* and carotenoids which is a unique feature of this genus (Herbert 1976). Carotenoids pigments were from spirilloxantin series since absorbance peaks were at 363 nm, 476 nm, and 774. There were no absorption peaks for bacteriochlorophylls *b* and *c* (660–668 nm) which in turn confirms the characters of the genera that the isolated belongs. The presence of photosynthetic pigments was further evidenced with the results of TLC. Based on the previous literature $R_f$ value of 0.40 and $R_f$ of value 0.85 represented bacterialchlorophyll and carotenoids respectively (Selvakumar and Dhevendran 2011).

Growth of isolate was further observed as optical density (OD) at wavelength of 660 nm using different temperatures and pH. Neutral pH was preferred by isolates as the RV, since the pH of the places where these organisms naturally grow is neutral.

Acedic or alkaline environment will denature the intracellular enzymes as well as will change the cell structure (Ozdemir and Kelly 2010). Previous work also indicated that low or high pH will change the structures of the carotenoids too (Ainon H et al. 2006). The results also confirmed the neutrophilic and measophilic nature of the isolate since the optimum growth was at 30 $^{o}$C. Higher temperature and lower temperature reduce the bacterial growth and pigment production, however, RV have been isolated from hot springs (Ainon H et al. 2006). This suggests that RV has not been characterized fully. The studies related to the *Rhodospirillum rubrum* and *Rhodobacter sphaeroides* have been revealed that both organisms increased their cellular bacteriochlorophyll contents with increasing temperature (Roodyn 1981) which was not observed for isolates at current work.

Research indicates that staining and microscopic observation provides evidence related to bacterial morphology, Gram reaction, structures such as endospores and genus/species information of particular bacterium. However, to identify the information related to metabolism, biochemical testing is required. Biochemical reactions are unique for each and every bacteria because it provides the information of DNA codes for enzymes of protein synthesis which is important to catalyze various chemical reactions (Madigan et al. 2000).

There are no available data on studies of exoenzymes of the genus *Rhodomicrobium* from previous studies. This study found that genus *Rhodomocrobium* lacks exoenzyme such as gelatinase, amylase, lipase and lecithinase (Table 4). Gelatinase allows the organisms to break down gelatin into smaller polypeptides, peptides, and amino acids that can be utilized by the organism (Balan et al. 2012). Once the organism break down gelatin, the areas where the organism has grown will remain liquid, which was not observed in current work. Amylases are a class of enzymes that are capable of digesting the

glycosidic linkages in starch (Nath and K.V. 2015). If Amylases are present in organisms, they secrete out the enzyme and produce glucose and maltose by breaking down starch, in starch added culture medium. Having starch in the culture medium, confirmed the absence of amylase enzyme in isolates.

Lipases break down lipids (fats) into fatty acids. Tributyrin oil is a type of lipid called a triglyceride (E Mobarak-Qamsari et al. 2011 ). Isolates which were identified as RV did not hydrolyze Tributyrin oil indicating isolates were lack of Lipase exoenzyme. Bacteria which compose Lecithinase enzyme have ability to destroy animal tissues including humans. Bacterial lecithinases break down lecithin into an insoluble diglycerides (Prakasam et al. 2011). Isolated RV did not show enzymatic digestion of lecithin demonstrating absence of lecithinase enzyme as well. Detection of endoenzymes (Table 3) such as catalase, cytochrome C oxidase, tryptophanase and nitrate reductase by growing isolated RV on relative culture media and reaction with particular reagent demonstrated the presence of all these endoenzymes. Positive results for indole test and nitrate test is a suggestive of the existences of tryptophanase and nitrate reductase enzymes for the isolated RV. Most PNSB have the ability to grow as chemotrophs under dark conditions (Ainon H et al. 2006). Previous study has been observed that members of PNSB contain nitrate reductase and it serve as the terminal electron acceptor in respiratory pathway by replacing oxygen (Okamura et al. 2009). Although, the presence of catalase and cytochrom C oxidase in *Rhodomicrobium* has been identified by previous studies (Staley et al. 1989, Whittenbury and Dow 1977), ability of producing tryptophanase and nitrate reductase of genus *Rhodomicrobium* were not identified previously. Presences of these tryptophanase and nitrate reductase indicate their ability of utilizing tryptophan amino acids and nitrate in their cellular activities while having negative results for glucose and citrate utilization test confirmed the inability of genus *Rhodomicrobium* to utilize glucose and citrate in their cellular metabolisms.

*Rhodomicrobium* species growing photosynthetically require an electron donor, a terminal electron acceptor, and a source of cell carbon (Whittenbury and Dow 1977). Organic acids; pyruvate and succinate were used while benzoate and citrate were not. In sugar utilization; sucrose and D-xylose were used while fructose, glucose, mannitol, mannose and sorbitol were not. The results are similar to the substrate utilization ability of *Rhodomicrobium vannielii* mentioned in Whittenbury R and Dow CS and Bergey's Manual of Systematic Bacteriology. Current study also further observed capacity of utilizing arabinose, cellobiose, galactose, glycogen, Inulin, maltose, melibiose, raffinose, rhamnose, ribose, salicin and trehalose by isolates of RV which was not reported previously. Identification of ability to utilize non digestible carbohydrates by human such as arabinose, cellobiose, inulin by isolated RV is a novel. Therefore, this study will be extending to identify their capacity to form short chain fatty acids such as acetate, butyrate and propianate from arabinose, cellobiose, and inulin and to determine the mitochondrial DNA (mtDNA) content in relation to their nuclear DNA (nDNA) content.

Their ability to utilize those energy sources permits PNSB to occupy such ecological niches effectively (Welsh et al. 1998). Even though RV unable to use glucose and fructose directly, glucose and fructose moieties of maltose, sucrose and trehalose utilization indicate that this strain may be impaired in glucose transport rather than glucose and fructose metabolism (Fig. 10).

## CONCLUSION

The preferred growth media of *Rhodomicrobium vannielii* is simple electron donors and carbon sources. Pyruvate may be the best, but other substances such as acetate lactate, intermediates of citric acid cycle and malate also serve as favored carbon sources. Studies have yet to reveal the metabolism of newly identified enodoenzymes, sugars, and organic acids which will help to identify RV using quick and simple methods. Study further suggests that presence of RV should be confirmed apart from traditional morphological and biochemical testing using newly identified endoenzymes, sugars and organic acids.

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# A STUDY TO FIND OUT THE REASONS FOR THE DEGREE OF STUDENTS' PREFERENCE OF THE BILINGUAL EDUCATION SUBJECTS IN THE NATIONAL SCHOOLS OF THE NORTH CENTRAL PROVINCE

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**ABSTRACT**

Bilingual Education (BE) prepares individuals to function in a global society, which has become a cornerstone of education in the twenty-first century. The North Central Province (NCP) in Sri Lanka possesses a 2963 of a BE student population and a 181 BE teacher population. One of the researcher's previous surveys highlighted the English Language (L2) errors and mistakes made by the BE teachers and also Mathematics as the most preferred BE subject of the students. This study examines the possible reasons for the students' preference and at the same time the reasons for the less preference of BE subjects. The study is based on a complex analysis which consists of web pages, questionnaires distributed among 50 BE students in the North Central Province, the written documents of 20 selected Bilingual Education teachers, classroom observations and interviews. The data was collected and analyzed manually using Microsoft Office Excel 2007. The findings suggest that the reasons for the preference of BE subjects are the questions asked in the question papers are clear enough; the language used by the teacher in the classroom is clear; the notes given by the teacher are clear and could be understood and the teaching methodology is good. In contrary, it also proved the reasons for the students' less preference of the BE subjects: the lesson taught in English is not understood; the question papers given cannot be understood; the pronunciation of the teacher is very poor and some words written on the blackboard are not found in dictionaries.

***Keywords: Bilingual Education (BE), English Language (L2), Government schools, North Central Province (NCP)***

## 1. INTRODUCTION

Bilingual Education (BE is an educational programme in which both a child's native language and the second language (L2) are taught as a subject matter and used as the media of instructions for academic subjects. BE has been introduced to the Sri Lankan Education System in 2001 under the Amity School Project as English Medium Education. North Central Province which has 768 schools provided the first English Medium pupil who ever sat the GCE (O/L) Examination from the Sri Lankan Government schools in 2007 from A/Mihintale MV. In 2001, English Medium Education was established in 28 schools in the province and in 2008, 198 pupils sat for the GCE (O/L) Examination with the result of 100% admission to GCE (A/L). This made a new trend in education and as a result the number of pupils increased. At the same time, English Medium for all streams in GCE (A/L) has been introduced in two national schools in 2007, with the Circular No. 2007/05. All the schools were renamed as Bilingual Education (BE) Schools. Currently, BE in the North Central Province is implemented in 32 schools with a student population of over four thousand, facilitated by approximately one hundred and seventy teachers. Majority of the BE teachers (BETTs) are Diplomats from the National Colleges of Education (NCOE). Some are the Graduate English Medium Teachers while there are monolingual subject teachers and the English Language teachers, who still engage in the teaching-learning process of the BE learners.

One of the previous studies of the researcher made the chance to identify the errors and mistakes done by the BE teachers in the use of English Language (L2). It clarified that the current English Language proficiency of the BE teachers of the government schools in NCP does not help to facilitate the students in their subject matter. The same study highlighted a special students' preference for Mathematics out of all the subjects learnt n BE. This study was carried out with the objective of finding out the possible reasons for students' preference or the less preference and to make the stakeholders aware of the current needs and to increase the teachers' professional development.

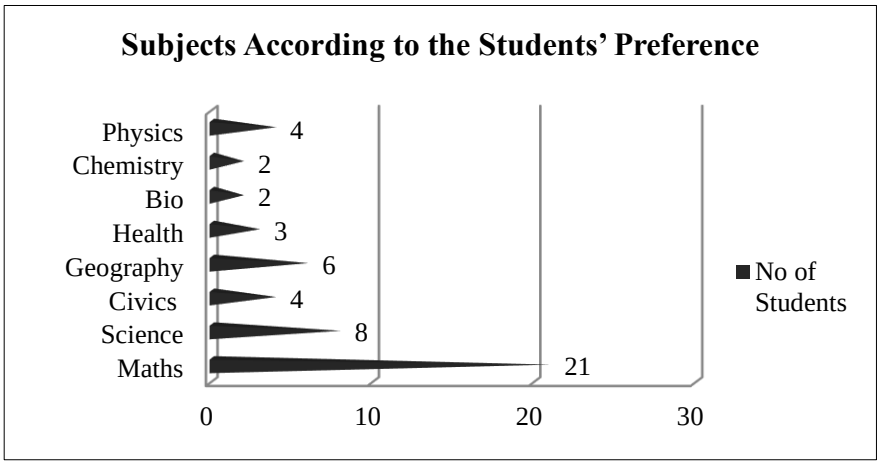
## 2. METHODOLOGY

For the collection of primary data qualitatively and quantitatively, after getting the permission of the relevant officials, questionnaires were distributed among 50 BE students from grade eight to thirteen selected randomly from 05 selected schools (simple random sampling) covering both Anuradhapura and Polonnaruwa districts. Pre-tested structured interviews were conducted with the BE students, BE teachers, Provincial Coordinator and the Zonal Coordinators of BE in the NCP and also with the help and under the guidance and the supervision of the relevant officials, translated past papers and the lesson plans of some BE teachers were observed to make the data from the questionnaires clarified. Secondary data was obtained with the reference to a number of books, journal articles, web pages and study reports done by the scholars and stakeholders. Data was collected and analyzed manually with MS Excel 2007 and is presented using graphs. Data output is central to statistical analysis and is an integral part of the study.

## 3. ANALYSIS OF DATA AND FINDINGS

The data presented in this section was obtained by the questionnaires distributed among 50 BE students, who were chosen randomly from 05 schools of NCP for the research. They were given one choice to be selected out of several choices.

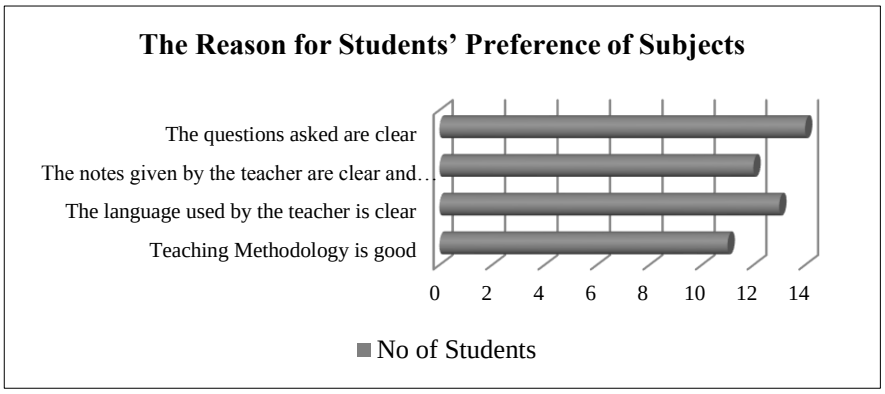
### 3.1. The Subjects Studied in BE According to the Students' Preference




**G.3.1. The Subjects Studied in BE According to the Students' Preference**

Out of the 50 BE students, 21 students have marked Mathematics as the subject that they like to study in BE. Through the discussions done with the researcher with the students helped to sort out the reason for their preference is that the language used in the subject is less. It is obvious that the number of students those who have selected the other subjects is less than ten for each.

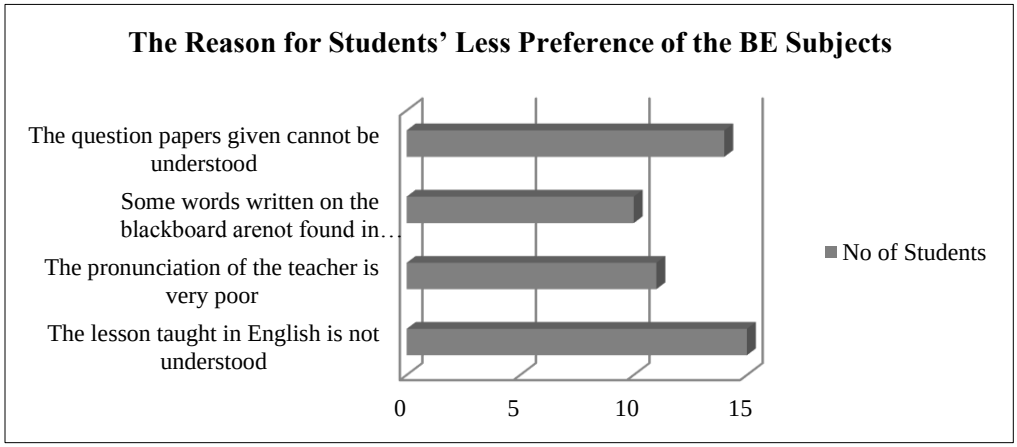
### 3.2. The Reason for Students' Preference of BE Subjects




**G.3.2. The Reason for Students' Preference of BE Subjects**

Out of the 50 questionnaires, 11 stated the reason for their preference is the methods used in teaching the subjects in English are good. 13 students have stated the reason for their preference as the language used by the teacher is clear. The reason that the notes given by the teacher are clear and could be understood is selected by 12 pupils while 14 have stated the questions asked on the exam papers are clear.

### 3.3. The Reason for Students' Less Preference of the BE Subjects




**G.3.3. The Reason for the Students' Less Preference of the BE Subjects**

Out of the 50 questionnaires, 15 stated their reason for the less preference as the lesson taught in English is not understood. 11 have stated the pronunciation of the teacher is not clear enough, and 10 pupils have stated that some words used and written on the blackboard are not found in dictionaries, while 14 have stated their reason as the questions asked in the exam papers cannot be understood.

## 4. DISCUSSION

### 4.1. Bilingual Education (BE)

Bilingual Education (BE) means a total educational approach with total curriculum development approach where minimum two languages of different political positions in a given society are used as media of instructions to teach prescribed non language subjects with government intervention in a given curriculum. The Encyclopaedia defines "BE refers to an educational programme in which both a native language and a second language are taught as a subject matter and used as media of

instructions for academic subject/s." It is defined as a system of education in which, at a given moment of time and for a varying amount of time, simultaneously or consecutively, instruction is planned and given in at least two languages. In their book, Bilinguality and Bilingualism, Hamers J. and Blanc M. (1989) mentions "yet L2 teaching (In addition to that there may be some other local or foreign languages under various titles. Accordingly they are used in various social contexts) may be a part of bilingual education programme." In the US Congress Amendments Act (1974), it is stated "it is instruction given in, and the study of English (to the extent necessary to a child to progress effectively through the education system) the native language of the children of limited English speaking ability; and such instruction is given with appreciation for the cultural heritage of such children and ( with respect to elementary school institution) such institution shall 9 to the extent necessary) be in all courses or subjects of study which will allow a child to progress effectively, through the education system." According to the International Handbook for Educational Change (2005), Jim Cumming in the Language Issues and Educational Changes asks when students lag behind in first language proficiency, they also lag behind in academic achievement and intelligence test scores despite their abilities in their own language. Failing to address the issues of linguistic diversity effectively leads to capitalize on children's academic potential. Different countries practice different policies of BE to suit their own goals, socio cultural aspects, cognitive aspects, psychological aspects, intercultural aspects and political aspects. These areas have to be addressed by the BE of a country. In this programme, students receive part of their instructions through the medium of a second language and partly through their first language. Basically there are three instructional models used in the BE as transitional, development and immersion. The taxonomy developed by Fishman and Lovas (1970), in a socio linguistic perspective has been identified as more satisfactory when concerning various types of BE.

### 4.2. Bilingual Education in Sri Lanka

Early history of Sri Lanka proves her to be a host for many invasions revealing her to flourish literacy with mix cultures. Bilingualism and Bi-literacy has been practiced in the country beyond 3rd BC. In introducing Buddhism to the country, Pirivena Education system used Pali, Sanakrit with Sinhala as media of instructions. During the Portuguese period medium of instruction at schools were Portuguese. 'Predikants' (Fully qualified preachers from Holland) realised the value of mother tongue as the medium of instructions at school during the Dutch period of Sri Lanka. British period shows many changes and discussions under many commissions. During this period the government considered English as a common language and as a link language to both Sinhala and Tamil educated personnel. The historical events prove the use of BE in Sri Lanka which fulfilled many of her goals for centuries. After 1956, many curriculum changes took place. As a result in 2001 BE was introduced to study A/L Science subjects in English medium and the grade six class learners were given the opportunity to learn a few subjects in L2 and the rest in LI. Yet both practices have been targeted promoting English as a link language for instrumental purposes within the Sri Lankan context, but still the misleading term 'English Medium Education' was used. Though it has different meaning to different people, BE involves learning a second language. Out of the recent educational policies in Sri Lanka, bilingualism and practice of BE have been first proposed by the National Education Commission in its report published in 2003. According to the NEC Report on the proposal in 2003, Bilingualism should be promoted by using English as the medium of instruction in selected subjects such as Mathematics, Science, Technology including Computer Literacy, Social Science in the secondary grades, year by year from Grade 6, depending on the availability of teachers. It is expected that students will reach an acceptable level of proficiency in English at the end of junior secondary education without jettisoning Sinhala and Tamil which will continue to be the medium of instructions in selected subjects. After this policy document, no clear policy level statement has been introduced, other than the circulars which have been issued by the School Affairs and Private School Branch of the MOE as Cir. No. 2002/12, Cir.No.2002/17, Cir.No.2003/18, Cir.No.2003/28, Cir.No.2008/12, Cir.No.2008/43 Cir.No.2010/7 and ED/01/12.01/10/13. When referring to the statements of the NEC, it is evident that BE has introduced at the school level for the learner to improve the proficiency in English. At the same time the BE learner has to overcome two challenges: learn subject matter in their L2 or the foreign language, and at the same time to learn the target input

under each subject. Majority who deal with BE pays less attention to the language aspect. Even in Sri Lanka it is the same but; BE is identified and used as a suitable approach to curriculum development wherever a language of utmost necessity should have to develop with a familiar language of the community. If not the L1 would become a dead language. In Sri Lankan context, both L1 and L2 are expected to be developed in various degrees depending on the developmental stages of a child's, developmental stages of language and cognition – maturity parallel to language enhancement through language transfer. Therefore, in Sri Lanka the target is balanced bilingualism with additive aspects. The recent NEC (National Education Commission) changes helped the BE learners to strengthen their abilities and their families to climb up the social ladder without any hesitation who are much proficient in English language. This result paves the path to create an environment for providing education for cultural diversity and ethnic harmony. This serves to bring an atmosphere for fostering a generation who can be politically conscious of the multi ethnic character of the Sri Lankan society, which in turn contributes to social cohesion and national integrity. BE widens the horizons of the students. They look into the problem with different perspectives. Hence, BE can go a long way to achieve national goals of Sri Lanka.

### 4.3. Bilingual Education in North Central Province

Introduction of English Medium in the Sri Lankan Education System generated much criticism among every social stratum in urban, semi urban and rural areas in the country. As a result, the first student to sit for the G.C.E.O/L from English medium in 2007 was from A/Mihintale M.V. In 2001, NCP started English Medium Education in 24 schools under the Amity School Project both in Anuradhapura District and the Polonnaruwe District. At that moment no English Medium teachers were working in the system and no steps were taken to produce English Medium subject teachers. Therefore, the subjects proposed were taught by English language teachers, graduate teachers and monolingual subject teachers who were capable of giving instructions in L2 of the learners in the classroom teaching learning process. The first group who ever sat for the G.C.E. (O/L) in 2008 received a hundred percent of results. Results proved implementation of English Medium to be a successful attempt but, it was already implemented as BE in the year 2007 by circulars. Few learners undergo BE in their A/L in two schools in NCP. A/Central College and A/Kekirawe Central College provide Science, Maths, Arts and Commerce streams in BE. In 2013, there were only 18 BE schools in NCP. Compared to 2008 the BE population of learners and the teachers have increased. In 2013 necessary strategies were taken to uplift the situations and as a result in 2014 there were 27 schools of BE in the NCP. These 27 schools represent all the types of schools in the education system at the moment. These learners represent Sinhala and Tamil as their L1. They belong to urban, semi urban and remote areas of the NCP. The female learners of BE is greater than the male population. Most of the parents are government servants and at the same time some are farmers, army personals and trishaw drivers. Not only in their subjects, even in other extracurricular activities the BE learners show their talents. The province is benefitted with about 130 teachers of BE; diplomats from the National College of Education, Graduate English Medium teachers, monolingual subject teachers and English Language teachers. There are 8 Zonal Coordinators and a good resource pool specially trained for BE and CLIL (Content Language Integrated Learning) by the Ministry of Education and the NIE. Most of the teachers have undergone the workshops on BE and CLIL. They apply their pedagogy on BE and CLIL in their classroom learning situations. By now, it has increased up to 32 schools with over 4000 student population and a teacher population of over 170.

## 5. CONCLUSIONS AND RECOMMENDATIONS

### 5.1. Conclusions

In conclusion, the findings of the study proves that the BE students prefer the subjects that are taught with less usage of English Language (L2) by the BE teachers, creating a question, whether the English Language (L2) proficiency of the BE teachers in the Sri Lankan Government schools of the North Central Province (NCP) helps to facilitate the students in their subject matter.

### 5.2. Recommendations

The findings and results of the research highly recommend that the trainees, who enter the NCOE, should at least possess a credit pass for English Literature at the GCE (O/L) Examination; the graduate teachers, who are recruited to the system as Bilingual Education teachers should possess a Distinction for English at the GCE (O/L) Examination or a Very Good Pass for English Literature at the GCE (O/L) Examination. Especially, the internal supervision has to be continued weakly, while providing the BE teachers with language improvement programmes on English. It is also recommended that they should be exposed to similar situations in other provinces or in other setups to understand and to recognize the mistakes and the errors that they produce. On the other hand, forums should be organized to make the Bilingual Education teachers aware that they should change.

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# PERFORMANCE EVALUATION OF VEGETABLE OIL BASED METAL WORKING FLUIDS (MWFS) IN FLOOD AND MINIMUM QUANTITY LUBRICATION (MQL) TECHNIQUES – REVIEW

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**Abstract**

The Metal Working Fluid (MWF) which commonly known as the cutting fluid plays a significant role in metal machining operations to facilitate a favorable condition for the cutting parameters. The integrated functions of the MWFs comfort the machining operation for a better quality of the final product. Hence, the economic value of the cutting operation increases due to the reduction of the cutting forces and power consumption. The cooling medium and the method are considered as the one of the most critical elements for the better performances during metal machining. Variety of cooling mediums and methods are used during the metal machining operations, but most of the techniques and practices pose considerable issues and problems. This paper discusses the related performance of the methods in term of flood cooling and Minimum Quantity Lubricating (MQL) while considering the cooling mediums as mineral oil and vegetable oil.A series of suitable vegetable oil based MWFs are discussed with the permitted additives for the enhancement of the performances while comparing related parametric values of the work-tool interface temperature, chip formation, surface quality and tool wear with mineral oil based MWFs. In addition, the importance of the usage of health and environmental friendly MWF has emphasized. Almost all the parametric values expressed the better results for the MQL while using the cooling medium as vegetable oil based MWFs in range of low to high speed metal machining.

***Keywords: Metal Working Fluids, Flood Cooling, Minimum Quantity Lubricant, Vegetable oil, Mineral oil***

## Introduction

A Metal Working Fluid (MWF) which is known as a lubricant or coolant plays a major role in machining process [1]. Lubricating the cutting process or cutting tool-work piece interface primarily at low cutting speeds, prevents the cutting zone from blocking chips and cooling the work piece at high cutting speed, can be indicated as the primary functions of a MWF [2, 3]. Additionally, it derogates the corrosion of machined surface, enabling part handling by cooling the hot surface, reduces thermal deformation of work piece and provides longer tool life and better surface finish [1, 4]. Conventional mineral oil based cutting fluids cause to create various environmental and technical problems such as water pollution and soil contamination during disposal, environmental infection caused by chemical disassociation of MWF at high cutting temperatures and biological issues to operators [5]. In mid 1970s or earlier, the cancer cases were recorded with the use of mineral oil based MWF at that season. Furthermore, operator's skin, lungs, pancreas, bladder and etc. may be affected by chemicals used in the MWF. Cost of the cutting fluids also higher due to appropriate properties than those related to cutting tools [6]. Effectiveness of the machining process is depending on quality

of the cutting fluid. The effective lubricants with more additives to improve the quality and it will be increased the cost also.

Due to unique properties like biodegradability, renewability and its adequate performance in wide range of applications, vegetable oil based lubricants provide significant environmental benefits than the mineral oil based lubricants [6]. But the cost associate with vegetable oil based MWF, can't directly compare with mineral oil based MWF. Because it depends on the additives and the lubrication method use while machining.

The flood cooling or the most common conventional cooling method is less effective methods due to lack of cooling and lubrication of the cutting tool-work piece interface with increasing cutting velocity and feed rate. The MWF cannot reach the interface properly due to massive plastic contact in between chip and tool rake surface [7]. To achieve the more efficient machining process, reduce the cost of machining and create environmental friendly vicinity, the industries were focused on cooling methods which can minimize quantity of cutting fluid using while machining [5]. The alternative cooling techniques such as High Pressure Coolants (HPC) [8], cryogenic cooling [9], solid lubricant [10], air/vapor/gas as coolant [11] and Minimum Quantity Lubrication (MQL) or near dry cooling machining (NDM) [12], were identified as more effective techniques than conventional methods. But when compare the performances and drawbacks of above mentioned techniques, MQL technique using vegetable oil based MWF was identified as the most efficient cooling method [5].

**Vegetable oil based MWF**

Due to growing of responsible environmental and energy saving issues with use of conventional mineral oil based MWF [13], vegetable oil based MWF were become unique solution for industrial applications [6]. The use of natural oil based lubricant has a history ago 1650BC. Different types of natural oil obtained from palm oil, olive, caster beans, rapeseed and fats from animal hard, wool grease and sperm whale were used from the time of AD 50 until the early 19$^{th}$ century [14]. Those natural oils had limited stability. Therefore the industrial revolution needed inexpensive, thermally and oxidative stable lubricants in late 18$^{th}$ and 19$^{th}$ centuries. Therefore in around 1930s the synthetic lubricants were developed [14]. Those synthetic lubricants had presented optimal characteristics as cutting lubricants [15]. Then the vegetable oil has come into attention than synthetic esters due to less expensive, biodegradability, availability from renewable sources [14], relatively non-toxic, low emission of hydrocarbons [16] and consists primarily of triglycerides structure which can serves the best functions as lubricant [17].

Palm oil, castor oil, canola oil, soybean oil, rapeseed oil, coconut oil, sunflower oil and jatropha oil and etc. are the most common base oils use to develop vegetable oil based MWFs [1, 16]. The esters of glycerol and fatty acids which is having less molecular weight are the two main constituents in vegetable oil. Those fatty acids and polyol esters are extracted from vegetable oils and hive after categorizing according to the carbon percentage. Palmitic acid (C16:0), Stearic acid (C18:0), Oleic acid (C18:1) and trimethylolpropane (TMP), neopenthylglycol (NPG), pentaerythitol (PET), can be identified as most commonly used fatty acids and polyol esters. Within above mentioned most commonly used vegetable oil is palm oil. Due to its wide range of fatty acid components from C12 to C24, it gives superior benefits in the biofuels and bio-lubricants production [18]. But the oxidative degradation resistance of coconut oil is high, because it contains more than 90% saturated fatty acids [19]. Vegetable oil give more advantages than petroleum oils such as high lubricity, high load carrying capacity, low volatility, low emission of hydrocarbons, good thermal properties, good solvency and higher fire resistance [16].

But vegetable oils couldn't directly use as lubricants in their natural. Because it has low temperature characteristics, weak thermo-oxidation stability and tribochemical degrading process which lead to occur metal corrosion close to the machining surface [16, 20]. Whatever fluid which can stand as cutting fluid if it has unique properties such as high decomposition or oxidation temperature, should not froth or smoke arrogating, must not be gummy and should not act as a contaminant which changes

the properties of lubricants used elsewhere in the machine. Otherwise it may cause to ecological or health issues [21]. Therefore in order to convert vegetable oils into MWF having pre-explained properties some additives should be added [6, 20]. Anti-wear agents, corrosion inhibitors, friction modifiers, viscosity modifiers, dispersants, antioxidants and etc. are the available additives which improve the performance of the base fluid [14]. And also some researches were conducted to identify the superior performances of vegetable oils after adding particular additives. For an example, dibutyl 3.5-di-t-butyl 4-hydroxy benzyl phosphonate (DBP) was shown superior anti-wear performance [22], zinc diamyl dithiocarbamate (ZDDC) and antimony dialkyldithiocarbamate (ADDC) were used to investigate about low temperature and oxidation stability of different types of vegetable oil based MWFs [23].

**Minimum Quantity Lubrication (MQL)**

Minimum quantity lubrication (MQL) or micro lubrication or near dry lubrication, is a lubrication technique of applying fine mist of oil instead a flood of MWF [7, 24]. Through the exploration of researches it was found that typical flow rate MWF is 50-500ml/hour in MQL and which is larger reduction of use of MWFs when compared flood cooling [7, 25]. In the MQL system, the MWF should be supplied at high speed and high pressure to the cutting zone. Therefore at first the MWF should mix with compressed atmospheric air. The process of mixing of MWF and compressed air can be achieved externally via inside the mixing chamber or internally via inside the nozzle or tool spindle. According to the type of feed or delivery, the MQL system can be categorized into two groups which are external distribution through a nozzle and internal distribution through the tool. Both internal feed and external feed systems have number of advantages and disadvantages. For an example external feed system needs low investment cost but it has limitations in some machining operations like drilling, taping and reaming. In internal feed system, it gives optimal lubrication at the cutting point but it requires high investment cost [2, 25, 26, 27].

The conventional cooling techniques had shown inefficient performances due to disability of reach the real cutting area with gradually increasing feed rate and cutting velocity [7]. It was revealed through experiments that the MQL technique is more convenient for not only low but also high cutting speed and feed rates [25]. In MQL, from machining zone to MWF, the heat is transferred in efficient manner due to increase of cross sectional area of MWF through the evaporation by tiny droplets and forced convection by compressed air [28]. The MQL is a credible technique of cooling/lubrication within industrial applications, because it minimizes the usage of quantity of MWF, machine cleaning cycle time, overall cost of machining, demand of infrastructure facilities, environmental pollution, ecological and human health issues [24, 28, 29]. At the same time it has improved machining performances like cutting force, feed force, surface roughness, tool wear, chip thickness ratio and cutting temperature [7, 28, 30].

**Experimental Investigation**

To consolidate the importance of vegetable oil based MWF in MQL, number of experiments had conducted using different kind of metals and alloys. An experiment conducted based on turning operation of AISI 9310 alloy had shown best performances when compare with dry and flood cooling environment. The average temperature at chip-tool interface was reduced by 10% in MQL system which used food grade vegetable oil as MWF, than wet machining. When consider about the chip formation, the pattern of chip produced was shifted from ribbon type to less tubular type continuous chips with respect to the feed rate changes from low to high, under both dry and wet conditions. But turning under the MQL technique the pattern of ductile chips was not changed and back surface of those chips had brighter and smoothed appearance. It indicates that MQL had provided satisfactory chip-tool interface and reduction in build-up edge formation. Furthermore it had proved that the growth rate of flank wear was reduced and therefore tool life or productivity was improved at extreme values of feed rate and cutting velocity. Beside that most common metal reactions can be occurred during the machining like abrasion, adhesion and thermal sensitivity wear are delayed in MQL than

wet and dry machining. Therefore it reduces deep grooving. It was investigated that the reduction of tool-tip damage and wear caused to improve the surface finish of work piece [31].

The performance of palm, coconut, sesame and olive oil based MWFs were evaluated under MQL technique by assessment of surface roughness and surface integrity of AISI 316 stainless steel in drilling process. Within aforementioned MWFs, the cutting fluid which used coconut oil as base fluid had lowest viscosity value of 0.196P. Therefore it had reduced the heat generated during the machining. The specimen had shown that the least amount of micro cracks was appeared on the metal surface which used coconut oil as MWF. At cutting speed of 12.192 m/min, depth of cut of 23mm, feed rate of 54.8 mm/rev and spindle speed of 456.56 rev/min, the coconut oil lubricated drilled holes were given lowest surface roughness value and best performance compared with other MWFs [17].

Another development was occurred through the examine of effects and mechanisms using rapeseed oil based MWF under MQL machining of aluminum alloy during turning process. In here the machining performance in terms of cutting force with reference to specific cutting parameters under MQL was compared with oil in water (O-in-W) condition. At cutting speed of 200 m/min and feed rate of 0.05 mm/rev, the cutting force was increased from 700N to 750N for the some range of cutting length ratio under O-in-W condition while increase in cutting force was from 810N to 1200N under MQL condition. It was fertilized that increase of cutting force under MQL condition (32%) was higher than that of O-in-W (6.6%) [5, 29].

There was another experimental investigation where palm oil had shown better performance than synthetic ester under MQL condition. The palm oil under MQL condition was induced the lowest torque where it was indicated the 32% reduction in toque at 100 m/min value of cutting speed, 0.1 mm/rev value of feed rate while cutting speed increased from 60 to 100 m/min. Beside that it had given the lowest temperature and tool wear than synthetic ester under MQL, air blow cutting condition and flood cooling at low cutting speed than MQL which was 60 m/min and at same feed rate of 0.1mm/rev [32].

Through exploration of another experiment it was identified that MWF which used vegetable oil as base fluid in MQL machining had shown better performances than compressed air, flood and dry machining. In here machining performances of aluminum alloy (ACP 5080 plate) of Brinell hardness of 85 under different machining conditions were evaluated. Machining under both MQL (vegetable oil based MWF) and flood cooling had shown better recession in torque than compressed air and dry machining. But when consider about the surface roughness the flood lubrication had given 76.4% improvement while in MQL it was 11.5% [33].

In 2010, the best performance of micro milling machining of SKD 61 steel by using vegetable oil based MWF in MQL technique was investigated. This experiment had two stages. In the first stage machining under MQL was compared with dry machining to identify the performance in terms of surface roughness, burr formation and tool wear. The deviation of tool performance with respect to oil flow rate, tool material and air flow rate in MQL machining was studied in second stage. There was an excellent improvement in tool's life under MQL condition than dry machining at different feed rates. It was observed that, valuable improvement in reduction of tool flank wear under MQL condition compared with dry cutting. The tool flank wear reduction, after cutting 96 mm long, under different feed rates are shown in table no.01.

Table 5: Improvement in tool flank wear reduction under different feed rates

| Feed rate (µm/rev) | 1.0 | 1.5 | 2.0 |
|---|---|---|---|
| Improvements in tool flank wear reduction (%) | 67.65 | 62.66 | 54.59 |

The variation of surface roughness (Ra) under MQL machining was in between 0.1 and 0.2 µm for all cutting lengths and feed rates. But in the dry cutting the Ra value was increased with increasing cutting lengths and feed rates. It is clear that machining under MQL given a better surface finish than dry condition with reference to the increasing cutting lengths and feed rates. When consider about the burr formation, it had formed small burrs in all cutting tests under MQL condition, while larger burrs were formed at small feed of 1 µm/rev and feed rate of 1.5 and 2µm/rev under dry cutting [34].

In 2009, an experiment was conducted to identify the feasibility of using palm oil as MWF under MQL condition. In here hardened STAVAX ESR stainless steel having hardness of 50 HRC was used as work piece. The machining performances of end milling operation were investigated by using TiAlN and AlTiN coated carbide tools as cutting tools. In here performances of palm oil were compared with Fatty Alcohol (Both as MQL mist), dry and wet conditions. At 0.03 mm/tooth value of feed rate and 60 m/min value of cutting speed, the palm oil under MQL condition had shown lowest rate of tool wear compared other cooling methods. The palm oil (MQL mist) had given the greatest tool life of 160.27 minutes while other techniques fatty alcohol, flood and dry machining were obtained tool life of 137.74, 39.86 and 35.16 minutes respectively at same feed rate and cutting speed. Furthermore when machining by using palm oil as MQL mist had obtained largest value of cutting length and which was 35885mm. At the same time the fatty alcohol, flood and dry machining were obtained cutting length of 31788mm, 9099mm and 8057mm respectively. When consider the surface roughness at the initial stage both palm oil (0.73µm) and fatty alcohol (0.69µm) under MQL condition had shown higher Ra values while under both flood and dry techniques those values were 0.15µm and 0.24µm respectively. It had shown the lower surface roughness values at final stage than initial stage in MQL and those values were 0.31µm (palm) and 0.48µm (fatty alcohol). At the same time dry and flood coolant conditions had shown higher surface roughness values than its initial stages (dry-0.54µm, flood-0.72µm). Therefore it was clear that superior surface finish was given by the MQL condition than other cooling techniques at the end of the process. At initial stage of cutting, the MQL had given chips having uniform shape for MQL, dry conditions and in flood cooling it was non-uniform shape. The variation of chip shape from uniform to non-uniform was obtained by the fatty alcohol (MQL mist) while palm oil and dry machining were obtained uniform shape of the chips at middle stage. For both fatty alcohol and dry machining conditions the chip color was changed to brown due to the burning effect, while the original color of chips were maintained by palm oil and flood cooling in this stage. At final stage the uniform shape of chips was maintained by palm oil coolant while the uniform shape of the chips under dry, flood and fatty alcohol were lost due to the negative effect of tool's worn cutting edges [6].

**Conclusion**

The cutting fluids play very important functions during machining operations and have a considerable effect on the machining performances. The vegetable oil based MWFs are elegant potential substitutes for mineral oil based MWFs due less environmental and health issues. The MQL can be considered as alternative to conventional cooling methods and having great improvement in performances. The vegetable oil based MWF in MQL had given better machining performances in terms of surface roughness, tool wear, cutting force, chip formation and temperature of tool-chip interface than conventional cooling techniques. Further it can be regarded as an environment friendly substitute for mineral based MWFs.

**Future works**

Even considerable amount of experiments had conducted by using vegetable oil based MWFs under MQL, high amount of cost for specific additives and less stability of MWF act as main obstacles for its industrial applications. It is supposed to identify the most suitable vegetable oil based MWF for wide range industrial usage through further study of experimental results which relate to vegetable oil based MWFs under MQL. Besides that, it is expected to prove validation of novel coconut oil based MWF under MQL condition, which was developed in Department of Mechanical and Manufacturing Engineering, University of Ruhuna.

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# OPTIMIZATION OF WORKFORCE PERFORMANCE THROUGH SMART HUMAN RESOURCE MANAGEMENT AND INDUSTRY 4.0 CONCEPTS IN THE CONTEXT OF SRI LANKAN APPAREL INDUSTRY

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With the globalization, competition among the firms are rapidly increasing. This rivalry has forced organizations to perform better and retain in the industry. Employee engagement in every field in the organization is vital to enhance the performance. The modern world is in the fourth industrial revolution. Since, the human involvement in the business processes has been at a higher level during the past decades, the new advancement of technology has influenced organizational functions including human resource management (HRM) disruptively. This paper investigates how the new concepts of industry 4.0 can be used to evaluate the necessary skills such as Internet of Things (IoT), Artificial Intelligence (AI), Virtual reality (VR), 4G and 5G wireless communication technology in order to enhance the performance. Smart human resource concepts can be applied from the beginning of recruitment process of the employee. It will reduce both unnecessary time and cost while increasing the performance and efficiency. To implement these concepts to measure the workforce performance, Sri Lankan apparel industry has been identified as one of the key industries since it involves both human and machinery in its processes. This study presents the findings of a comprehensive and systematic review of literature and subsequently presents an innovative model to enable apparel industry to enhance HRM processes using technologies through industry 4.0 applications. The article provides an insight to current state of knowledge available in the respective area and set up the path for future research as well.

***Keywords: Workforce performance, Industry 4.0 application, Smart human resource, Apparel industry***

## Introduction

Beginning of the new revolution of industrialization, there were many functions adhere with the new terms. In this era industry 4.0 concepts are used in cloud based systems, Internet of Things, Virtual Reality, Artificial Intelligence and also 4G and 5G technology for the use of effective management communication purpose (Hecklau et. al., 2016). Human resource management is a vital function in every aspect. Now there is a discussion on how human resource management integrate with those technologies.

This digitalization can be used for HR functions such as recruitment and selection, talent on boarding and off boarding, talent development, training and development (Sivathanu & Pillai, 2018). With the new technological era, it seems that there are conflicts between human and the machines. Many organizations have begun their industrialization with the technology. Technology have been replaced the human by robots. But it is a question that everyone has been asked that how the impact on employee jobs with the new immerging technologies are. Objectives of the research are study the industry 4.0 concepts with human resource concepts, Study the apparel human resource process

improvements with industry 4.0 concepts, to identify the new skill levels required for the workforce and To develop a model to optimize the workforce performance with industry 4.0 concepts.
Without human resource, it is hard to maintain an organization. Especially developing countries like Sri Lanka, there are many things to improve. In this research, mainly focused on how to use industry 4.0 concepts and smart human resource management concepts towards the workforce job performance. There are variables that has identified to deliver the best output such as industry 4.0 application, skill development, job satisfaction and job performance. Apparel industry is an industry where the human interaction is higher. This study suggest the best way to handle the human resource functions integrating with industry 4.0 concepts.

**Method and Materials**

The approach adopted to investigate the selected area through the content analysis. Initial step of the analysis conducted by searching for articles considering the broad domain of the study and it resulted in thirty articles. These articles were screened through its title and abstract and this further screening resulted in twenty six articles. Further they thoroughly screened the content, six out of the twenty six articles were excluded from the study. The full text of each paper was reviewed in order to eliminate those articles that were not really related to the title and the other divided variables. Thus, in total twenty articles were considered into this study. The selection process of the study is shown in Figure 1.The list of references listed on this paper contains all the articles studied.

A comprehensive literature review was conducted with the aim of constructing a framework for optimize the workforce performance and revealing the research gap in the relevant area. The review focused on refereed journal papers and publications. This search was done by electronically using Google scholar, Emeralds and Research gate.

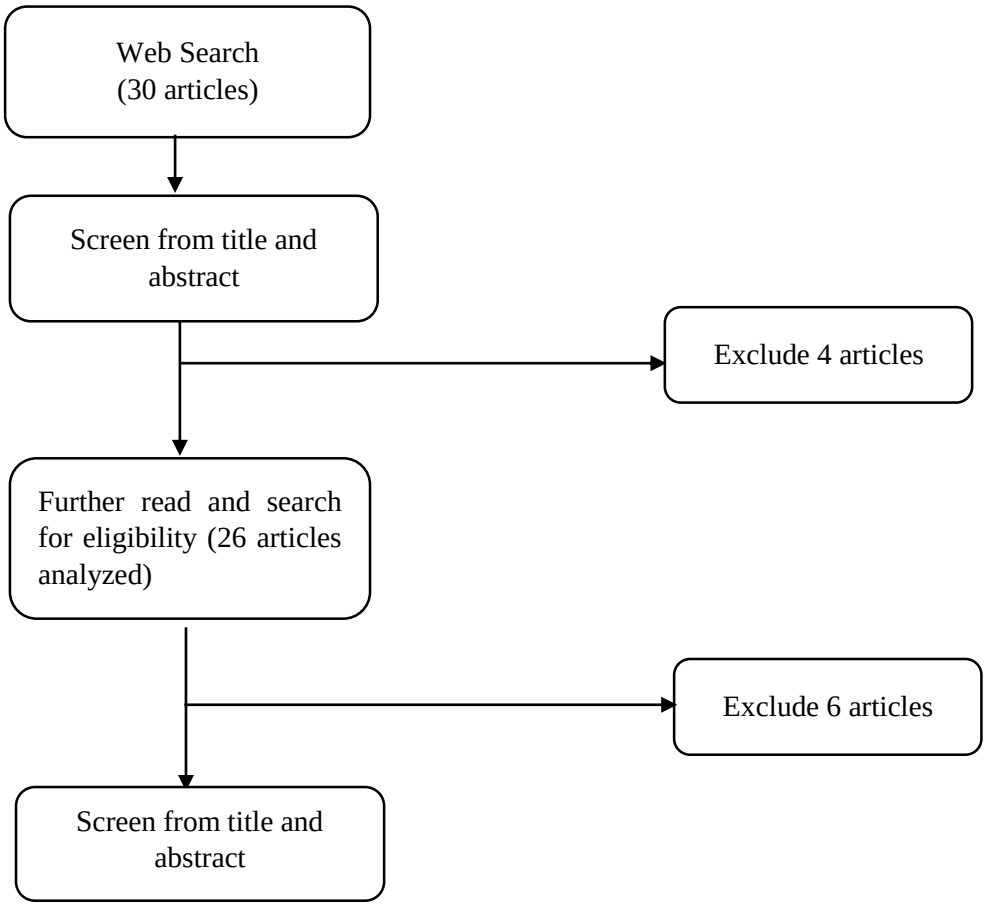


*Figure 1- Selection process of the study*

**Main results of the reviewed studies**

All the articles were taken into consideration in the analysis according to the methodology are presented. Based on the findings of the literature review, there has introduced a conceptual framework in the latter part.

In the 4th industrial revolution, it is concern about the new technologies which are bounded with the new era, such as Internet of Things, Cloud based systems, Virtual Reality, Artificial Intelligence etc. With those technologies Human Resource Management also can be integrated with them.

According to (Shamim et. al., 2016) industry 4.0 is characterized by smart manufacturing, implementation of Cyber Physical Systems (CPS) for production, i.e., embedded actuators and sensors, networks of microcomputers, and linking the machines to the value chain. It further considers the digital enhancement and reengineering of products.

Smart Human Resource is a one of method to overcome traditional organizational HR practices with these new immerging technologies. Industry 4.0 concepts can be used in HR processes beginning with the recruitment to the exit. For an instance new technologies can be used for talent on boarding, talent off boarding and talent development. New revolution has helped to keep the organizational data with the Big Data and AI technologies. To gain the HR practices to the organizations, it is necessary to align with the new technologies and to be a part of the new era. These concepts have been discussed on these papers (Sivathanu & Pillai, 2018; Bhaskar, 2017 ; Renjen, 2018).

Connect to the digital world, real time data is vital. Internet of Things are empowering the physical things to associate the new digital era to enable a massive storage of real time organizational data in a cloud based systems. To fulfil the job requirement AI and Big data help to automate the candidate resume and job description to match the highly capable job profiles for interviews that consume high possibility of fulfilling the necessary job requirements. Augmented reality and Virtual reality would assistance to the new joiners to be guided through the various layouts and culture in the office without reducing time for an induction period. Candidates can learn themselves about the company through this new technology. Furthermore AI can identify the knowledge gaps of each employee based on the skill requirement in the market. Wellness apps and wearable using Internet of Things based smart devices can track the employee wellbeing. When an employee intends to leave the company, it will be tracked by analyzing employee profiles. HR can take immediate responses to remain the employee by awarding more benefits and also it can identify the low performers and can take the necessary steps to improve the performance of employees (Sivathanu & Pillai). There are number of ways to use technology to increase the efficiency of the human resource functions and reduce the traditional time and cost which gain a lot of resources waste due to inefficiency of the most functions.

New skills need to be developed both technical and managerial skills. It is important to identify the current states of the employees and development need areas to implement the necessary requirements. Job designs should be evaluated with the new smart industry concepts and how to adapt those skills (Habraken & Bondarouk , 2017).

Labor hours of a one person is considered as an important fact when it considered under the final outcome of an organization. If the sufficient worker is inefficiency in a work due to the lack of ICT skills, it vastly effect on the organizational goal firstly as individual finally as a group. When decreased the educational level, it increased the losses (Deursen & Dijk, 2014). Therefore skill development is effect on employee performance level.

To ensure the retention of employee jobs, it is needed to have qualify employees to shift their capacities in order to suit the complex job roles (Hecklau et. al., 2016).

Technical skills are very important for first level management and for the executive level, conceptual skills are needed. The study says that it is tolerable to have unskilled people to new management

positions if the critical competencies and new skill levels be identified and the people who promoted newly were developed to improve those skills. To learn totally different skills rather than the previous job roll had, can easily improve for the candidates which have high potential in their jobs. Study revealed that technically competent workers perform well in their new responsibilities (Hawkins, 2004).

Changes of the job complexity will lead employees to expose to new challenges and therefore concentrate on their new skill developments. And also there is a relationship between organizational characteristics and skill development (Russo, 2017).

Training and informal learnings impact for the employee skill development. People who take part in both trainings and informal learnings have been showed better improvement in skills rather than the people who did not take part any of them. Workers continuous skill development is essential in order to increase the productivity of the firm. Employees should match their skills according to rapidly changing market and economy ( Ferreira et. al., 2017).

With different worker characteristics it is easy to measure the job satisfaction of workforce such as age, gender, education, work experience, marital status and many more. They effect on job satisfaction on various ways. To achieve the high level of job satisfaction, results of the research shows that rewarding systems and establishing management training programs will help to achieve the targets of the firm (Linz, 2003).

Young workers more incline with the flexibility of the job than the older workers when shifting the functional flexibility (Pagani & Origo, 2008).

Training is another factor for impact in job satisfaction. Employees who are not very skilful, they can achieve the target by having training programs (Jones et. al., 2008).

Complexity of the organizations may lead to a conflicts among team members and organization. While performing individual jobs, task interdependency involve in team members. With a high task interdependency individuals tend to perform well in their job roles. But on the other hand it leads to conflicts among team members while they are actively participating in a particular task. Although there are conflicts task interdependency increases the communication of the team members (Jen ,2013).

Many of the Canadian organizations have been faced the problem that high performed skillful workers leave their jobs. It is needed to have an attitudinal change to decrease the employee turnover (Fabi et. al., 2015).

And also locus of control plays a major role in job satisfaction in order to achieve the job performance. Higher locus of control decrease the stress and increase the job performance (Chen & Silverthorne,2008).

The skill development in clothing industry is needed to its employees to develop their skills to enhance the performance. And also multi skilled workers are very useful to the firm. Training for team work and development of managerial skills also needed to be a successful employee (Winterton & Winterton, 2002).

Workforce commitment is change according to quality of work life balance and human resource practices such as low intensives, low investment in technology etc. These are doing a great impact on enhancing the organizational commitment in apparel industry in Sri Lanka. So increasing the quality of essential needs, it will do a great impact on apparel industry (Dharmasiri & Gnanayudam ,2008).

In order to achieve competitiveness, advanced technology plays a major role in apparel industry to increase the productivity, lower the cost and maintain the short cycle time, improve the product quality. In this paper it has found that top management commitment and technical skills on technology adaption were not significant. And also technology adaption is a challenge for developing countries to achieve competitive advantage (Varukolu & Poaps, 2009).

Wearable technology in textile and clothing sector is a new thing to Sri Lanka. But in the European countries have started use this technology already. Wearable technology has associated with various range of products such as smart gloves with sensors and controls, smart socks with thin blood pressure sensors and smart devices that measures blood pressure and fatigue etc. From these devices can use to determine the health condition of a worker and increase the productivity. Development of ICT sector is vital for the apparel industry in various ways (Pavlinić, 2017).

According to the literature, to enhance the performance, industry 4.0 applications and smart human resource concepts are vital. Skill development and job satisfaction mediate between industry 4.0 application and job performance. The developed conceptual model has shown in the Figure 2.

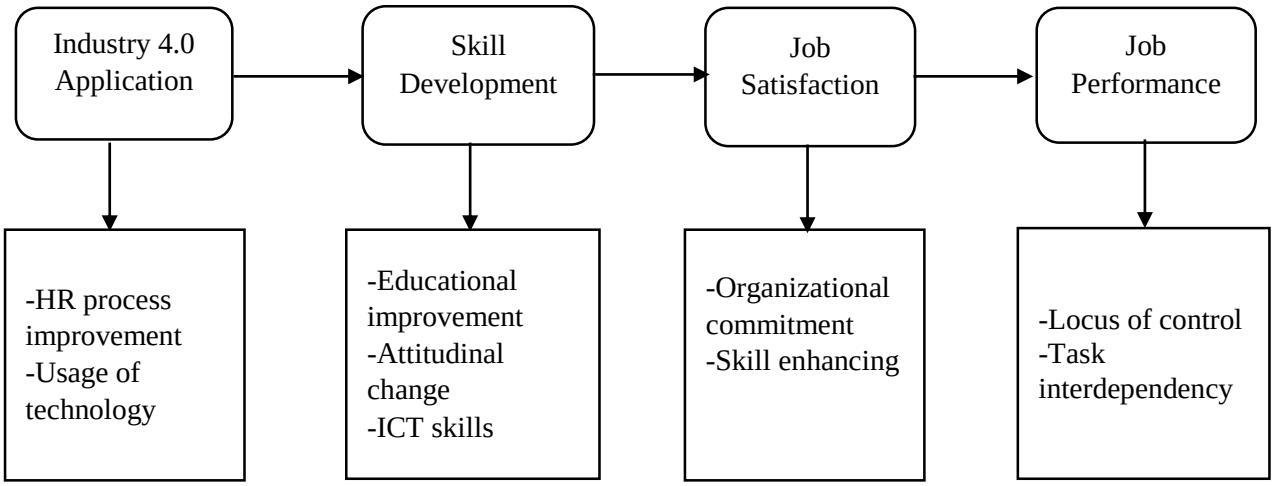


*Figure 2 – Conceptual model*

Above figure has shown the factors that has been identified from the literature. Every fact is vital and there is a clear relationship between these variables in order to enhance the workforce performance.

**Discussion**

The categorization of factors studied in the selected articles is discussed in the below Table 1.

*Table 1- Categorization of factors*

| Study | Impact of industry 4.0 application | Impact of skill development | Impact of job satisfaction | Impact of job performance | Consideration of apparel industry |
|---|---|---|---|---|---|
| (Shamim et. al., 2016) | * | | | | |
| (Sivathanu & Pillai, 2018) | * | | | | |
| (Bhaskar, 2017) | * | | | | |
| (Renjen, 2018) | * | | | | |
| (Habraken & Bondarouk , 2017) | | * | | | |
| (Deursen & Dijk, 2014) | | * | | | |
| (Hecklau et. al., 2016) | | * | | | |
| (Hawkins, 2004) | | * | | | |
| (Russo, 2017) | | * | | | |
| ( Ferreira et. al., 2017) | | * | | | |
| (Linz, 2003) | | | * | | |
| (Pagani & Origo, 2008) | | | * | | |
| (Jones et. al., 2008) | | | * | | |
| (Jen ,2013) | | | | * | |
| (Fabi et. al., 2015) | | | | * | |
| (Chen & Silverthorne,2008) | | | | * | |
| (Winterton & Winterton, 2002) | | | | | * |
| (Dharmasiri & Gnanayudam ,2008) | | | | | * |
| (Varukolu & Poaps, 2009) | | | | | * |
| (Pavlinić, 2017) | | | | | * |

Four of the studies which are under impact of industry 4.0 application, has identified the importance of human resource process improvement such as recruitment, talent on-board and talent off-board, training and development. And also about the usage of technology such as IoT, AI, AR. To achieve the technological improvement and handling capability of new application and concepts, skill development is vital.

Under impact of skill development, there are six studies which has identified the educational improvement, attitudinal change of the workers, and ICT skills are vital for remain in the job and those skills are impact for job satisfaction.

Three of studies are in the impact of job satisfaction category and has identified the organizational commitment and skill enhancement are impact on the job satisfaction. Then the job satisfaction leads to enhance the job performance. There are three studies on job performance and high locus of control and task interdependency are impact on enhancement of the job performance. Four of the studies are in the apparel industry and considered about importance of these concepts and its usage. This model can be applied for further improvement of the apparel industry.

**Conclusion and future recommendations**

In the modern world many of the developed countries are getting more usage and efficiency increasing due to apply industry 4.0 concepts in every aspects. Developing countries like Sri Lanka are far behind in applying those technologies. This research is to identify those industry 4.0 application and smart human resource management concepts together with optimize the workforce performance. In that skill development and job satisfaction factors are also impact when achieving the objectives. Considering the selected studies it could be seen that technological skills of the workers are essential when perform a task. The given framework can be used as a model to implement the industry 4.0 concepts and other required skills and factors into the organization.

It is essential to do more studies on this area and identify the new trends in the modern world. This research will be set up the path for future researchers to enable the apparel industry to enhance the human resource management processes using technologies through industry 4.0 application.

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