ANALYSIS OF THE IMPACT OF TELEWORKING ON THE PRODUCTIVITY OF SOFTWARE ENGINEERS IN SRI LANKA

Theshani Madhusanka Sathsarani Vithanage

189129A

A research project submitted in partial fulfillment of the requirement for the

Degree of Master of Business Administration in Information Technology

Department of Computer Science and Engineering

University of Moratuwa

Sri Lanka

May 2020

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

………………………………….

T.M Sathsarani Vithanage
(Signature of the candidate)   Date: 24/05/2020

The above candidate has carried out research for the Masters thesis under my supervision.

………………………………..………………….

Dr.Dulani Meedeniya   Date: 24/05/2020
Signature of the Supervisor

COPYRIGHT STATEMENT

I hereby grant the University of Moratuwa the right to archive and to make available my thesis or dissertation in whole or part in the University Libraries in all forms of media, subject to the provisions of the current copyright act of Sri Lanka. I retain all proprietary rights, such as patent rights. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

……………………………….

ABSTRACT

Telework can be defined as a work arrangement which allows employees to work from home or any other flexible place with flexible working hours instead of their office. For IT professionals teleworking is an ideal alternative working arrangement with their knowledge and the advance of the technology. There are a lot of studies had conducted in this area. But there are not many studies conducted in the Srilankan context. This study intends to find and analyze factors that affect the software professional's productivity when they telework in Sri Lankan IT organizations.

Based on the review of the literature on teleworking and the productivity of software professionals, teleworking is not a new concept to the world. Especially for the IT industry. It has been proved that teleworking increases the productivity of the employees. Hence this study has chosen nine factors that affect to the teleworker's productivity by analyzing the past studies. The preliminary survey has been conducted to identify the most important variables in the real software industry within the Sri Lankan context. These factors are work-flexibility, work-wellbeing, technology, effective communication, and self-regulation. The quantitative research method has been followed as a research methodology in this study. Hence an online survey questionnaire is distributed among the 500+ employees in software companies in Sri Lanka. The questionnaire has contained 38 questions. Before publishing, this survey researcher has done a reliability analysis to check the goodness and internal consistency of the questions. Descriptive analysis is utilized to describe the fundamental characteristic of the data in the research study. Pearson correlation coefficient is used to test the hypothesis of this study. Furthermore, in order to estimate the strength of the correlation between the variables, the researcher has conducted the regression analysis.

As a consequence of the investigation, it can be concluded that work flexibility work-wellbeing and self-regulation have a strong correlation with the teleworker's productivity while effective communication has a moderate impact. Even though it has a low impact, technology has a considerable impact on teleworking productivity. Furthermore, a set of recommendations are suggested to improve the teleworking productivity of software professionals in the Sri Lankan software industry. These suggestions will enable the employer to motivate his fellow employees. The motivation of software engineers directly affects the quality of the software that they develop. Thus, by implementing these suggestions while meeting the need of employees, productivity can be increased.

ACKNOWLEDGMENT

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

WWW   World Wide Web

ICT   Information and Communications Technology

IT   Information Technology

ANOVA   Analysis of variance

FWA   Flexible Working Arrangement

DTVC   Desktop Video Conferencing

1. CHAPTER 1: INTRODUCTION

1.1. Background

The software industry has become a leading industry over the past couple of decades. Every software development company is trying to achieve a competitive advantage over others for their long-time existence. To gain competitive advantage top-level managers are seeking ways to reduce overhead costs and other expenses like building rent, travel expenses, etc while increasing the productivity of the employees. Teleworking is one of the best concepts for this situation. Telework can be characterized as a working arrangement that permits employees to work from home or any other flexible place with flexible working hours instead of their office using the technological connection for operation and communication with colleagues (Onyemaechi et al., 2018). With advanced technologies, many countries have adapted the telecommuting / teleworking concept. Teleworking is a kind of flexible working arrangement. Many leading IT organizations around the world have already enforced telecommuting in order to enhance their employees' work-life balance as well as to maintain job satisfaction. According to (Russell et al., 2007) there are several factors that can induce employers to adopt work alternatives which facilitate employee's work-life balance. These work arrangements assist with reducing absenteeism, less employee turnover, improved worker productivity, and several benefits to the employer. Not only that but also (Russell et al., 2007) has stated that technology advancements and changes in employee's working policies open doors for telecommuting.

To make a software project success, there are few things to be considered from the employee side. Some of them are less interrupted environment, job satisfaction, productivity, and morale. There are not any other factors that can increase productivity levels like motivation (Ariasa et al., 2012). Not only that (Arso et al., 2018) have indicated that employers should be able to increase their worker's job performance and productivity.

There are barriers as well as benefits of implementing telework. (Nakrošienė et al., 2019) highlight that shortage of communication with coworkers and colleagues and social isolation can be identified as the main detriment of telework. There is a problem with measuring the

performance of employees while working in a teleworking environment because managers are not able to see how they work. Some managers think that they can only measure their employee's performance by monitoring their work at the office. The supervisor's trust of subordinates is essential for telework implementation (Brown et al., 2016). On the other hand, some employees may take inappropriate advantages from the telework concept and try to do their personal work rather than organization objectives. This definitely causes failures in the projects. This could be one reason, why some managers believe that telecommuting has negative effects on both employee's productivity and organization success. Since there is no face-to-face monitoring, management unable to do the traditional supervision on their employees (Gani & Toleman, 2006). This might be caused by less productivity and the inability of meeting deadlines. This is the underlying apprehension of the management (Gani & Toleman, 2006).

The intention of doing this research study is to find out and analyze the factors that affect the Sri Lankan software engineers' productivity while they telework. Then identify some recommendations to improve the productivity of teleworkers in Sri Lankan IT organizations by analyzing the selected factors.

1.1.1. Motivation

To make a software project successful, it should be delivered on time with the utmost quality and estimated budget. For that, some key things like employee productivity, motivation, job satisfaction, etc... need to be considered. Employees have been seeking an opportunity to work in a flexible workplace due to their complex lifestyle. This will increase their job satisfaction which leads to an increase in the productivity level. However, for certain reasons, some managers are hesitating to allow telework (working from home) for their subordinates. That could be a reason to reduce employee job satisfaction as well as the increase in employee turnover. Teleworking can improve overall productivity but that depends on the trustworthiness of the employee. And also, telework is a good approach when employees are physically unable to present to work due to illness, family commitments, etc since he/she can complete the assigned task by teleworking from home.

As per previous studies, it is being proven that teleworking is an emerging solution for the employees' job satisfaction, motivation, and the increase of productivity level. Improved productivity and quality of work are associated with teleworking (Onyemaechi et al., 2018). Most organizations around the world have already started implementing teleworking concepts. Teleworking as a business practice has grown significantly due to the increasing pressure on organizations to cut costs and to increase employee productivity (Onyemaechi et al., 2018).

Other than these aspects, in situations like last year's Easter attack, people were reluctant to travel to the office. Even if they have come to the office, they may not have been that much productive due to the fear of blasting. So teleworking is a really useful and good solution in such situations. Most IT companies have allowed working from home during this time period by managing technological aspects like VPN. Nevertheless, unfortunately, some were not allowed due to the VPN issues. But those companies were taking a risk as they were putting their employees' life in danger.

Hence, this is a study on how telework is effectively implemented in Sri Lankan base software organizations and finds out the factors that affect the software professional's productivity in the teleworking environment.

1.1.2. Research Scope

This research will focus on identifying the factors affecting the software professional's productivity in the teleworking environment and analyzing data for finding out how much they affect productivity.

The scope of this research is limited to the Sri Lankan IT industry since the target population and sample is selected from Sri Lanka. The survey questionnaire was distributed only among the Sri Lankan IT professionals.

1.2. Problem Statement

(Gajendran & Harrison, 2007) has indicated that teleworking prompts decreased expenses of working by saving, transportation cost, the cost for employees, and cost for formal office dresses to the employees. Not only cost-saving, but it also helps to reduce the stress level of the employee and allows them to work with flexible working hours and fewer interruptions. In general, extensive meetings and interruptions can be lost workers' psychical control, concentration, and abatement job satisfaction. And also these king of interruptions likely prod negative emotions and prevent employees from working productively and inability to meet deadlines (Fonner & Roloff, 2010). A software engineer needs a peaceful mindset without any distractions for their office work. More interruptions can cause less quality with more bugs and it may delay the project delivery time since it directly impacts productivity. Many IT organizations' environments in Sri Lanka are not peaceful and quiet. In some cases, an employee has to pay attention to many tasks like meetings, emails, chats, telephone calls, background noises. Paying attention to these unexpected things may cause to decrease in the attention of his assigned task. Because of that, the effective hours of the employee can be reduced. It might be a cause for delaying the project delivery time and the quality of the project. Not only that, but teleworking can also reduce the absenteeism of employees. If one is unable to come to the office due to an illness of a family member/ urgent personal commitment, one has to get leave if teleworking is not allowed. If that task is an urgent one for a release, it may delay. So it may affect the company profit also. Hence telecommuting is the best approach to address this situation.

But there are some failure factors also. Some employees may misuse opportunity and they may use the time for their personal things (Onyemaechi et al., 2018). Not only that, measuring the performance of the employees is another factor for managers' negative feelings about teleworking.

This study is focusing on how to improve software engineer's productivity while they teleworking. So, in this research, I am going to find factors that affect the software professional's productivity when they telework in Sri Lankan IT organizations. And based on the result, I will formulate some set of recommendations to improve teleworking productivity.

1.2.1. Research Objectives

- To identify the factors affecting the software engineer's productivity in the teleworking environment.

- To determine the impact of the selected factors on the productivity of the software engineers in the teleworking environment in the Sri Lankan software industry.

- To provide recommendations to improve the teleworking productivity of software professionals in the Sri Lankan software industry.

1.2.2. Research Significance

To make a software project a success, employers should consider the job satisfaction and motivation of the employees since these factors straightforwardly influence the productivity, quality, and success of the project. Few researchers have identified job satisfaction is one positive outcome of the telecommuting concept. This research outcome can be used to encourage the telecommuting concept in Sri Lankan software development companies. This concept is most important for female software engineers because they have to do many commitments in work life as well as family life rather than male engineers. Many female software engineers stop their carrier life after a child is born. So, telecommuting is the best solution to address this problem and encourage them to continue their carrier path. Then they can do their family commitment while doing office work.

And also, the outcome of the research suggests that a flexible workplace increases employee's motivation and productivity level to give their maximum commitment to the company. It affects the company outcomes such as revenue, productivity, retention, performance, turnover intention, etc.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Chapter Introduction

The researcher has examined several literature sources with regard to teleworking and the productivity of the software professionals when they do telework in this chapter. A lot of literature sources such as journals, research publications, books, websites have been used to collect information for this chapter. The researcher has analyzed the factors that influence the software professional's productivity while they telework. Furthermore, the researcher has mentioned the statistical analysis methods which can be used to analyze the survey data for propose recommendations.

2.2. Overview of teleworking

Teleworking also called telecommuting/ working from home/ flexible working place/ remote work is emerging as a common practice in several countries (Bloom et al., 2018). Telework is an alternative work practice in which employees don't have to commute to the regular office daily and they are allowed to complete their office work remotely while communicating with colleagues, managers, clients.

Telecommuting has firstly introduced by Jack M. Nilles in 1975. (Nilles, 1975) had stated that Teleworking is a work arrangement that has telecommunication and computational components which facilitate employees who work in huge associations to work in workplaces near their homes, rather than travel long distances to a central office. There are a lot of studies related to teleworking conducted by several researchers from time to time. They have commented on teleworking in different ways which result in misunderstanding and confusion (Davis, 2014). So it is hard to find the exact definition for teleworking.

With the emerging complexity, people are always looking for flexible work arrangements to make their life more balanced with their work. Work-life balance has a highly positive consequence of employee attitudes towards their personal lives as well as their organizations (Scholarios & Marks, 2004). So many organizations provide telework opportunities to increase the job satisfaction of their employees since the effect of telework on job satisfaction

is inconsistent (Suh & Lee, 2017). Not only that (Greer & Payne, 2014) had stated that employees were persuaded to remain in the current organization by allowing teleworking facilities. Furthermore (Greer & Payne, 2014) have mentioned that telework has a positive relationship with lower turnover intentions.

Throughout the most recent three decades, teleworking has turned very common and popular in many organizations, but the adoption of telework is very slow since there are many challenges to implement this concept. A well-defined teleworking program can deliver the number of potential benefits for employers as well as for employees. (Dissanayake, 2017) has said teleworking is a cost-effective strategy for the organization and also, it allows to cut the cost while keeping in crucial employees. Besides, as a result of allowing teleworking, there may be fewer absences, fewer days late, and fewer deadlines. It also helps to reduce costs. Other than that telework increase productivity, job satisfaction & motivation level of employees, increase the quality of work, improve trust among employees, and reduce the stress level. As for the drawbacks of teleworking, researchers have mentioned security concerns, loss of on-site brainstorming, isolation, social and professional isolation, have to self-motivated and introverted, etc. However, teleworking is one of the most appropriate solutions for many problems that are faced by both employees and employers.

2.3. Evolution of teleworking

The history of teleworking is highly correlated with technology development, mainly with information transfer and communication technologies. If there is no technology, no telework at all. Today workforce and technology advancement is different by comparing it to decades ago. According to GlobalWorkplaceAnalytics.com, the majority of US employees engage with working from home during part of the week (Cordero, 2018). Jack Nilles have considers as a father of terms "Telecommuting", "Teleworking". The idea of the word "Teleworking" is to avoid commuting to the central office daily, thus it helps to reduce the fuel usage (Boell et al., 2014).

(Messenger & Gschwind, 2016) have divided the evolution of telework into three generations in pursuit of technological advancement. The first generation is the home office. The idea of that is long commuting hours were replaced by personal computers and fixed telephones

(Messenger & Gschwind, 2016). In this generation, ICTs were not capable of mobilizing the employees while working. This generation telework only considers about one frame of work that is "home office" (Messenger & Gschwind, 2016).

The second generation is the mobile office. This one be aside from the first one by only technological aspects (Messenger, 2019). In this generation, small and lightweight wireless devices like laptops and mobile phones were used to work remotely. since these devices are wireless, employees were able to work from anywhere they can work. they didn't want to stick the home. In this generation, telework was perpetually brought about FWAs with powerful technological devices. From this generation onwards, teleworking accompanied by the fast-growing dispersion of the Internet and WWW (Messenger & Gschwind, 2016).

The final generation is the virtual office. Smartphones and other technologically advanced devices can be identified as new ICTs are used in this generation (Messenger, 2019). These technologies enable constant connection with work colleagues, managers as well as families (Messenger, 2017). In this generation, ICTs were making progress fastest way and all information is stored in cloud-based systems and anyone who is authorized to access these systems can access this information by using only tiny devices (Messenger, 2019). These blossom technological devices enable employees to work from anywhere at any time. Telework is widely accepted by many organizations during this generation. but one event gets the attention of the teleworking world, that is Marissa Mayer, CEO of the Yahoo is prohibit yahoo workers to do teleworking. Suddenly she has proclaimed that working from the home facility is end up and they have asked all teleworkers to come to the office and work (Boell et al., 2014). However, this decision lead to more serious debates with regard to teleworking. Even Yahoo banned telework, some of the best companies in the United State are practicing the teleworking arrangement.

2.4. Challenges and opportunities of Teleworking

Once you get started, the benefits outweigh the challenges. Telework implementation and practice have significant challenges as well as the potential benefits for both employees and their employers.

2.4.1. Challenges of Telework

The "supervisor's trust and support" is one of the biggest challenges for teleworking practice. Since teleworkers are less visible to their managers especially supervisors, it causes less recognition and reduces career opportunities. thus, the supervisor's trust in their subordinates has a huge impact on successful telework practice. Trusting less visible employees is indeed a risk. But Trust is playing a very important role in a good supervisor-manager relationship. The CEO of Yahoo, Melissa Mayer had taken a decision to ban telework from employees who were doing working from home (Boell et al., 2014). That was very surprising news for many since Yahoo has placed on Forbes 100 Best Companies to work for three years due to it's non-traditional and fun work practice (Brown et al., 2016). Yahoo was one of the role model company for many IT organizations. Seems Mayer has lost her trust in the ability of Yahooers to increase their productivity while they do working from home. She believes that she lost the employees' creativity and innovation due to teleworking practice. A week later Melissa had banned working from home opportunity, the "Best Buy" and "HP" also decided to join yahoo and proscribed the teleworking facility (Brown et al., 2016; Weinert et al., 2014). (Brown et al., 2016) has stated that even after President Obama approved the Federal Telework Enhancement Act of 2010, still some federal government managers inhibit their employees from working from home by reason of their lack of trust in their less visible employees. Some employees indeed think that teleworking is an opportunity to quest their personal goals while abanding their office works (Onyemaechi et al., 2018). Managers are prohibiting this golden opportunity for teleworking by reason of these kinds of wrong workers. Tracking teleworkers' performance also depends on the manager's trust. (Arso et al., 2018) has proposed a KPI using the balanced scorecard to measure the performance of teleworking employees.

It is proven that the supervisor's trust in their subordinates is one of the vital circumstances to implement a successful telework program. According to (Nakrošienė et al., 2019) successful teleworkers have the ability to build trust in their manager's mind and get full support from them to work from home.

Due to the lack of supervision at telework, there is another challenge besides trust. That is "security concerns". Especially in dealing with sensitive data, this becomes a major concern (Dissanayake, 2017). However, (Dissanayake, 2017) has stated that managers should be very

9

careful when assigning tasks for teleworkers and regularizing feedback systems and daily performance maintain the system is identified as required aspects for successful telework arrangements. According to the 2018 Apricorn survey, some organizations have faced to data/ information breaches as a result of teleworking. (McNeely, 2019) has quoted that the sharing information via network can be concerned as the major security issue which arises from teleworkers.

Another key challenge to Telework is "Isolation" (Weinert et al., 2014). (Conradie et al., 2018) telework may result in isolation. This isolation is unavoidable and can be divided into two as "Social Isolation" and "Professional Isolation". Social isolation can be occurred due to fewer interactions with their co-workers (Boell et al., 2014). Professional isolation refers to isolation from professional peers like managers, supervisors, etc. This is not about the distance matter, it is all about professional network and communication. According to (Kurland & Cooper, 2002) employees worry about being isolated due to the managers' fear of loss of supervision when they telework. This can be caused to reduce the promotion opportunities due to the lack of visibility, less recognition, and rewarding (Collins et al., 2016). Not only that, when working in the office, but it is also very easy to get help from experts when issues spring up. but it is somewhat difficult to get help while doing telework. These isolations can be eliminated to some extent by maintaining effective communication. Maintaining good communication is also a challenge face by both employees and employers.

These are the main challenges that can be identified for teleworking practice. Besides, "Knowledge transfer"(Taskin & Bridoux, 2010), "cultural resistance" (Morgan, 2004) can be identified as other challenges.

2.4.2. Opportunities of Teleworking

Telework is a great opportunity for work-life balance. (Sikes et al., 2011) has said that telecommuting increases employee morale and motivation by recognizing the work-life balance. Work-life balance is a vital factor of any employees' life and it directly links with job satisfaction (Campbell, 2015). Job satisfaction may have an impact on the productivity of individuals.

When employees have flexible working time, they have the opportunity to spend more time with their family members and look after them. When kids suffer from illness, parents can give more attention while doing their assigned office works owing to Telework. These things make employees feel that their organization care about them as well as their family (Onyemaechi et al., 2018). Hence employees try to give their full commitment to achieve the organization targets. (Caillier, 2014) has professed that teleworkers are more satisfied with their job by comparing to the employees who work in office since they were able to manage both work and personal responsibilities while doing telework. This may help to make less employee turnover and less absenteeism (Bloom et al., 2018). Not only that but also the company is able to attract top talented people by giving telework as a benefit.

Another vital benefit for both employees and employers is to reduce costs (Dissanayake, 2017; Onyemaechi et al., 2018; Sikes et al., 2011). Teleworking eliminates travel time and travel expenses for employees while eliminating the cost of renting or buying office space and the cost of electricity, heating, air conditioning, etc for the employer. The most important thing is telework help to reduce air pollution by reducing traffic (Nakrošienė et al., 2019).

Teleworking has given a job opportunity for women with children, disabled persons, and students (Nakrošienė et al., 2019). With emerging ICT, telework is able to facilitate employment for people who are disabled by removing barriers of traditional work environments like "employees must work in the office" (Linden, 2014).

Since there are fewer office interruptions, teleworker is able to work more productive manner. Telework may allow avoiding workplace distractions and interruptions (Fonner & Roloff, 2010). There are so many interruptions like unexpected conversations, telephone calls, chat, background noise, etc in the workplace which may cause stress and reduce job satisfaction. These kinds of distractions are able to take employees' focus from work. So most employees used to do telework to avoid these kinds of distractions and increase their productivity (Fonner & Roloff, 2010). However, telework cannot eliminate all interruptions. But, it dismisses distractions to some extent. These are some benefits that past researchers have proven in their studies.

2.5. Teleworking in the Software Industry

With a life that is complicated, the younger generation of workers expects more flexible and relax working arrangements in which they can complete their official tasks while fulfilling family commitments. Many organizations were looking for FWAs to give that benefit to their employees while gaining maximum output from them together with technological advancement. Teleworking is one of the best arrangements to address this problem. Unfortunately, some employees like nurses, teachers, carpenters, civil engineers, etc, are unable to work remotely due to the nature of the job. It is not an option for them. But for software engineers, teleworking is an enormous working opportunity for both employees and the employer (Sikes et al., 2011). Because IT professionals are work in remote servers with the rapid improvement of ICTs like portable computers, good and reliable wireless internet connections, cloud computing systems that enable software engineers can work anywhere (Weinert et al., 2014). By this, many IT organizations worldwide have started the virtual team concept. Furthermore (Weinert et al., 2014) have mentioned that the "WorldatWork" report has shown 88% of organizations in the whole world have allowed working from the home facility for their employees. They try to hunt knowledgeable talented people from everywhere in the world by using this remote workplace concept.

(Yoshida, 2018) has mentioned that Teleworking has become a current trend in modern software development environments, IT industry. Nowadays, a specialist who has a wide range of technical capabilities and knowledge which can satisfy the customer requirements is a required resource for any software development projects. This requirement could not be able to satisfy with the traditional working environment. Furthermore (Yoshida, 2018) has stated that the Japanese government encouraged the companies that adopt teleworking with the purpose of improving their employees' quality of life by offering flexibility. Present, by comparing to the other industries, most of IT companies have established the teleworking concept. Researchers have found that the industry which has the highest potential capability, demand, and the feasibility to adopt teleworking is the ICT industry (Yoshida, 2018). There is indeed a problem with trust and accountability, but this is not a problem in the software industry as the dedication and working context of software engineers is promoting teleworking

(Conradie et al., 2018). And also (Conradie et al., 2018) have noted that teleworking is a very popular working arrangement among South African software development organizations.

In this study, researcher stick in the boundary of working from home concept. Since still Sri Lankan IT organization doesn't adopt that virtual team concept, the researcher trying to research the hybrid method of teleworking, not the fully virtual teams. Miserably, no major researches have been done to seek out the feasibility of adoption teleworking in the Sri Lankan software industry. (Gunasekare, 2015) has researched the virtual team concept in the companies which are appertinent to the BPO sector. He was explored how BPO sector companies have implemented and practice the virtuality concept. (Gunasekare, 2015) has done qualitative research and used the interview method as his methodology. As a result of this study, he has found some virtual team features which are practice in BPO sector companies. (Perera, 2010) was done the research to investigate about the Sri Lankan IT Professionals' impression on teleworking. According to (Perera, 2010) it is possible to implement teleworking as a timely working arrangement within Sri Lankan software organizations. furthermore, (Perera, 2010) has stated that a successful telework program mainly depends on the employees' commitment and capability. (Perera, 2010) found that teleworking has improved the employees' productivity by allowing flexible working hours and stopping the commuting.

2.6. Productivity of Software Engineer and Teleworking

Productivity is the key to success for any organization as it directly connects with the revenue of the business. When concern software industry, productivity focus on developing high-quality software products with low budgets, and software developers' productivity plays a vital role in that (Oliveira et al., 2016). (Murphy-hill et al., n.d.) has defined productivity of Software developers as developers can spend their free time on other beneficial tasks such as implementing a new feature or brush up their programming knowledge of the newest technologies after completing their assigned task on time. As a manager's perception, it is very important to measure software productivity since it can be used for comparing the performance of each developer. (Oliveira et al., 2016) has found some factors for managers

to measure the developers' productivity, According to (Oliveira et al., 2016) most managers have mentioned the on-time task delivery is the most influential one.

Most researches define developer's productivity as; the number of tasks completed per month, number of lines added to the code per year, number of issues arise from the release, etc. (Meyer et al., n.d.). (Meyer et al., n.d.) have found that the most productive day is a day in which they work fewer interruptions and distractions such as distractions from colleagues, phone calls, unexpected conversations, etc. (Beecham, 2014) has stated that the quality of software products fully depends on one the software developer's motivation level. They expect rewards, appreciation for quality works, managers' trust, regular feedbacks, flexible times, etc for being motivated. Researchers have found that most software developers leave their current company by virtue of their manager's behavior. Not only that, but work-life balance also plays a vital role in software developers' motivation and the turnover rate (Scholarios & Marks, 2004). Most companies in Scotland have introduced "Teleworking" as a flexible working arrangement to increase the software developer's work-life balance and the motivation level (Scholarios & Marks, 2004). Even telework leads to the feeling of isolation, it is highly impacted by the employees' motivation and productivity (Chen & Mcdonald, 2014). Since teleworker has the ability to work on their most productive time with less distracted by office colleagues, he is able to work more productively.

2.7. Teleworking factors

2.7.1. Work flexibility

(Campbell, 2015) explained that Flexible working programs bolster the capacity to work a characterized number of foreordained hours and leaving flexibility for the rest of the hours. Employees utilize flexible work hours to deal with the everyday duties between their own lives and expert professions effectively. (Mcnall et al., 2009) found that flexible work arrangement is positively correlated to the work-life balance and satisfaction. (Campbell, 2015) has stated that this working arrangement draws in regard and trust among workers and managers, while additionally cultivating employees' trust to the association, consequently reducing worker turnover. Not only that this fascination can profit associations by recruiting

excellent workers. Healthier and satisfied employees can give a higher level of productivity and outputs with minimal stress levels (Mcnall et al., 2009).

According to (Conradie et al., 2018; Mcnall et al., 2009) FWAs can be categorized into two sections by its viewpoint, be specific, flextime, and teleworking /work from home. Teleworking offers an adaptable time and a working environment for the employees by using modern collaboration and communication technologies. (Sa´nchez et al., 2007) has proven that the performance of the organization is positively correlated with FWAs mainly telework mode. (Groen et al., 2018) has stated that some firms (call centers) were able to increase productivity by 20%-30% by allowing flexible work arrangements through teleworking.

2.7.2. Work well-being

International Labour Organization has defined that Working environment Wellbeing can be identified with all parts of working life, from the quality and security of the physical condition, to how employees feel about their work, their workplace, the atmosphere at work and work association. Work well-being includes both physical and mental well-being aspects. (Haddon, 2018) has stated that an employees' performance and productivity in the work environment are firmly connected to their general wellbeing and prosperity, so investing in and dealing with welfare programs ought to be at the heart of an organization's culture. Many companies have organized well-being programs to by purposive of attracting and retain talented employees and motivate them.

Teleworking permits employees to have a superior work-life balance by increasing their well-being. Researchers at the Unversity of Melbourne (IBES) (Bosua et al., 2013) have found that teleworking increases wellbeing as well as the productivity of the employees. (Graziotin & Fagerholm, 2019) has proven that happy software developers are the most productive ones. Furthermore (Graziotin & Fagerholm, 2019) said that nowadays IT companies provide remote working place facilities, free breakfast, sports facilities, etc to keep their employees happy and increase their wellbeing. (Greer & Payne, 2014) have found that employers can increase their employee's job and life satisfaction while diminishing mental health issues by making their work-life balance.

(Weinert et al., 2015) has stated that one possible negative effect of teleworking is employer's stress due to the isolation and poor time/ work management. Job stressors are directly affected by the employees' mental health and their work (Caillier, 2014). On the other hand (Halpern, 2005) has proven that by enabling flexible work schedules like teleworking, management can reduce their employees' stress level and increase both mental and physical health.

2.7.3. Technology

According to (Bosua et al., 2013) "Technology" is an enabler for successful telework practice. With the advancement of technology and the broadcast internet, new FWAs such as teleworking, flextime, job sharing, etc have been introduced (Conradie et al., 2018). Any IT Organization can start teleworking practice with a fast and reliable internet connection and it is an indispensable condition for an efficacious teleworking program (Onyemaechi et al., 2018). (Conradie et al., 2018) said that a slow or implausible internet connection is a significant impediment to successful teleworking programs. The software industry is a possible industry to implement telework due to its working culture and ICT knowledge and capabilities of software professionals (Perera, 2010).

Technology variables are positively correlated with teleworkers' productivity, performance, and satisfaction (Weinert et al., 2014). Teleworkers can connect to the organization network through the virtual private network (VPN), terminal servers, web-based portals, and other available connectivity modes easily (Sikes et al., 2011). When an organization enables telework for its workers, it must be considered about these aspects: proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches and cloud computing systems to make trustworthy share information (Boell et al., 2014).

2.7.4. Effective Communication

Effective communication assists with building a better relationship and understanding among team members as well between the team and management. With ICT evolution, teleworkers can use videoconferencing, intranet systems, Softwares which can work together with co-

workers, email to keep the connection and exchange information among the team (Gunasekare, 2015). Not only that good communication always helps to clear conflict among team members as well the management.

Telework completely relies upon the effective communication system that connects managers, employees and customers (Dissanayake, 2017). (Sikes et al., 2011) has stated that the successful remote worker will be proactive in communicating with co-workers and both internal, external customers and not hold back to be solicited to give updates on their daily work. Furthermore (Sikes et al., 2011) mentioned that IT Managers should give realistic feedback to the remote workers about their effective communication. According to (Smith et al., 2015) there is a positive correlation amongst effective communication and the job satisfaction of teleworkers. And also effective communication increase teleworker's productivity.

2.7.5. Self-regulation

(Mcclelland et al., 2018) has defined self-regulation is key to the effective achievement of adjustable developmental duty at all phases of life. Researches found that employee self-regulation is the key to successful teleworking practice (Meulen, 2017). Teleworkers should be self-motivated, self-disciplined, and confident working without, peer monitoring, peer-competition, and manager supervision. Teleworkers should be able to be productive with supervision as well as when no-one is checking up on him/her. According to (Sikes et al., 2011) the ability to work independently means teleworkers should be able to complete assigned tasks on-time with minimal guidance and without any interference by others.

Remote workers may encounter less immediate supervision and track from supervisors and companions on account of their physical separation from the traditional office workspace (D. G. Allen et al., 2003).

2.8. Testing and Analysing method

2.8.1. Descriptive analysis

Descriptive analysis is used descriptive statistics to portray the fundamental features of the information in a research study (Trochim, 2020). This analysis structure the foundation of virtually every quantitative analysis of data in association with simple picturesque analysis such as diagrams, tables, and basic statistics, such as mean and standard deviation. According to (Trochim, 2020) Descriptive Statistics are utilized to introduce quantitative depictions in a sensible structure.

2.8.2. Central tendency

This measures the average value of the sample. This measure is sometimes called measures of central location. Mean is the most popular measure of central tendency. Mean is the average value of the sample. It is measured by dividing the sum of data points in the sample by the number of points.

2.8.3. Cronbach's alpha calculation

Cronbach's alpha is firstly named by Lee Cronbach in 1951 to measures the reliability or internal consistency of survey questionnaires (Tavakol & Dennick, 2011). The test scale of this alpha is between 0 and 1.

By using Internal consistency the one can check whether all the things in a test measure the same idea. since it is related to between relatedness of the things which incorporate the test. Further reliability test shows the number of measurement mistakes in a test. If the alpha value near one, that means the items in a test are highly correlated with each other. Another thing is (Tavakol & Dennick, 2011) have stated that Cronbach's alpha value is reliant on the length of the questionnaire. If the test is a lengthy one, the value of alpha is increased. The formula for Cronbach's alpha is shown in Equation 1. The strength of the internal consistency level of each Cronbach's alpha range is shown in Table 1.

$$\alpha = \frac{N.\bar{c}}{\bar{v} + (N-1).\bar{c}}$$

Where:

N = The number of items

$\bar{c}$ = Average covariance between item-pairs

$\bar{v}$ = Average variance

Equation 1: Cronbach's Alpha Formula

Table 1: Standards for reliability analysis

Cronbach's alpha	Strength of Association
< 0.6	Poor
0.6 – 0.7	Moderate
0.7 – 0.8	Good
0.8 – 0.9	Very Good
> 0.9	Excellent

2.8.4. Pearson correlation coefficient analysis

The correlation coefficient is utilized to examine the connection between two quantitative factors (independent and dependent variable). Pearson correlation coefficient analysis has measured the strength of the quality of the relationship between the two factors. The coefficient value range is +1 to -1 where +1 demonstrates an ideal positive relationship, -1 depicts an ideal negative relationship and 0 demonstrates no relationship exists between variables.

Positive relationship means when increasing one variable in positive, the other variable increases positively with a fixed amount. Negative relationship means when increasing one variable in positive, the other variable decreases negatively with a fixed amount. Zero relationship means for each increment, there is no positive increment or negative decrease. Table 2 shows the Standards of the Pearson correlation coefficient. Based on Table 2, the level of relationship between variables can be decided. The formula for the Pearson correlation coefficient is shown in Equation 2.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

Where,

r = Pearson Correlation Coefficient

n = number of pairs of the stock

$\sum$xy = sum of products of the paired stocks

$\sum$x = sum of the x scores

$\sum$y = sum of the y scores

$\sum$x2 = sum of the squared x scores

$\sum$y2 = sum of the squared y scores

Equation 2: Pearson correlation coefficient formula

The value generated as Pearson correlation named as r-value and the significance value is named as p-value. There is two significance level, that is 0.01 and 0.05. this is decided by the statistic tool. Past researchers have given APA format to write the correlation result.

APA Format: r(degrees of freedom) = r statistic, p = p-value

Degrees of freedom for r is N - 2

Eg: Pearson correlation value (r) = 0.598, Significance value (p) = 0.023, N=382

APA format = r(380) = 0.598, p = 0.023

Table 2: Standards of Pearson correlation coefficient

Strength of Association	Coefficient, r	
	Positive	Negative
Small	.1 to .3	-0.1 to -0.3
Medium	.3 to .5	-0.3 to -0.5
Large	.5 to 1.0	-0.5 to -1.0

2.8.5. Hypothesis analysis

A hypothesis is a supposition which should be demonstrated or refuted by the investigation. It is a testable explanation and it is utilized to forecast the relationship among selected factors. Hypothesis testing is an essential one in statistics. Hypothesis testing is utilized to evaluate the believability of a theory by utilizing test data.

Alternative hypothesis

The alternative hypothesis can be divided into two sections, directional hypotheses, and nondirectional hypothesis (Lavrakas, 2013). The alternative hypothesis is normally indicated as H1.

The nondirectional hypothesis is an explanation that a relationship exists between two factors, without anticipating the specific nature (direction) of the relationship. This can be used when the situation is not certain. From the Non-Directional hypothesis, researchers can't predict the direction, but it states the difference between variables (Salkind, 2012b).

Directional hypotheses are the ones that can predict the direction. "higher, lower, more, less, increase, decrease, positive, and negative can be recognized as keywords of the directional hypothesis (Salkind, 2012a).

Null hypothesis

The null hypothesis shows that there is no relationship or contrast among the factors (Freeman & Julious, 2008). This is something to endeavor to negate or ruin. The null hypothesis is normally indicated as H0.

2.8.6. Hypothesis testing methods

Bivariate Pearson correlation analysis can be used to test the hypotheses. Based on the significance value researcher can reject or accept the null hypothesis. And also the direction of the relationship can be decided based upon the sign of the Pearson correlation value.

The t-test can also be used as a hypothesis testing method. It helps to determine if there is a significant difference between the means of two groups. Based on this difference, researcher can reject or accept the null hypothesis. It is valuable when the population isn't known and when the sample measurement is little.

2.8.7. ANOVA test

Analysis of variance (ANOVA) is a critical technique in exploratory and corroborative data analysis. It is the most widely used statistical technique for hypothesis testing (Sthle & Wold, 1989). In simply, the ANOVA test helps researchers to acknowledge the alternative hypothesis or reject the null hypothesis. However, in complex issues, it is difficult to set up a suitable ANOVA. Mainly, there are two sorts of ANOVA testing, "One-Way" and "Two Way". Both allude to the number of independent variables in the ANOVA test. One-Way has only one independent variable where Two-Way has two or multiple independent variables.

2.8.8. Regression Test

Regression analysis is an exceptionally powerful statistical method for establishing the relationship between groups of variables. It is a reliable method to identify the impact on a dependent variable by a set of independent variables. And also it can be utilized to evaluate the strength of the relationship between independent variables and the dependent variable.

2.9. Discussion

2.9.1. Literature related to the teleworking factors

Table 3 depicts the summary of the factors which were addressed by the followed researches in this study. Some factors were considered by many related works while some were addressed by only one research study. As per Table 3, 2 studies have considered technology, effective communication, and productivity. Some researches have proved that communication technologies are an essential thing for effective communication. That may be the reason for considering both features together in many related works.

Table 3: Summarize of the literature related to the teleworking factors

Research article	Work Flexibility	Work Wellbeing	Technology	Effective communication	Self Regulation	Productivity
(Campbell, 2015)	√					√
(Mcnall et al., 2009)	√					
(Conradie et al., 2018)	√		√			√
(Sa´nchez et al., 2007)	√					
(Groen et al., 2018)	√					
(Dissanayake, 2017)	√			√		√
(Haddon, 2018)		√				
(Bosua et al., 2013)		√	√			
(Graziotin & Fagerholm, 2019)		√				√
(Greer & Payne, 2014)		√				√
(Weinert et al., 2015)		√				
(Caillier, 2014)		√				
(Halpern, 2005)		√				√
(Onyemaechi et al., 2018)			√			
(Perera, 2010)			√			√
(Weinert et al., 2014)			√	√		√
(Boell et al., 2014)			√			
(Sikes et al., 2011)			√	√	√	√
(Gunasekare, 2015)				√		
(Smith et al., 2015)				√		√
(Mcclelland et al., 2018)					√	
(Meulen, 2017)					√	
(D. G. Allen et al., 2003)					√	

2.9.2. Related Works

Table 4 describes an examination of literature resources about the variables which are tended to by those investigates, advantages and disadvantages of the referred literature resource

Table 4: Comparison of past research works

Related work	Method	Factors Considered	Advantages	Disadvantages
(Weinert et al., 2014)	An empirical online survey has conducted among 57 IT professionals. SmartPLS and SPSS were used for data analysis	How teleworking-induced stress influence IT professional's well being and discontinuous intention towards telework? How Stress affects productivity?	The researcher has identified that all selected stressors which induced from teleworking have a considerable influence on IT professional's fatigue due to telework	Considered only four influence factors caused by teleworking. And also they are restricted by a single item measuring the intention to suspend teleworking.
(Boell et al., 2014)	Analyzed broad discussions about telecommuting in social media platforms which are doing telecommuting following Yahoo's choice to prohibit its employees from teleworking	What is the role of IT for effective communication and decision making in Telework practice? How it affects productivity?	Teleworking can help in improving efficiency for certain tasks. However, for these tasks, effective communication technologies are the most influenced ones to the telework	Considered the debates about telework as the main data gathering method.
(Halpern, 2005)	In order to test hypotheses, the researcher has used the data set which got from the US National Study of the Changing Workforce	How flexible work arrangements decrease stress and increase worker wellbeing? How flexible work policies affect employee productivity?	The researcher has found that healthy employees will reduce the healthcare cost, make less absence and increase productivity	The researcher didn't gather data for this study. used already collected data set for test hypotheses
(Sikes et al., 2011)	Used secondary data as results to give recommendations	How self-motivation affect productivity? How effective communication affects productivity? How did technology use to make success telework and increase productivity?	The researcher has addressed several challenges and advantages within his study. He has proposed solutions for teleworking challengers which help to increase the productivity of IT professionals.	The researchers haven't done any questionnaire or interview to get ideas from employees

2.10. Conclusion

In this chapter, the researcher has done an investigation about the teleworking environment and productivity of software professionals through past works of literature. According to this review, it is determined that there is an effect on employees' productivity by teleworking. And also the researcher was able to identify the factors which affect the software professional's productivity in a teleworking environment.

Using this inquiry, the researcher was able to get a better idea in relation to what has already done and what needs to be done within this study.

3. CHAPTER 3: RESEARCH METHODOLOGY

3.1. Chapter Introduction

The aim of this research is to find out and analyze the factors that affect the Sri Lankan software engineers' productivity while they telework. Hence, this chapter firstly describes the research approach of the study. Then it describes the data collection method, sample design, conceptual framework, and the hypothesis. After that, it describes the pilot studies and reliability analysis. Finally, this chapter explains the data analysis techniques used for analyzing the collected data.

3.2. Research approach

The research approach is a blueprint or framework for the research study which guides for accurate data collection and data analysis. According to the research design, research studies can be divided into three types as "Exploratory Studies", "Descriptive Studies" and "Casual studies". Descriptive researches are used to describe the characteristics or various aspect of the phenomenon. This research is designed as descriptive research since this is basically focused on "what" research subject and conducted by using the survey method. And also the intention of doing this research is to find and analyze the relationship between the variables which are well defined.

According to (HU & CHAN, 2017) John Creswell has indicated that there are three research designs called Qualitative, Quantitative, and mixed approaches. The researcher used a quantitative research method which attempts to collect quantitative information from an existing sample by a survey that is to be used for statistical analysis to achieve the main object of this research. The survey questionnaire is distributed among the sample of employees in software companies in Sri Lanka. Numeric data scale which can be quantified opinions, attitudes, and behaviors have been used for the questionnaire to identify the perspective of participants. After data collection, the IBM SPSS statistics subscription tool was used to formulate facts and uncover patterns in the research by analyzing collected data. Based on

these facts and patterns, a set of guidelines is recommended to improve the productivity of software professionals via teleworking in the Sri Lankan software industry.

Figure 1: Research Approach reveals the stages that have been used in this research approach.
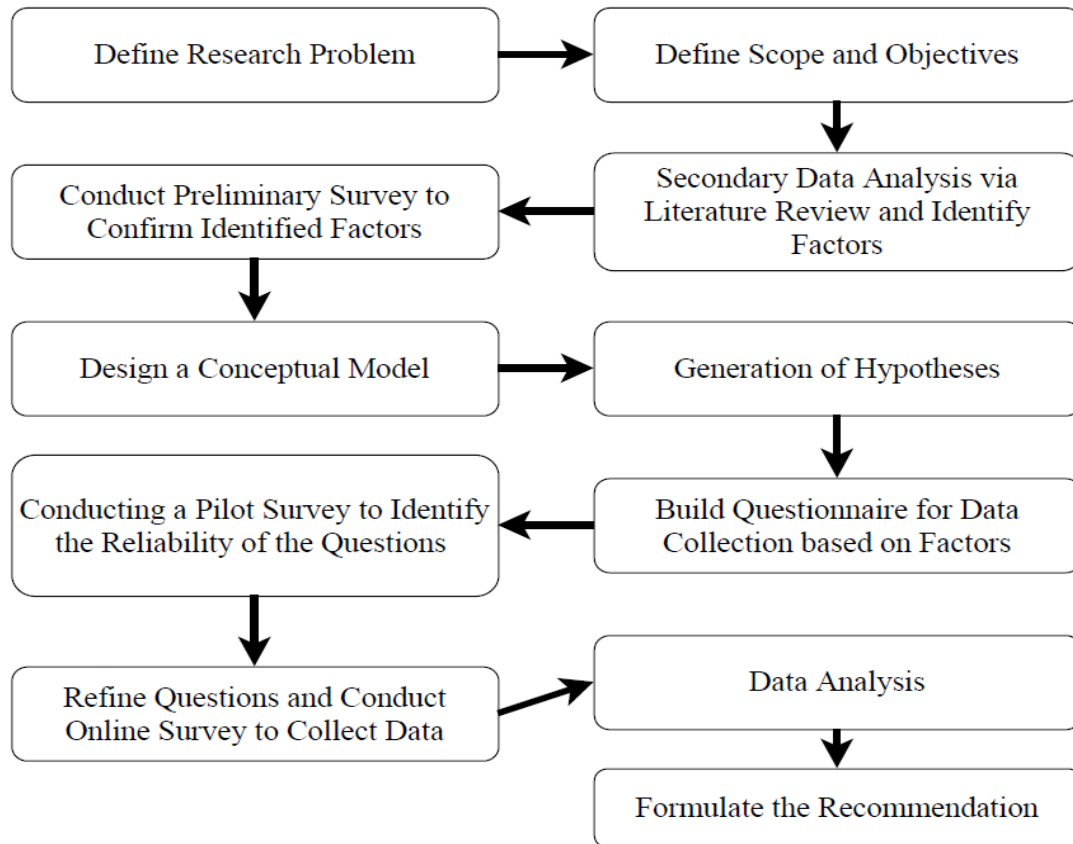
Figure 1: Research Approach

The problem which is going to be addressed through the research is identified in the initial phase. Then defined the scope and objectives for the research. Then the literature review was done as secondary data analysis to get an idea about past research and to see what has been investigated and what hasn't been touched yet in this area. Based on the literature resources, the researcher has identified 9 independent variables that can affect the software professional's productivity when doing teleworking. Then the preliminary survey has been directed to discover the reliability of these factors in the real software industry within the Sri Lankan context. As an outcome of this survey, the number of variables refined to 5, which are mostly impact the software engineer's productivity in the teleworking environment. It is shown in Figure 2.

The conceptual framework is shown in Figure 3. It was created by using these selected independent teleworking factors against the one dependent variable which is, the software engineer's productivity in the Teleworking environment. Then hypotheses were defined to cover all the selected variables. As the next step, the researcher had built a questionnaire to cover all the relationships between the selected independent variables and the dependent variable. This questionnaire was distributed amongst 382 software professionals who work in the Sri Lankan IT industry. The researcher had conducted a pilot survey to figure out the reliability of the questions by distributing this survey among a small number of software professionals. After refining all questions, the final questionnaire was distributed through online sources. Then concluded which hypotheses have been accepted and rejected by analyzing the collected data. In accordance with the outcome, a set of guidelines were recommended to improve the productivity of software professionals via teleworking in the Sri Lankan software industry.

3.3. Data collection methods

Data collection is a very important aspect of any research study. It is a process of collecting data from the relevant sources for the purpose of finding answers to the problem which is going to be addressed by the research. For that, researchers have used these data to test hypotheses, analyze the data, and evaluate the results. Hence data collection must be very reliable and accurate since inaccurate data may lead in the wrong direction and it may negatively affect the research. Data collection methods can be categorized into two ways as primary methods(data) and secondary methods(data).

3.3.1. Primary Data

As mentioned by (Hox & Boeije, 2005) primary data are data that is gathered for the particular research problem within reach, utilizing a methodology that fits the exploration issue best. Since this is a quantitative study, data must be numerical and must be able to compute mathematically. Hence questionnaire with close-ended questions that cover all selected variables was used to gather primary data for this research. Besides, few interviews were conducted for the preliminary survey.

3.3.2. Secondary Data

(Muhammad & Kabir, 2016a) has mentioned that secondary data is the data collected from a source that has already been verified and published in any form. Since these data have been published publically, it can be easily accessed by anyone. These data can be outdated, hence before use, researchers have to check the time period and applicability for the requirement. As secondary data, the researcher has referred to many literature sources to gain background knowledge of techniques for the productivity of software engineers and teleworking. Since these sources are already validated and analyzed, they can be used during this study in a reliable manner.

3.4. Sample Design

The sample design is a well-defined plan to select a sample from the target population. (Muhammad & Kabir, 2016b) has stated that the basic purpose of sampling is to provide an estimate of the population and to test the defined hypotheses. That means it enables us to collect and analyze data for a smaller potion which must represent a larger population.

3.4.1. Population

The target population is a large collection of individuals that the researcher is interested in researching and analyzing. Generally, this population shares one or more similar characteristics. Credibility is the most important factor in any research. Since the population is able to influence the research credibility, researchers have to carefully identify and define their target population (Asiamah et al., 2017).

This study identifies the population as software professionals in Sri Lanka who are already teleworking as well as not teleworking.

3.4.2. Sample size

Sampling is selecting a subset of a large population that can represent the entire population. When the sample is good enough and has the same characteristics which can represent the

29

whole population, the researcher doesn't need to test every item in the population (Zikmund, Babin, Carr, n.d.) For reliable outcomes from the population, the researcher has to select good and valid samples.

(Asiamah et al., 2017) have stated that quantitative researchers must think about the sample selection criteria to achieve the targets after specifying the target population. Otherwise, it may lead to incorrect results. Furthermore, (Asiamah et al., 2017) have stated that the quantitative researcher has to choose a relatively small sample from a defined large target population that is fairly eligible.

As a small sample technique, this study has adopted the formula which was used by (Krejcie & Morgan, 1970). This formula is shown in Equation 3. According to Krejcie's defined sample size table, the representative sample size for this study is 382 with an error margin of 0.5 and a confidence level of 3.841.

$$S = \frac{x^2 NP(1 - P)}{d^2(N - 1) + x^2 P(1 - P)}$$

Where,

S: Required sample size.

x^2: The table value of chi-square for 1 degree of freedom at the desired confidence level(3.841)

N: The population size.

P: The population proportion (assumed to be .50 since this would provide the maximum sample size)

d^2: The degree of accuracy expressed as a proportion (.05)

Equation 3: Krejcie and Morgan's sample size calculation Formula

3.4.3. Research Instruments

Research instruments are tools that assist the data collection for the purpose of analysis. According to (Roxana Trigueros, Med Juan, 2018) among the most used research instrument

is the survey. In this research, the questionnaire which has close-ended questions was used as the main instrument, distributed among selected sample software professionals in Sri Lanka.

This questionnaire contains 38 questions in a google form that can be accessed publically. Five-point Likert scale used as the rating scale. This questionnaire includes two sections and one open-ended question. The first section is used to collect demographic information while the second section has focused on collecting statistics for the purpose of testing hypotheses. The open-ended question is an optional one and it used to find out the general idea of the responders about teleworking and productivity.

The researcher has designed an interview for the preliminary survey as one of the data collection instrument for this study. The preliminary survey has been conducted to identify the most important variables in the real software industry within the Sri Lankan context. As a part of the preliminary survey, few software professionals from 3-5 software companies have been interviewed. These interviews were conducted in a casual manner and some of them were conducted over the phone. In this survey, the researcher has asked to state their preference on the factors which can have the highest impact on productivity among the selected factors. After analyzing the responses, 5 variables that have the highest responses have been selected to address in this research. Figure 2 indicates a summary of the responses of the preliminary survey.
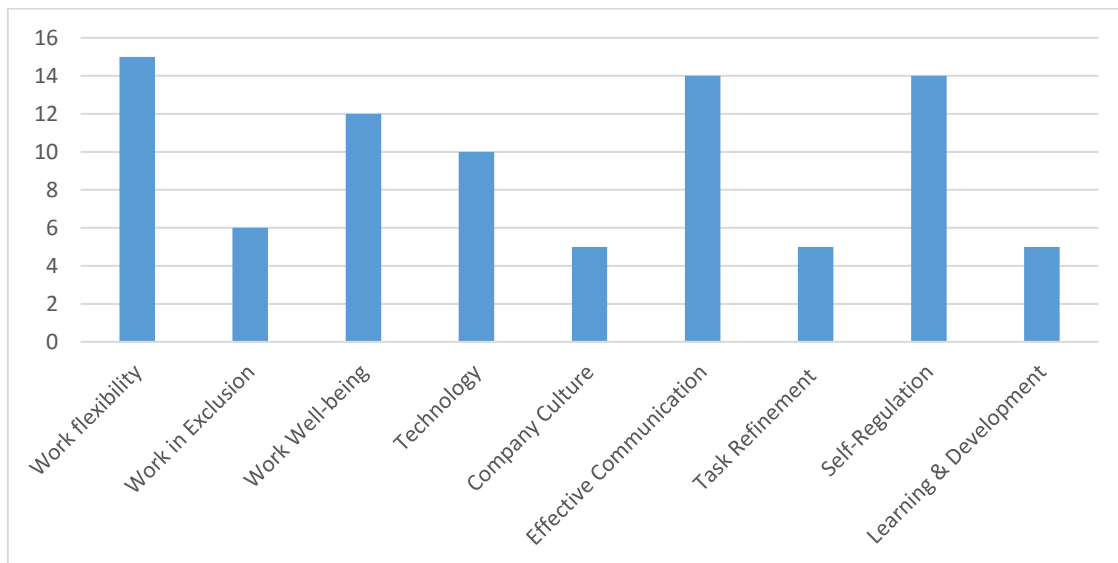
Figure 2: Summary of the preliminary survey result

3.5. Conceptual Diagram

The conceptual framework is shown in Figure 3. It is used to explicate what is the purpose of the research and how variables that are considered through the research relate to each other. (McGaghie, W. C.; Bordage, 2001) stated that the conceptual framework "sets the stages" of the specific research question that leads to the investigation based on the problem statement. Independent variables are fixed ones while the dependent variable depends on the changes of the independent variables.

Based on the literature sources, ten independent teleworking factors have been identified by the researcher for this study. Those are work flexibility, work in exclusive, work well-being, technology, company culture, effective communication, task refinement, self-regulation and learning, and development. A preliminary survey was done to identify the most important teleworking factors to the software engineer's productivity. Five factors have been chosen to address in this research after analyzing the preliminary survey result. Hence in this research, Work Flexibility, Work Well-being, Technology, Effective Communication, and Self-Regulation are identified as independent variables betwixt productivity of software engineers while teleworking is recognized as the dependent variable.
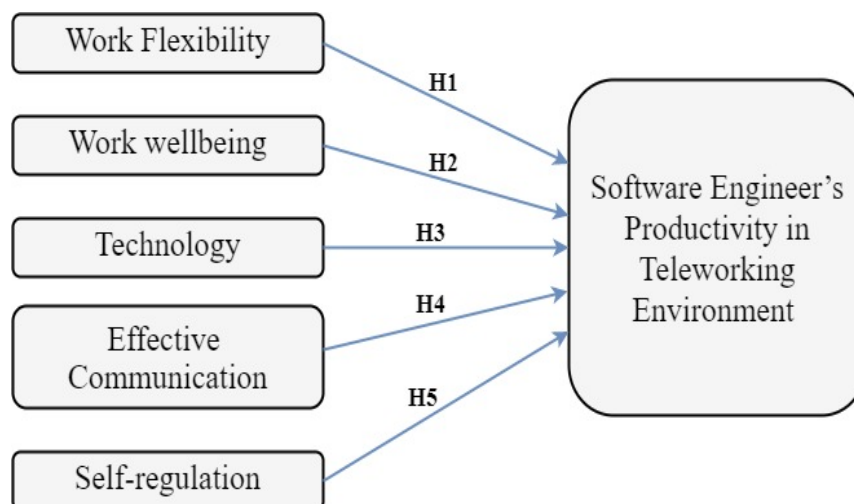
Figure 3: Conceptual framework

3.6. Hypothesis

The hypothesis can be defined as a guess since it is informed by what the researcher already knows. A hypothesis is a well-defined, verifiable statement that expresses what is investigated while conducting a research study. There are two sorts of hypotheses called the alternative hypothesis and the null hypothesis. Alternative one is the opposite of the null one and it can be only reached if the null one is rejected. So ten hypotheses have been defined by the researcher for this study dividing 2 hypotheses per one identified factor.

Work Flexibility

H_{1-0}: There is no relationship between Work Flexibility and the software engineer's **Productivity** in Teleworking Environment.

H_{1-1}: There is a relationship between Work Flexibility and the software engineer's **Productivity** in Teleworking Environment.

Work wellbeing

H_{2-0}: There is no relationship between Work wellbeing and the software engineer's **Productivity** in Teleworking Environment.

H_{2-1}: There is a relationship between Work wellbeing and the software engineer's **Productivity** in Teleworking Environment.

Technology

H_{3-0}: There is no relationship between Technology and the software engineer's **Productivity** in Teleworking Environment.

H_{3-1}: There is a relationship between Technology and the software engineer's **Productivity** in Teleworking Environment.

Effective Communication

H_{4-0}: There is no relationship between Effective Communication and the software engineer's **Productivity** in Teleworking Environment.

H_{4-1}: There is a relationship between Effective Communication and the software engineer's **Productivity** in Teleworking Environment.

Self-regulation

H_{5-0}: There is no relationship between Self-regulation and the software engineer's **Productivity** in Teleworking Environment.

H_{5-1}: There is a relationship between Self-regulation and the software engineer's **Productivity** in Teleworking Environment.

3.7. Pilot survey

According to (In, 2017), the pilot survey is an important aspect of improving the quality and efficiency of the research study. The pilot survey has been carried out to verify the reliability of the questionnaire. After creating a questionnaire including all variables and demographic questions, it has been distributed among 25 Software Engineers. After that researcher has checked Cronbach's alpha for each question to check the reliability of the questions by using pilot survey responses.

3.7.1. Reliability analysis

High quality is one of the most important characteristics of any research study. So, reliability analysis must be carried out to verify the reliability of the research instrument. The instrument can be considered as a reliable one if it gives consistent results under the same conditions. Relationships between every individual item in the instrument/scale is provided by the reliability analysis. In reliability analysis, internal consistency which is based on the correlation between items is used to measure the reliability of items in research instruments. With a high positive correlation value, the questionnaire can be considered as a reliable one.

Cronbach's alpha is one of the measures which is used on a large scale to measure the internal consistency by computing correlation when the questionnaire has multiple Likert scale questions (Trizano-hermosilla & Alvarado, 2016).

In this study, the researcher has used Cronbach's alpha to measure the reliability of the questionnaire. Table 1 shows the strength of the internal consistency level of each Cronbach's alpha range.

After conducted the pilot survey, reliability analysis was done to all independent variables which were selected to consider in this study as well as the dependent variable. This analysis was done using IBM SPSS Statistics Subscription software.

According to Table 1, if the Cronbach's alpha value is greater than 0.7 then the questions of the variable have good reliability. Further, there is a good internal consistency of the questions to measure the relevant variable. If the alpha value is less than 0.6, then the questions are not good enough to measure the variable. Hence in order to get high alpha value, the researcher has removed some questions and some were modified.

Table 12 shows the summary reliability analysis result, Cronbach alpha for a set of items as a group for this research study.

3.8. Questionnaire

The questionnaire which is used as the main research instrument in this study comprises thirty-two questions in two sections. This was designed to assemble data that relates to the software engineer's productivity while doing telework. The first section consists of 5 demographic questions to learn more about the selected sample and 6 general questions with regard to the organization and teleworking. With these 11 questions, the researcher was able to know what the selected sample thinking.

The second section consists of twenty-six questions designed to collect data related to variables. Four questions out of twenty-six are used to gather data related to the dependent variable while the other twenty-two questions are used to collect data related to identifying five independent variables. Some questions are designed to measure multiple factors

(variables). All of these questions are five points Likert scale which spread Strongly Agree (1) to Strongly Disagree (5) ones. Table 5 demonstrates the detailed background of the structure of these twenty-six questions. As the last question, the researcher has used an open-ended question to collect the information related to what the selected sample is thinking of telework and to know about the recommendations and new ideas from the respondents.

This questionnaire is published as a Google Form, which is publically available and distribute among 500+ software professionals to get a maximum number of responses.

Table 5: Structure of the questionnaire

#	Question	Work Flexibility	Work wellbeing	Technology	Effective Communication	Self-regulation	Productivity
12	It would be better if the company can provide opportunities to work from home when an employee is not able to report to work for a reliable reason.	X					
13	When I have control over my working time & working place, it increases my capability to work more.	X					X
14	Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments	X	X				
15	I'm able to manage my time and workload well by prioritizing tasks and setting deadlines.	X					
16	When I'm working from home, I feel very comfortable and more refreshed.		X				
17	When I'm working from home, I feel less stressed since there are fewer office interruptions and I have control of my work time & place		X				
18	When I'm working from home, I can take health breaks which is important for musculoskeletal relaxation which helps to reduce musculoskeletal pain (pain in muscles, bones, nerves, etc.).		X				
19	I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.		X			X	

#	Statement						
20	Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers			X			
21	Teleworker needs cloud computing systems to make trustworthy share and use of software and files.			X			
22	Teleworker needs proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches.			X			
23	Teleworker needs adequate training in the use of IT tools and quick technical support.			X			
24	Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers.			X			
25	Teleworker should be a good team player and communicate frequently with supervisors and fellow workers.				X		
26	Communication is an essential way to build trust between managers and teleworkers. With this trust, I feel that supervisors recognize and appreciate my work.				X		
27	Teleworker should attend meetings using methods such as WebEx or webinars.				X		
28	Teleworker has to interpret the content of audio/emails/chat clearly to get the exact requirement since teleworker isn't able to interpret the body language.				X		
29	Without frequent feedback from supervisors/experts, teleworker may go in the wrong direction towards project implementation and end up with the wrong software.				X		
30	Teleworker should be self-motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition.					X	
31	Teleworker should be able to be productive with supervision as well as when no-one is checking up on him/her..					X	X
32	Teleworker should be able to complete assigned tasks independently, on-time and with minimal guidance					X	
33	Teleworker should be highly focused and have the ability to handle potential family/ home distractions.					X	
34	Teleworking allows me to save working hours by stopping me from driving in heavy traffic.						X
35	I feel that I am more productive when teleworking since it ends up working longer hours than required.						X
36	I feel that the hybrid arrangement of telework (telework on need basis) positively affects my productivity.						X
37	Teleworking makes me feel that I may able to finish my work on time.						X

3.9. Conclusion

The research methodology is a procedure used to identify the relationship between the teleworking and the software engineer's productivity in the Sri Lankan Software industry. This chapter explains how this study was conducted, what was the target population and the sample of this study, how the sample was chosen from the population, how the data was collected for analyzing, etc. All teleworking factors which may affect the productivity of software engineers have been identified by the literature review and survey questionnaire was designed to cover these selected factors. Furthermore, this describes how the researcher checks the reliability of the questionnaire using Cronbach's alpha to increase the quality of the questionnaire. this questionnaire has been distributed as a google form via social media and emails.

4. CHAPTER 4: DATA ANALYSIS

4.1. Chapter Introduction

This chapter characterizes the data analysis and findings of this research study. Quantitative research investigations mainly analyze the relationship between numerically estimated factors with the use of statistical applications. So in this study, the questionnaire was used to collect data from the target population and use some statistical tools like SPSS software to analyze the data.

First, the researcher has done a descriptive analysis to get a better understanding by simplifying the dataset. Then one has done the statistical investigation to acknow the relations among the selected variables. Cronbach's alpha coefficient calculation and the Pearson correlation coefficient analysis were done as the statistical analysis. After that regression analysis has been conducted. Finally one has done hypothesis validation by using the result of the above-conducted analysis.

4.2. Data Collection

Since this is a quantitative study, quantitative data that are generally communicated in the numerical structure was gathered. The statistical techniques can be used to measure the reliability of the data and analyze the data set.

The research data collection has been conducted around one month time period. Quantitative data were accumulated by an online survey questionnaire which was distributed among the employees who are working in the Sri Lankan IT industry. This questionnaire was created using an online google form tool and distributed via social media, Gmail, and LinkedIn.

The entire survey was done by means of electronic technique by utilizing an online survey. The researcher was able to collect around 382 counts of data and this information assortment was completed within the one-month timespan. There are no missing values in the data set. Figure 4 shows the pattern of the data collected through the online survey questionnaire.
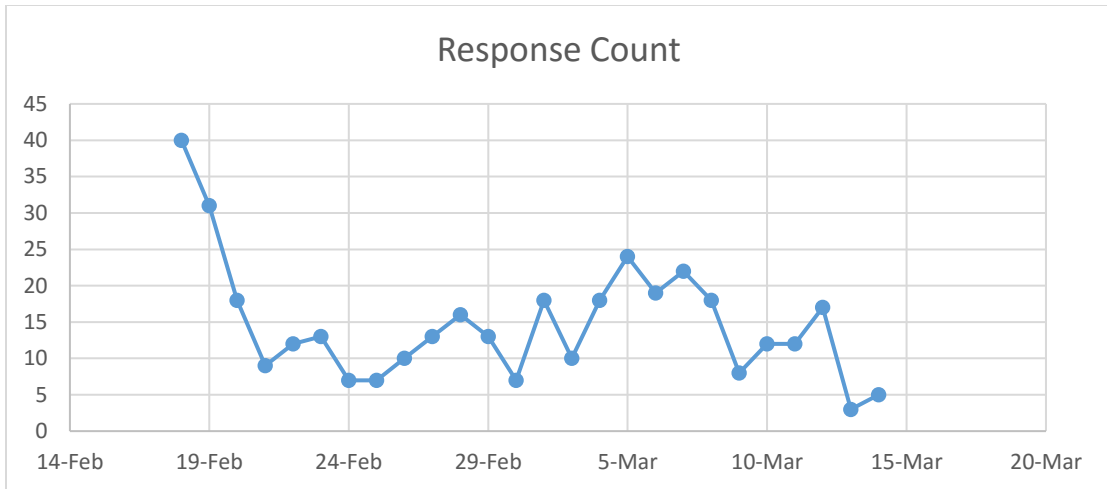
Figure 4: Data collection pattern

4.3. Reliability Analysis

Since it is indispensable to check the goodness of the questionnaire which is used for data collection, the researcher has conducted the reliability analysis as a first analysis. In reliability analysis, internal consistency which is based on the correlation between items is used to measure the reliability of items in research instruments. With a high positive correlation value, the questionnaire can be considered as a reliable one.

In this study, the researcher has used Cronbach's alpha to measure the reliability of the questionnaire.

Table 1 shows the strength of the internal consistency level of each Cronbach's alpha range. This reliability analysis was conducted using IBM SPSS Statistics Subscription 25 tool. The summary of reliability analysis is shown in Table 12 and Figure 5.

4.3.1. Work-Flexibility

Table 6: Reliability Analysis of Work Flexibility

	Reliability Statistics	
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.703	.710	4

The reliability analysis result for work flexibility is shown in Table 6. According to the result, work flexibility has 0.703 Cronbach's alpha value. Based on Table 1, the questions which are used to measure the work flexibility has good reliability. And also there is a good internal consistency of the questions to measure the particular variable.

4.3.2. Work Wellbeing

Table 7: Reliability Analysis of Work Wellbeing

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.704	.700	5

The reliability analysis result for work wellbeing is shown in Table 7. According to the result, work flexibility has 0.704 Cronbach's alpha value. Based on Table 1, the questions which are used to measure the work wellbeing have good reliability. And also there is a good internal consistency of the questions to measure the particular variable.

4.3.3. Technology

Table 8: Reliability Analysis of Technology

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.706	.725	5

The reliability analysis result for technology is shown in Table 8. According to the result, technology has 0.706 Cronbach's alpha value. Based on Table 1, the questions which are used to measure technology have good reliability. And also there is a good internal consistency of the questions to measure the particular variable.

4.3.4. Effective Communication

Table 9: Reliability Analysis of Effective Communication

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.727	.736	5

The reliability analysis result for effective communication is shown in Table 9. According to the result, technology has 0.727 Cronbach's alpha value. Based on Table 1, the questions which are used to measure effective communication have good reliability. And also there is a good internal consistency of the questions to measure the particular variable.

4.3.5. Self-Regulation

Table 10: Reliability Analysis of Self-Regulation

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.706	.718	5

The reliability analysis result for self-regulation is shown in Table 10. According to the result, technology has 0.706 Cronbach's alpha value. Based on Table 1, the questions which are used to measure self-regulation has good reliability. And also there is a good internal consistency of the questions to measure the particular variable.

4.3.6. Productivity in the teleworking environment

Table 11: Reliability Analysis of Teleworkers' Productivity

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.698	.704	6

The reliability analysis result for productivity in the teleworking environment is shown in Table 11. According to the result, technology has 0.698 Cronbach's alpha value. That means the questions which are used to measure productivity has moderate reliability. Based on Table 1, this is near to a good strength level. Hence there is a good internal consistency of the questions to measure the particular variable.

Table 12: Summary of Reliability analysis

Variable	Number of Items	Cronbach's Alpha
Dependent		
Productivity in Teleworking Environment	6	0.698
Independent		
Work Flexibility	4	0.703
Work Wellbeing	5	0.704
Technology	5	0.706
Effective Communication	5	0.727
Self-Regulation	5	0.706
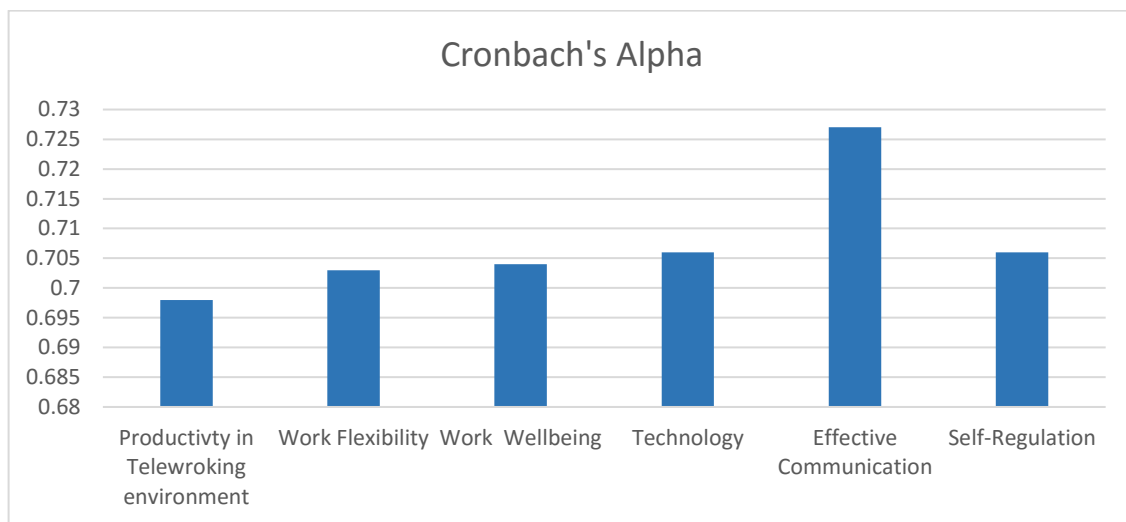
Figure 5: Reliability statistics using Cronbach's Alpha

4.4. Descriptive analysis of Demographic data

Descriptive analysis is utilized to describe the fundamental characteristic of the data in the research study. It provides a basic outline of the sample and the measures. Descriptive analysis structure the fundamental virtual of any quantitative investigation of data with simple graphical analysis.

4.4.1. Demographic Analysis using charts

4.4.1.1 Classification of the sample by gender

According to Figure 6 and Table 13 Gender Composition, it is notable that most of the sample respondents are male. Out of the total responder count 382, 51% was attributed to male software professionals and the rest of the 49% was attributed to female software professionals. This statistic is somewhat evident to prove that there is an equal count of male and female software professionals work in the Sri Lankan IT industry.

Table 13: Demographic analysis based on gender

Gender	Frequency	Percent
Male	196	51
Female	186	49
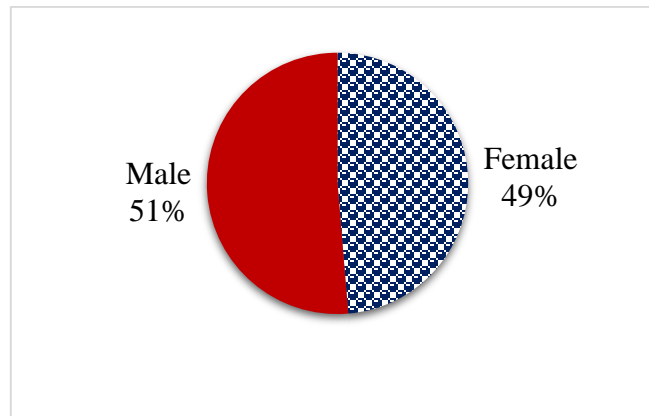
Figure 6: Respondent based on gender

4.4.1.2 Classification of the sample by the age

Table 14 and Figure 7 elaborate on the age of the responders. Out of 382, the majority of the software professionals belong to the 25 – 29 years age group that is 47%. The minority responders belong to the 20-24 years age group, which is 2%. Consecutively respondents whose age is between 30 – 34 years, 35 – 39 years, and 40 above are deputized in the sample by 40%, 6%, and 5%.

Table 14: Demographic analysis based on age

Age in years	Frequency	Percent
20 – 24 years	7	2
25 – 29 years	181	47
30 – 34 years	152	40
35 – 39 years	24	6
40 above	18	5
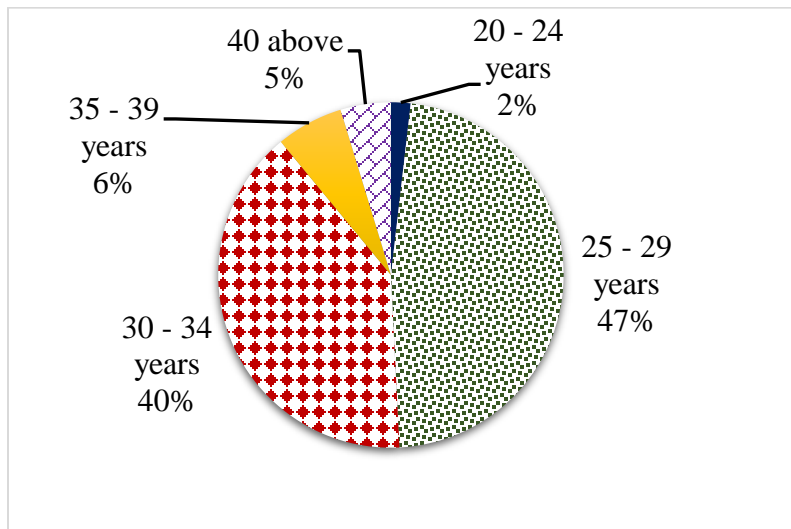
Figure 7: Respondent based on age

4.4.1.3 Classification of the sample by the marital status

Figure 8 and Table 15 describe the marital status of the responders of the study. Out of 382, the majority of the software professionals are "Single". That is 52% of the sample size. The minority responders belong to the "Married, have children above 5Y" marital status group. That is 3% of the sample. Married but haven't any children responders count is 110 out of 382 and it is 29% of the sample size. The responders who are married but have kids whose ages below 5, represent 16% of the sample. That is 16% of the sample size.

Table 15: Demographic analysis based on marital status

Marital Status	Frequency	Percent
Single	199	52
Married, no children	110	29
Married, have children below 5Y	61	16
Married, have children above 5Y	12	3
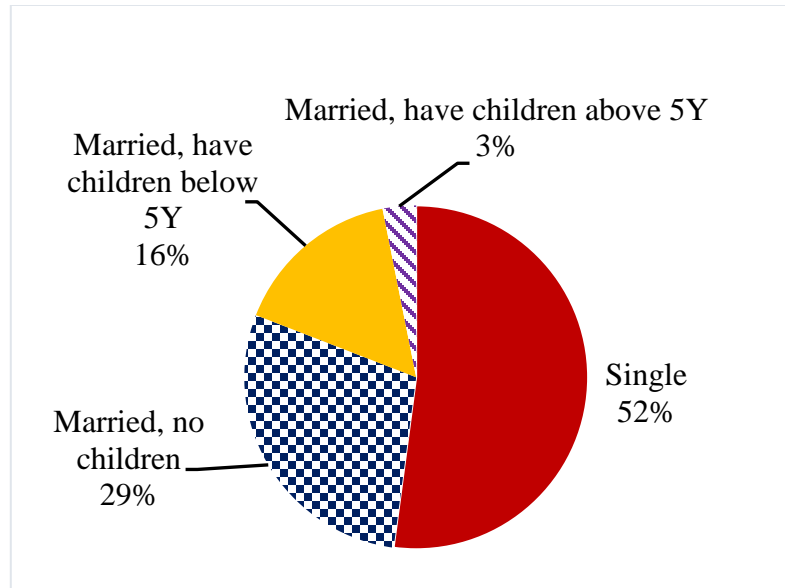
Figure 8: Respondent based on the marital status

4.4.1.4 Classification of the sample by different role categories in the software industry

Figure 9 and Table 16 represents the job role of the responders of the study. 214 responders out of the total responder count 382 are playing the " Software Developer" role. That is 56% of the sample size. The minority responders are the Business Analyst and they represent the 1% of the sample size. Consecutively respondents are "QA Engineer", "Team / Tech Lead", "Technical Architect", "Project Manager", and "System Engineer" are deputized in the sample by 6%, 21%, 5%, 7%, and 4%.

Table 16: Demographic analysis based on job role

Role	Frequency	Percent
Software Developer	214	56
QA Engineer	24	6
Team / Tech Lead	79	21
Technical Architect	19	5
Project Manager	29	7
System Engineer	14	4
Business Analyst	3	1
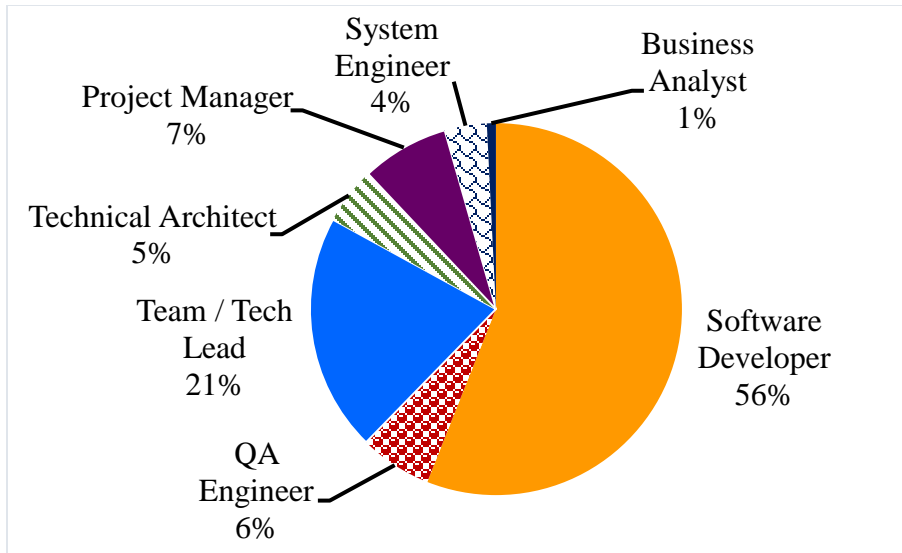
Figure 9: Respondent based on the job role

4.4.1.5 Classification of the sample by working experience in the Software Company which allows teleworking

Figure 10 and Table 17 describe the working experience of the responders in the company which allows teleworking. The majority of the employees have worked 2-5 years in the company which allows teleworking and that is 56% of the sample size. In sequence responders whose working experience is between 0-1 Year, 6-10 Years, and More than 10 years are deputized in the sample by 26%, 14%, and 4%. This represents the percentage of adopting telework by the IT companies in Sri Lanka. Based on this evidence, It can be observed that Sri Lankan IT companies have adopted this concept latterly.

Table 17: Demographic analysis based on work experience

Working Experience	Frequency	Percent
0-1 Year	100	26
2-5 Years	214	56
6-10 Years	53	14
More than 10 years	15	4

47
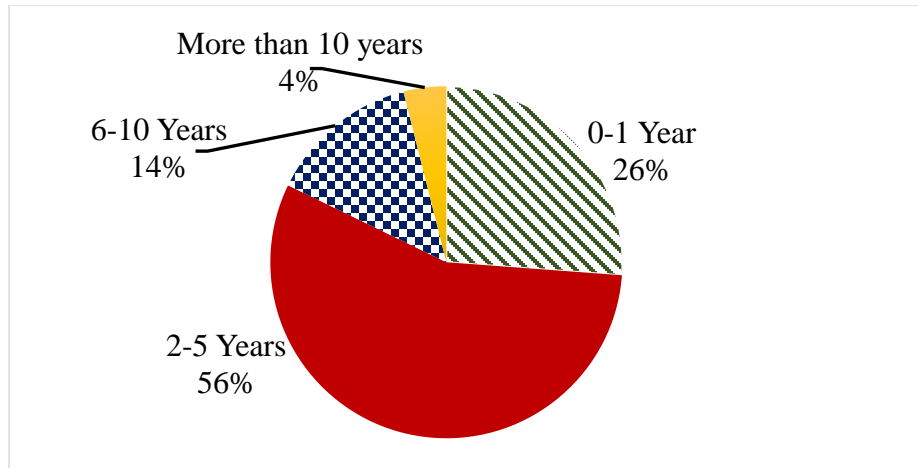
Figure 10: Respondent based on the work experience

4.4.1.6 Classification of the sample by the distance to the office

Table 18 and Figure 11 depicts the distance between the responder's home and the working office. According to the research data, the majority of the responders belong to the "Between 5km - 14km" distance group. That is 37% of the sample group. There is less number of responders belong to the "Between 45km - 54km" distance category. That is 3% of the sample group. Respectively, the distance between responder's living place and the office is "less than 5km", "Between 15km - 24km", "Between 25km - 34km", "Between 35km - 44km", and "More than 55km" are portrayed in the sample by 19%, 22%, 9%, 6%, and 4%. Based on this evidence, It appears that the Sri Lankan IT employees live around Colombo city. Some people live their own homes when some are living in a rent house or boarding place.

Table 18: Demographic analysis based on the distance between office and living place

Distance	Frequency	Percent
less than 5km	72	19
Between 5km - 14km	143	37
Between 15km - 24km	84	22
Between 25km - 34km	33	9
Between 35km - 44km	25	6
Between 45km - 54km	11	3
More than 55km	14	4
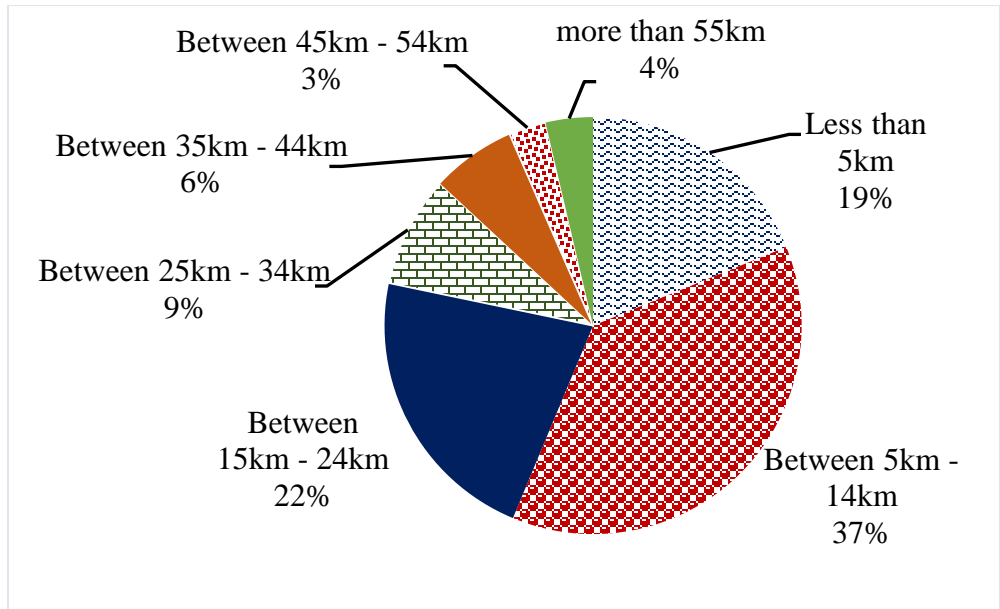
Figure 11: Respondent based on the distance between office and living place

4.4.1.7 Classification of the sample by the time to travel to the office

Figure 12 and Table 19: travel time to the office depicts the responder's traveling time to the office from their living place. The majority of software professionals take time between 31 - 60 minutes to come to the office. That is 38% of the sample size. Taking 60minutes to travel is a considerable time waste. Consecutively the travel time of respondents is "Less than 30 minutes", "Between 61- 90 minutes", "Between 61- 90 minutes", "Between 91 - 120 minutes", "More than 121 minutes" are deputized in the sample by 25%, 23%, 8%, and 6%. By saving travel time employees are able to commit the work more time.

Table 19: Demographic analysis based on travel time to the office

Travel Time	Frequency	Percent
Less than 30 minutes	96	25
Between 31 - 60 minutes	147	38
Between 61- 90 minutes	86	23
Between 91 - 120 minutes	32	8
More than 121 minutes	21	6

49
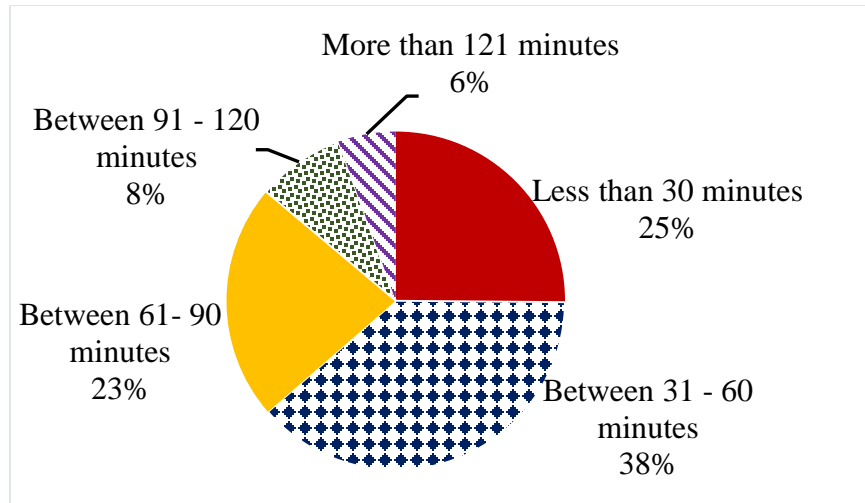
Figure 12: Respondent based on the travel time to the office

4.4.1.8 Classification of the sample by allowing Telework by company

Figure 13 and Table 20: allowing telework by company, it is notable that most of IT companies provide the teleworking facility to their employees. Out of the total responder count 382, 73% of employees are working in the companies which allow telework and the rest of the 27% are working in the companies which are not permitting to telework. This statistic is somewhat evident to prove that most companies in the Sri Lanka IT industry, allow telework to their employees.

Table 20: Demographic analysis based on allowing telework by company

Allow / Not	Frequency	Percent
Yes	279	73
No	103	27
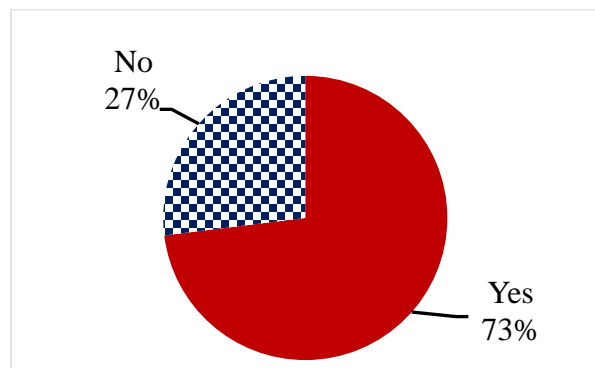
Figure 13: Respondent based on the allowing telework by company

4.4.1.9 Classification of the sample by the employee's willingness to do Telework

Figure 14 and Table 21 describe the willingness of the responders to do the telework. According to the data, it is notable that most employees are willing to do telework. Out of the total responder count 382, 94% was attributed to the employees who are like to do telework. The rest of the 6% were attributed to the employees who do not like to do telework. That ratio is very less compared to the other one.

Table 21: Demographic analysis based on employee's willingness to do telework

Willingness	Frequency	Percent
Yes	359	94
No	23	6
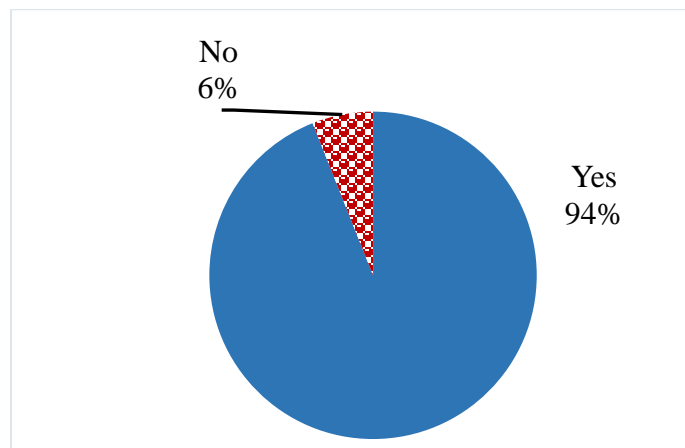
Figure 14: Respondent based on the employee's willingness to do telework

4.4.1.10 Classification of the sample by the frequency of doing Teleworking

Figure 15 and Table 22 represent the frequency of doing telework by IT employees. Most responders in the sample are doing telework on a need basis. That is 65% of the sample size. In sequence responders who are doing telework "At least once a week", "Once every two weeks", "Occasionally for special projects" are deputized in the sample by 13%, 3%, and 19%. Some responders state that they are doing telework due to the work-life balance and save the travel time. For work-life balance, they do telework on a need basis, such as family commitments.

Table 22: Demographic analysis based on the frequency of doing teleworking

Frequency of doing Telework	Frequency	Percent
At least once a week	50	13
Once every two weeks	13	3
Occasionally for special projects	71	19
On need basis	248	65
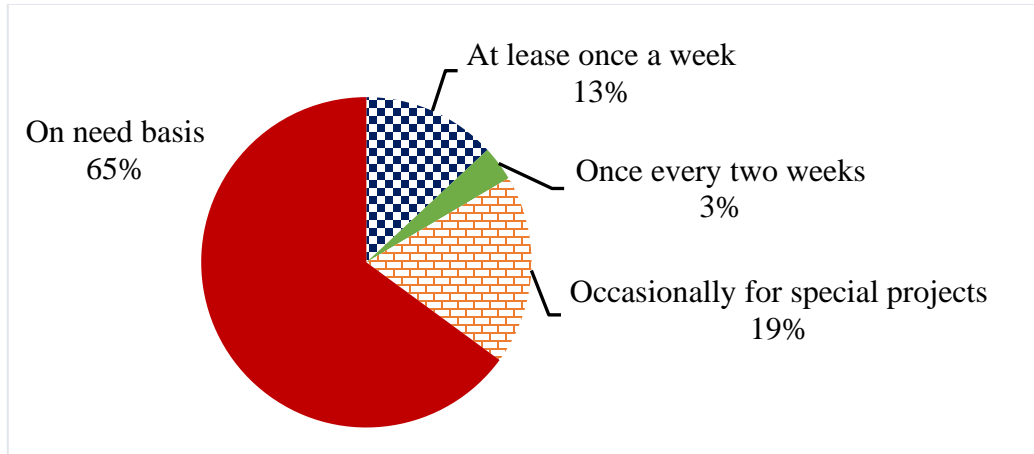
Figure 15: Respondent based on the frequency of doing teleworking

4.4.1.11 Classification of the sample by the employee's opinion on Teleworking

Figure 16 and Table 23 represent the IT employees' opinions on telework. Most responders in the sample have a Positive mindset regarding the telework. That is 48% of the sample size. 32% of responders have a very positive mindset toward telework. 18% of IT employees have a neutral mindset and 2% of responders have a negative mindset regarding the telework. This statistics is a piece of evidence to state that the majority of Sri Lankan IT employees have a positive mindset regarding telework.

Table 23: Demographic analysis based on the employee's opinion on teleworking

Opinion	Frequency	Percent
Very positive	121	32
Positive	184	48
Neutral	69	18
Negative	7	2
Very negative	1	0
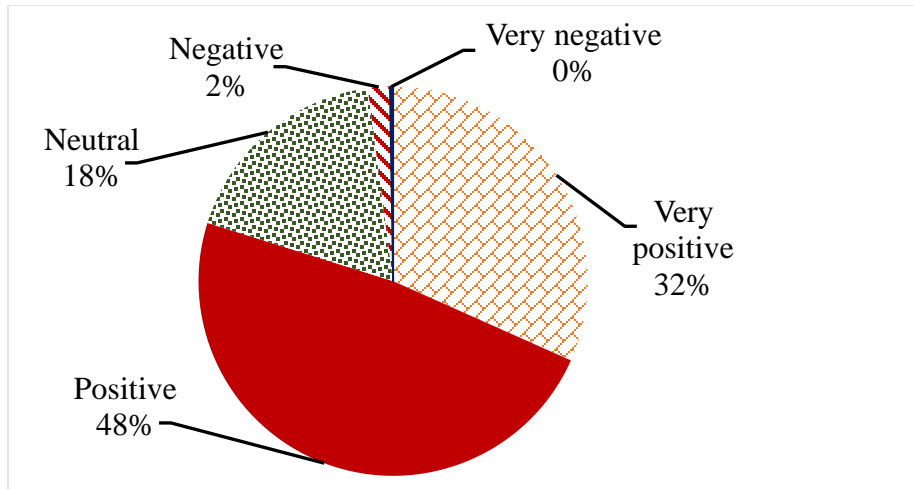
Figure 16: Respondent based on the employee's opinion on teleworking

4.4.2. Demographic Analysis using statistical methods

Pearson correlation coefficient under bivariate correlate was used to determine the relationship between the demographic variable and the dependent variable. There is a significant relationship between the two variables when the significance value(p) greater than 0.05. If the correlation value(r) is positive, this relationship is a positive one. Otherwise, it is a negative relationship. If the significance value(p) lesser than 0.05 or 0.01, there is no significant relationship between the two variables.

4.4.2.1 Analyze the relationship between Age and Productivity in Teleworking Environment

As appeared in Table 24, the Pearson correlation is computed to check if there is a relationship between age and productivity in the teleworking environment. According to the table, the correlation coefficient is 0.027 with a 0.595 two-tailed significance value.

$r(380) = 0.027$, $p = 0.595$ and $p > 0.05$

Therefore, there is no significant relationship between age and productivity in the teleworking environment.

Table 24: Pearson Correlation analysis for variables age and productivity

Correlations

		Productivity	Age
Productivity	Pearson Correlation	1	.027
	Sig. (2-tailed)		.595
	N	382	382
Age	Pearson Correlation	.027	1
	Sig. (2-tailed)	.595	
	N	382	382

4.4.2.2 Analyze the relationship between Gender and Productivity in Teleworking Environment

As revealed in Table 25, the Pearson correlation is computed to verify the relationship between gender and productivity in the teleworking environment. There is a 0.022 two-tailed significance value at the 0.05 level. As a consequence of the correlation analysis, there is a significant positive relationship between gender and productivity in the teleworking environment.

$r(380) = 0.117$, $p = 0.022$ and $p < 0.05$

Table 25: Pearson Correlation analysis for variables gender and productivity

Correlations

		Productivity	Gender
Productivity	Pearson Correlation	1	.117*
	Sig. (2-tailed)		.022
	N	382	382
Gender	Pearson Correlation	.117*	1
	Sig. (2-tailed)	.022	
	N	382	382

*. Correlation is significant at the 0.05 level (2-tailed).

4.4.2.3 Analyze the relationship between Marital Status and Productivity in Teleworking Environment

As appeared in Table 26, the Pearson correlation is computed to examine the relationship between marital status and productivity in the teleworking environment. According to the table, the correlation coefficient is 0.150 with a 0.003 two-tailed significance value at the 0.01 level.

$r(380) = 0.150$, $p = 0.003$ and $p < 0.01$

Therefore, there is a significant positive relationship between marital status and productivity in the teleworking environment.

Table 26: Pearson Correlation analysis for variables marital status and productivity

Correlations

		Productivity	Marital-Status
Productivity	Pearson Correlation	1	.150**
	Sig. (2-tailed)		.003
	N	382	382
Marital-Status	Pearson Correlation	.150**	1
	Sig. (2-tailed)	.003	
	N	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.2.4 Analyze the relationship between Distance, Travel Time and Productivity in Teleworking Environment

As revealed in Table 27, the Pearson correlation is computed to verify the relationship between distance & productivity, travel time & productivity, and distance & travel time. There is a 0.000 two-tailed significance value at the 0.01 level in-between travel time and the distance between office and living place.

As a consequence of the correlation analysis, there is a significant positive relationship between distance and travel time. But there is no significant relationship between distance and productivity as well as travel time and productivity.

Travel time and Productivity : $r(380) = -0.060$, $p = 0.242$ and $p > 0.05$

Distance and Productivity : $r(380) = -0.077$, $p = 0.131$ and $p > 0.05$

Distance and Travel Time : $r(380) = 0.774$, $p = 0.000$ and $p < 0.01$

Table 27: Pearson Correlation analysis for variables distance, travel time and productivity

Correlations

		Productivity	Distance-To-Office	Travel-time
Productivity	Pearson Correlation	1	-.077	-.060
	Sig. (2-tailed)		.131	.242
	N	382	382	382
Distance-To-Office	Pearson Correlation	-.077	1	.774**
	Sig. (2-tailed)	.131	.	.000
	N	382	382	382
Travel-time	Pearson Correlation	-.060	.774**	1
	Sig. (2-tailed)	.242	.000	
	N	382	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.2.5 Analyze the relationship between Role and Productivity in Teleworking Environment

As appeared in Table 28, the Pearson correlation is computed to check if there is a relationship between job role and productivity in the teleworking environment. According to the table, the correlation coefficient is -0.050 with a 0.327 two-tailed significance value.

$r(380) = -0.050$, $p = 0.327$ and $p > 0.05$

Therefore, there is no significant relationship between job role and productivity in the teleworking environment.

Table 28: Pearson Correlation analysis for variables job role and productivity

Correlations

		Productivity	Job-Role
Productivity	Pearson Correlation	1	-.050
	Sig. (2-tailed)		.327
	N	382	382
Job-Role	Pearson Correlation	-.050	1
	Sig. (2-tailed)	.327	
	N	382	382

4.4.2.6 Analyze the relationship between Offering Teleworking and Productivity in Teleworking Environment

As appeared in Table 29, the Pearson correlation is computed to examine the relationship between offering telework by IT companies and productivity in the teleworking environment. According to the table, the correlation coefficient is 0.100 with a 0.051 two-tailed significance value.

$r(380) = 0.100$, $p = 0.051$ and $p > 0.05$

Therefore, there is no significant relationship between offering telework and productivity in the teleworking environment.

Table 29: Pearson Correlation analysis for variables offer telework by company and productivity

Correlations

		Productivity	Allow-telewrok-by-office
Productivity	Pearson Correlation	1	.100
	Sig. (2-tailed)		.051
	N	382	382
Allow-telewrok-by-office	Pearson Correlation	.100	1
	Sig. (2-tailed)	.051	
	N	382	382

4.4.2.7 Analyze the relationship between willingness to Telework and Productivity in Teleworking Environment

As appeared in Table 30, the Pearson correlation is computed to verify the relationship between the willingness of employees to do telework and productivity in the teleworking environment. As a consequence of correlation analysis, the Pearson coefficient value is 0.135 with a 0.008 two-tailed significance value at the 0.01 level.

$r(380) = 0.135$, $p = 0.008$ and $p < 0.01$

Hence, there is a significant positive relationship between the willingness of employees to do telework and productivity in the teleworking environment.

Table 30: Pearson Correlation analysis for variables employees' willingness and productivity

Correlations		Productivity	Willingness-to-telework
Productivity	Pearson Correlation	1	.135**
	Sig. (2-tailed)		.008
	N	382	382
Willingness-to-telework	Pearson Correlation	.135**	1
	Sig. (2-tailed)	.008	
	N	382	382
**. Correlation is significant at the 0.01 level (2-tailed).			

4.4.2.8 Analyze the relationship between the experience and Productivity in Teleworking Environment

As appeared in Table 31, the Pearson correlation is computed to check if there is a relationship between work experience in the company which allows telework and productivity in the teleworking environment. According to the table, the correlation coefficient is -0.073 with a 0.153 two-tailed significance value.

$r(380) = -0.073$, $p = 0.153$ and $p > 0.05$

Therefore, there is no significant relationship between work experience and productivity in the teleworking environment.

Table 31: Pearson Correlation analysis for variables work experience and productivity

Correlations		Productivity	experience
Productivity	Pearson Correlation	1	-.073
	Sig. (2-tailed)		.153
	N	382	382
experience	Pearson Correlation	-.073	1
	Sig. (2-tailed)	.153	.
	N	382	382

4.4.3. Measures of Central Tendency

Here researcher has considered the mean value and the standard deviation as central tendency measures. The standard deviation is a statistic that gauges the scattering of a dataset relative to its mean. Standard deviation is calculated as the square root of variance. It indicates how far the responses to a question dispersion from the mean.

4.4.3.1 Productivity in Teleworking Environment

Table 32 and Figure 17 describe the six statements used to measure the dependent variable "Productivity in the teleworking environment". According to Table 32 and Figure 17, the least mean value, 1.52 and standard deviation, 0.701 are taken by the third statement "Teleworking allows me to save working hours by stopping me from driving in heavy traffic". Consecutively, first, second, fourth, fifth, and sixth statements are taken the mean values 1.8, 1.69, 2.18, 1.68, and 2.08. In that manner, respective standard deviation values are 0.79, 0.708, 0.925, 0.702 and 0.785. So the overall mean value (μ) of productivity in the teleworking environment is 1.8243.

Table 32: Central tendencies of Productivity in the teleworking environment

Question	N	Mean	Std. dev.
When I have control over my working time & working place, it increases my capability to work more.	382	1.8	0.79
Teleworker should be able to be productive with supervision as well as when no-one is checking up on him/her.	382	1.69	0.708
Teleworking allows me to save working hours by stopping me from driving in heavy traffic.	382	1.52	0.701
I feel that I am more productive when teleworking since it ends up working longer hours than required.	382	2.18	0.925
I feel that the hybrid arrangement of telework (telework on need basis) positively affects my productivity.	382	1.68	0.702
Teleworking makes me feel that I may able to finish my work on time.	382	2.08	0.785
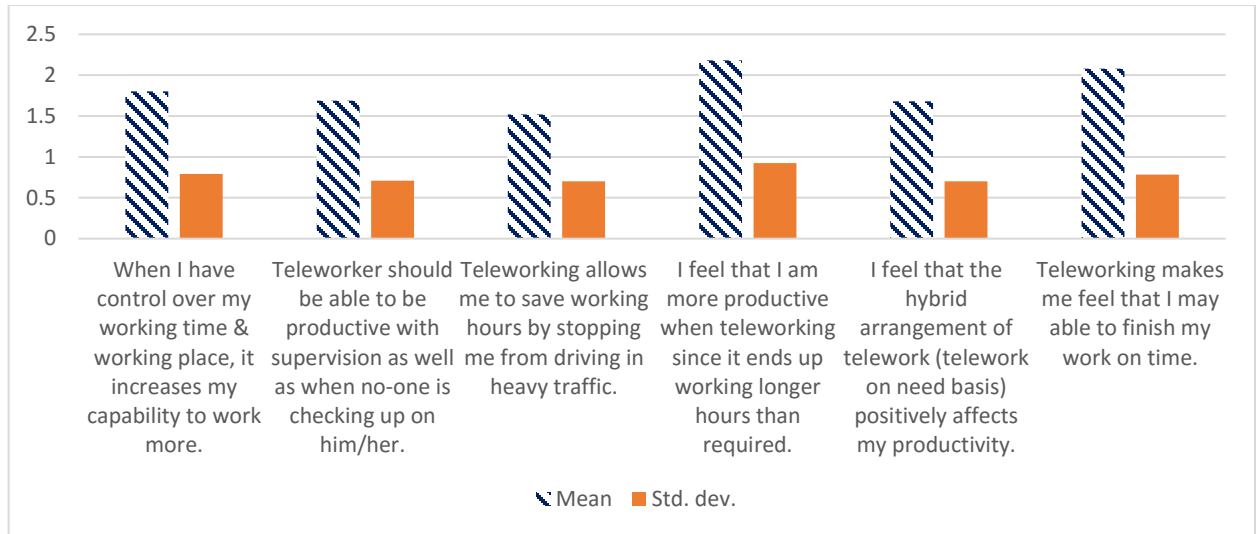
Figure 17: Central tendencies of Productivity in the teleworking environment

4.4.3.2 Work Flexibility

Table 33 and Figure 18 shows the four statements used to measure the independent variable "Work Flexibility". According to the Table 33 and Figure 18, the least mean value, 1.35 and standard deviation, 0.492 are taken by the first statement "It would be better if the company can provide opportunities to work from home when an employee is not able to report to work for a reliable reason". Respectively, second, third, and fourth statements are taken the mean values 1.8, 1.69, and 1.91. Like that, respective standard deviation values are 0.79, 0.707, and 0.702. So the overall mean value (μ) of work flexibility is 1.6839.

Table 33: Central tendencies of Work Flexibility

Question	N	Mean	Std. dev.
It would be better if the company can provide opportunities to work from home when an employee is not able to report to work for a reliable reason.	382	1.35	0.492
When I have control over my working time & working place, it increases my capability to work more.	382	1.8	0.79
Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments	382	1.69	0.707
I'm able to manage my time and workload well by prioritizing tasks and setting deadlines.	382	1.91	0.702
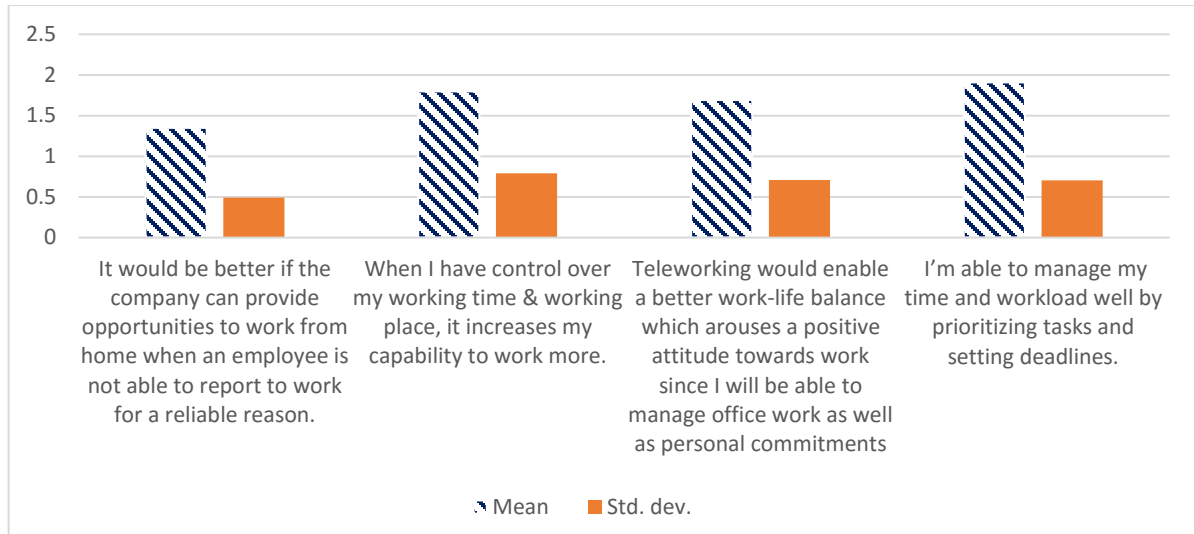
Figure 18: Central tendencies of Work Flexibility

4.4.3.3 Work Well-being

Table 34 and Figure 19 shows the five statements used to measure the independent variable "Work Wellbeing". According to the Table 34 and Figure 19, the least mean value, 1.69 and standard deviation, 0.707 are taken by the first statement "Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments". Consecutively, statements two, three, four, and five have mean values 1.87, 1. 95, 1.79, and 2.44. In that manner, respective standard deviation values are 0.817, 0.903, 0.821 and 0.999. So the overall mean value (μ) of work wellbeing is 1.9461.

Table 34: Central tendencies of Work Wellbeing

Question	N	Mean	Std. dev.
Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments	382	1.69	0.707
When I'm working from home, I feel very comfortable and more refreshed.	382	1.87	0.817
When I'm working from home, I feel less stressed since there are fewer office interruptions and I have control of my work time & place	382	1.95	0.903
When I'm working from home, I can take health breaks which is important for musculoskeletal relaxation which helps to reduce musculoskeletal pain (pain in muscles, bones, nerves, etc.).	382	1.79	0.821
I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.	382	2.44	0.999

61
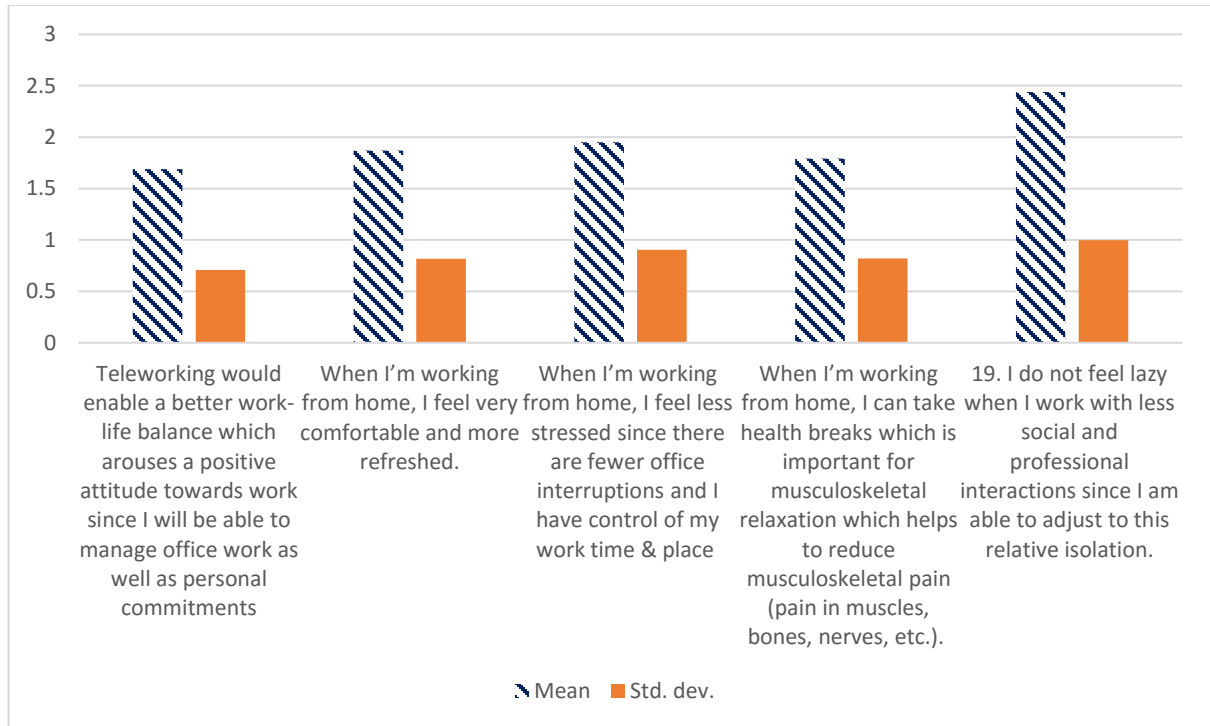
Figure 19: Central tendencies of Work Wellbeing

4.4.3.4 Technology

Table 35 and Figure 20 shows the five statements used to measure the independent variable "Technology". According to the Table 35 and Figure 20, the least mean value, 1.47 and standard deviation, 0.559 are taken by the first statement "Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers". Consecutively, statements two, three, four, and five have mean values 1.91, 1. 67, 2.04, and 1.66. In that manner, respective standard deviation values are 0.783, 0.7, 0.806 and 0.63. So the overall mean value (μ) of technology is 1.7503.

Table 35: Central tendencies of Technology

Question	N	Mean	Std. dev.
Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers	382	1.47	0.559
Teleworker needs cloud computing systems to make trustworthy share and use of software and files.	382	1.91	0.783

Teleworker needs proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches.	382	1.67	0.7
Teleworker needs adequate training in the use of IT tools and quick technical support.	382	2.04	0.806
Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers.	382	1.66	0.63
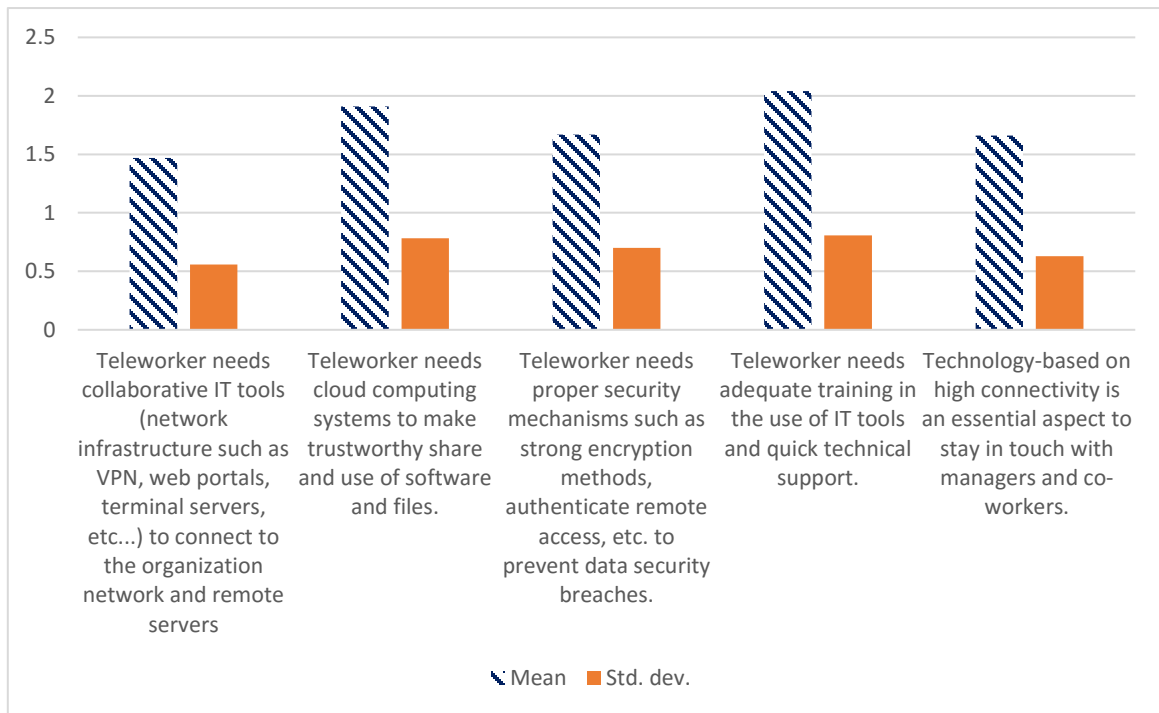
Figure 20: Central tendencies of Technology

4.4.3.5 Effective Communication

Table 36 and Figure 21 shows the five statements used to measure the independent variable "Effective Communication". According to Table 36 and Figure 21, the least mean value, 1.6 and standard deviation, 0.634 are taken by the first statement "Teleworker should be a good team player and communicate frequently with supervisors and fellow workers". Respectively, second, third, fourth, and fifth statements are taken the mean values 1.66, 1.67, 1.74, and 1.96. Like that, respective standard deviation values are 0.63, 0.633, 0.675, and 0.796. So the overall mean value (μ) of effective communication is 1.7277.

Table 36: Central tendencies of Effective Communication

Question	N	Mean	Std. dev.
Teleworker should be a good team player and communicate frequently with supervisors and fellow workers.	382	1.6	0.634
Communication is an essential way to build trust between managers and teleworkers. With this trust, I feel that supervisors recognize and appreciate my work.	382	1.66	0.63
Teleworker should attend meetings using methods such as WebEx or webinars.	382	1.67	0.633
Teleworker has to interpret the content of audio/emails/chat clearly to get the exact requirement since teleworker isn't able to interpret the body language.	382	1.74	0.675
Without frequent feedback from supervisors/experts, teleworker may go in the wrong direction towards project implementation and end up with the wrong software.	382	1.96	0.796
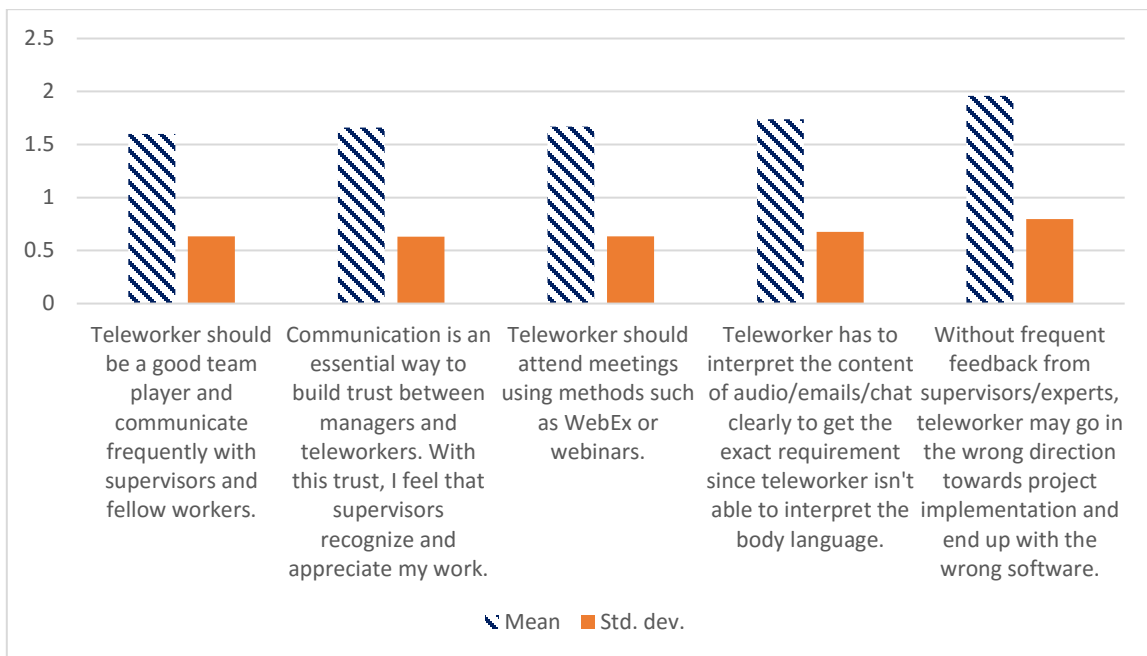
Figure 21: Central tendencies of Effective Communication

4.4.3.6 Self-Regulation

Table 37 and Figure 22 shows the five statements used to measure the independent variable "Self Regulation". According to Table 37 and Figure 22, the least mean value, 1.69 and standard deviation, 0.707 are taken by the second statement "Teleworker should be self-

motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition". Consecutively, statements one, three, four, and five have mean values 2.44, 1.69, 1.66 and 1.74. In that manner, respective standard deviation values are 0.999, 0.708, 0.725 and 0.679. So the overall mean value (μ) of self-regulation is 1.8346

Table 37: Central tendencies of Self Regulation

Question	N	Mean	Std. dev.
I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.	382	2.44	0.999
Teleworker should be self-motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition.	382	1.65	0.671
Teleworker should be able to be productive with supervision as well as when no-one is checking up on him/her.	382	1.69	0.708
Teleworker should be able to complete assigned tasks independently, on-time and with minimal guidance.	382	1.66	0.725
Teleworker should be highly focused and have the ability to handle potential family/ home distractions.	382	1.74	0.679
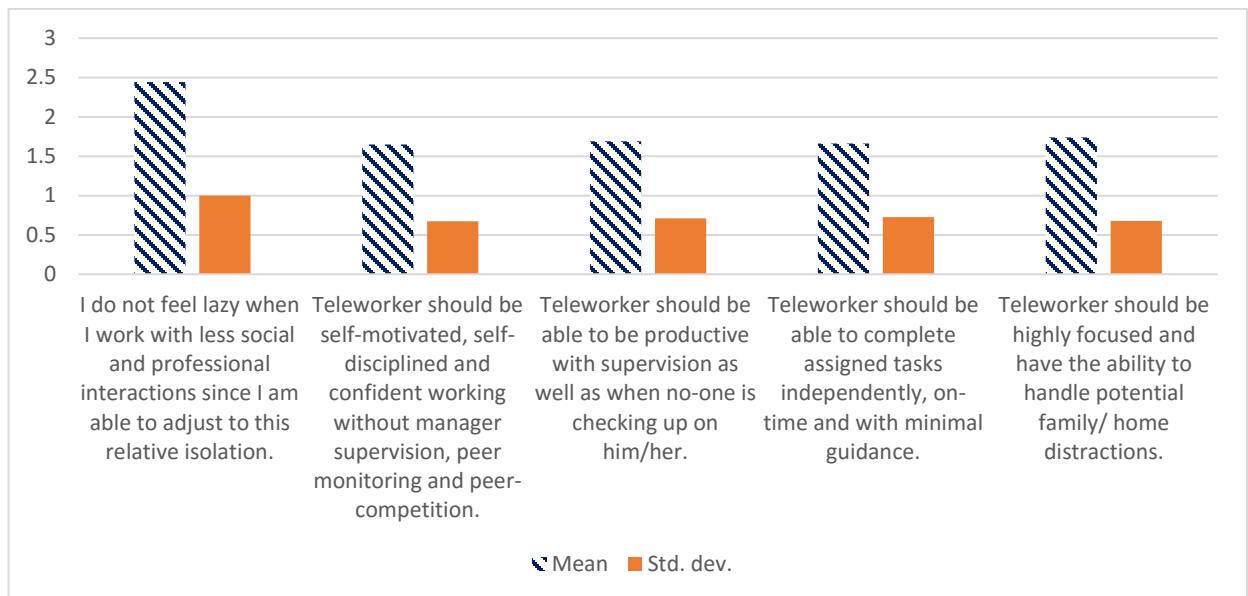
Figure 22: Central tendencies of Self Regulation

4.5. Inferential Analysis

4.5.1. Correlation Analysis of Variables for the Entire sample data

Pearson correlation coefficient under bivariate correlate was used to determine the relationship between the dependent variable and independent variables. According to Table 38, all independent variables work flexibility, work-wellbeing, technology, effective communication, and self-regulation have the positive Pearson correlation coefficient values with the dependent variable productivity in a teleworking environment. As described in Section 4.4.2, there is a positive correlation between all independent variables and the dependent variable. Table 38 also shows the relationship between the independent variables.

Table 38: Correlation analysis for variables based on the entire data set

Correlations

		productivity	flexibility	wellBeing	technology	effectiveCommunication	selfRegulation
productivity	Pearson Correlation	1	.557**	.513**	.298**	.365**	.568**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	382	382	382	382	382	382
flexibility	Pearson Correlation	.557**	1	.571**	.162**	.119*	.290**
	Sig. (2-tailed)	.000		.000	.002	.020	.000
	N	382	382	382	382	382	382
wellBeing	Pearson Correlation	.513**	.571**	1	.249**	.139**	.449**
	Sig. (2-tailed)	.000	.000		.000	.006	.000
	N	382	382	382	382	382	382
technology	Pearson Correlation	.298**	.162**	.249**	1	.420**	.340**
	Sig. (2-tailed)	.000	.002	.000		.000	.000
	N	382	382	382	382	382	382
effectiveCommunication	Pearson Correlation	.365**	.119*	.139**	.420**	1	.419**
	Sig. (2-tailed)	.000	.020	.006	.000		.000
	N	382	382	382	382	382	382
selfRegulation	Pearson Correlation	.568**	.290**	.449**	.340**	.419**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	382	382	382	382	382	382

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.5.2. Hypothesis Testing

As mentioned in Section 4.4.2, if the significance value(p) greater than 0.05, the analyzer can reject the null hypothesis and accept the alternative hypothesis. If the significance value(p) lesser than 0.05 or 0.01 (based on the significance level), then the analyzer has to accept the null hypothesis. According to the 2.8.6, the mean value (μ) of central tendency analysis can be used to test the hypothesis (Frost Jim, n.d.). If the mean values of the independent variable and the dependent variable are equal, then the null hypothesis has to be accepted. If the mean values of the independent variable and the dependent variable are different, then the alternative hypothesis has to be accepted.

4.5.2.1 Work Flexibility and Productivity in Teleworking Environment

H_{1-0}: There is **no relationship** between Work Flexibility and the software engineer's Productivity in Teleworking Environment.

H_{1-1}: There is **a relationship** between Work Flexibility and the software engineer's Productivity in Teleworking Environment.

As revealed in Table 39, the Pearson correlation is computed to verify the relationship between the work-flexibility and productivity in the teleworking environment. There is a 0.000 two-tailed significance value(p) at the 0.01 level.

$r(380) = 0.557$, $p = 0.000$ and $p < 0.01$

As a consequence of the correlation analysis, there is a significant positive relationship between work-flexibility and productivity in the teleworking environment and its value(r) is 0.557. And also the significance value(p) is lesser than 0.01.

According to Section 4.4.3.1 and Section 4.4.3.2

$\mu 1$ = Mean of productivity in the teleworking environment = 1.8243

$\mu 2$ = Mean of work flexibility = 1.6839

$\mu 1 \neq \mu 2$

Then the researcher has been able to reject the null hypothesis **H₁₋₀** and accept the alternative hypothesis **H₁₋₁**.

Table 39: Pearson correlation analysis result for work flexibility and productivity

Correlations

		productivity	flexibility
productivity	Pearson Correlation	1	.557**
	Sig. (2-tailed)		.000
	N	382	382
flexibility	Pearson Correlation	.557**	1
	Sig. (2-tailed)	.000	
	N	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.5.2.2 Work Well-being and Productivity in Teleworking Environment

H₂₋₀: There is **no relationship** between Work wellbeing and the software engineer's Productivity in Teleworking Environment.

H₂₋₁: There is **a relationship** between Work wellbeing and the software engineer's Productivity in Teleworking Environment.

As described in Table 40, the Pearson correlation is computed to verify the relationship between work-wellbeing and productivity in the teleworking environment. There is a 0.000 two-tailed significance value() at the 0.01 level.

$r(380) = 0.513$, $p = 0.000$ and $p < 0.01$

As a result of the correlation analysis, there is a significant positive relationship between work-wellbeing and productivity in the teleworking environment and its value(r) is 0.513. And also the significance value(p) is lesser than 0.001.

According to Section 4.4.3.1 and Section 4.4.3.3

$\mu1$ = Mean of productivity in the teleworking environment = 1.8243

$\mu2$ = Mean of work wellbeing = 1.9461

$\mu1 \neq \mu2$

Hence the null hypothesis **H₂₋₀** can be rejected and the alternative hypothesis **H₂₋₁** can be accepted.

Table 40: Pearson correlation analysis result for work-wellbeing and productivity

Correlations

		productivity	wellBeing
productivity	Pearson Correlation	1	.513**
	Sig. (2-tailed)		.000
	N	382	382
wellBeing	Pearson Correlation	.513**	1
	Sig. (2-tailed)	.000	
	N	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.5.2.3 Technology and Productivity in Teleworking Environment

H₃₋₀: There is **no relationship** between Technology and the software engineer's Productivity in Teleworking Environment.

H₃₋₁: There is **a relationship** between Technology and the software engineer's Productivity in Teleworking Environment.

As shown in Table 41, the Pearson correlation is computed to verify the relationship between technology and productivity in the teleworking environment. There is a 0.000 two-tailed significance value(p) at the 0.01 level.

$r(380) = 0.298$, $p = 0.000$ and $p < 0.01$

As a conclusion of the correlation analysis, there is a significant positive relationship between technology and productivity in the teleworking environment and its value(r) is 0.298. And also the significance value(p) is lesser than 0.01.

According to Section 4.4.3.1and Section 4.4.3.4

$\mu1$ = Mean of productivity in the teleworking environment = 1.8243

$\mu2$ = Mean of technology = 1.7503

$\mu1 \neq \mu2$

Then the researcher has been able to reject the null hypothesis **H3-0** and accept the alternative hypothesis **H3-1**.

Table 41: Pearson correlation analysis result for technology and productivity

Correlations

		productivity	technology
productivity	Pearson Correlation	1	.298**
	Sig. (2-tailed)		.000
	N	382	382
technology	Pearson Correlation	.298**	1
	Sig. (2-tailed)	.000	
	N	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.5.2.4 Effective Communication and Productivity in Teleworking Environment

H4-0: There is **no relationship** between Effective Communication and the software engineer's Productivity in Teleworking Environment.

H4-1: There is **a relationship** between Effective Communication and the software engineer's Productivity in Teleworking Environment.

As shown in Table 42, the Pearson correlation is computed to verify the relationship between effective communication and productivity in the teleworking environment. There is a 0.000 two-tailed significance value(p) at the 0.01 level.

$r(380) = 0.365$, $p = 0.000$ and $p < 0.01$

As a consequence of the correlation analysis, there is a significant positive relationship between effective communication and productivity in the teleworking environment and its value(r) is 0.365. And also the significance value(p) is lesser than 0.01.

According to Section 4.4.3.1and Section 4.4.3.5

$\mu1$ = Mean of productivity in the teleworking environment = 1.8243

$\mu2$ = Mean of effective communication = 1.7277

$\mu1 \neq \mu2$

Hence the null hypothesis **H4-0** can be rejected and the alternative hypothesis **H4-1** can be accepted.

Table 42: Pearson correlation analysis result for effective communication and productivity

Correlations

		productivity	effectiveCom munication
productivity	Pearson Correlation	1	.365**
	Sig. (2-tailed)		.000
	N	382	382
effectiveCommunication	Pearson Correlation	.365**	1
	Sig. (2-tailed)	.000	
	N	382	382

**. Correlation is significant at the 0.01 level (2-tailed).

4.5.2.5 Self-Regulation and Productivity in Teleworking Environment

H5-0: There is **no relationship** between Self-regulation and the software engineer's Productivity in Teleworking Environment.

H5-1: There is **a relationship** between Self-regulation and the software engineer's Productivity in Teleworking Environment.

As shown in Table 43, the Pearson correlation is computed to verify the relationship between self-regulation and productivity in the teleworking environment. There is a 0.000 two-tailed significance value(p) at the 0.01 level.

$r(380) = 0.568$, $p = 0.000$ and $p < 0.01$

As a conclusion of the correlation analysis, there is a significant positive relationship between self-regulation and productivity in the teleworking environment and its value(r) is 0.568. And also the significance value (p) is lesser than 0.01.

According to Section 4.4.3.1and Section 4.4.3.6

$\mu 1$ = Mean of productivity in the teleworking environment = 1.8243

$\mu 2$ = Mean of self-regulation = 1.8346

$\mu 1 \neq \mu 2$

Then the researcher has been able to reject the null hypothesis **H$_{5-0}$** and accept the alternative hypothesis **H$_{5-1}$**.

Table 43: Pearson correlation analysis result for self-regulation and productivity

Correlations

		productivity	selfRegulation
productivity	Pearson Correlation	1	.568**
	Sig. (2-tailed)		.000
	N	382	382
selfRegulation	Pearson Correlation	.568**	1
	Sig. (2-tailed)	.000	
	N	382	382
**. Correlation is significant at the 0.01 level (2-tailed).			

Summary of the Hypothesis Test

Table 44 depicts a summary of the hypothesis test. The level of relationship has been decided based on Table 2.

Table 44: Summary table of the hypothesis test

Hypothesis	Null Hypothesis	Alternative Hypothesis	Level of the Relationship	Direction
There is a relationship between Work Flexibility and the software engineer's Productivity in Teleworking Environment.	Rejected	Accepted	High	Positive
There is a relationship between Work wellbeing and the software engineer's Productivity in Teleworking Environment	Rejected	Accepted	High	Positive
There is a relationship between Technology and the software engineer's Productivity in Teleworking Environment	Rejected	Accepted	Low	Positive
There is a relationship between Effective Communication and the software engineer's Productivity in Teleworking Environment	Rejected	Accepted	Medium	Positive
There is a relationship between Self-regulation and the software engineer's Productivity in Teleworking Environment	Rejected	Accepted	High	Positive

4.5.3. Correlation Analysis of Variables for the Female Employees in the sample

Table 45: Correlation analysis for variables based on female respondents

Correlations[a]

		productivity	flexibility	wellBeing	technology	effectiveCommunication	selfRegulation
productivity	Pearson Correlation	1	.540**	.398**	.295**	.440**	.477**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	186	· 186	186	186	186	186
flexibility	Pearson Correlation	.540**	1	.507**	.236**	.166*	.242**
	Sig. (2-tailed)	.000		.000	.001	.023	.001
	N	186	186	186	186	186	186
wellBeing	Pearson Correlation	.398**	.507**	1	.346**	.185*	.390**
	Sig. (2-tailed)	.000	.000		.000	.011	.000
	N	186	186	186	186	186	186
technology	Pearson Correlation	.295**	.236**	.346**	1	.370**	.369**
	Sig. (2-tailed)	.000	.001	.000		.000	.000
	N	186	186	186	186	186	186
effectiveCommunication	Pearson Correlation	.440**	.166*	.185*	.370**	1	.487**
	Sig. (2-tailed)	.000	.023	.011	.000		.000
	N	186	186	186	186	186	186
selfRegulation	Pearson Correlation	.477**	.242**	.390**	.369**	.487**	1
	Sig. (2-tailed)	.000	.001	.000	.000	.000	
	N	186	186	186	186	186	186

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. 2. What is your gender? = Female

The researcher has done a correlation analysis by categorizing the data set based on gender. The female category analysis is shown in Table 45. When considering the female category, there is a positive high correlation between productivity and work-flexibility. It's value(r) is 0.540. And also, there is a positive high correlation between the work-wellbeing and the work-flexibility. Its value(r) is 0.507.

4.5.4. Correlation Analysis of Variables for the Male Employees in the sample

Table 46: Correlation analysis for variables based on male respondents

Correlations[a]

		productivity	flexibility	wellBeing	technology	effectiveCommunication	selfRegulation
productivity	Pearson Correlation	1	.560**	.597**	.301**	.283**	.656**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	196	196	196	196	196	196
flexibility	Pearson Correlation	.560**	1	.612**	.088	.061	.335**
	Sig. (2-tailed)	.000		.000	.218	.394	.000
	N	196	196	196	196	196	196
wellBeing	Pearson Correlation	.597**	.612**	1	.157*	.085	.504**
	Sig. (2-tailed)	.000	.000		.028	.237	.000
	N	196	196	196	196	196	196
technology	Pearson Correlation	.301**	.088	.157*	1	.476**	.311**
	Sig. (2-tailed)	.000	.218	.028		.000	.000
	N	196	196	196	196	196	196
effectiveCommunication	Pearson Correlation	.283**	.061	.085	.476**	1	.350**
	Sig. (2-tailed)	.000	.394	.237	.000		.000
	N	196	196	196	196	196	196
selfRegulation	Pearson Correlation	.656**	.335**	.504**	.311**	.350**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	196	196	196	196	196	196

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
a. 2. What is your gender? = Male

When considering the male category, there are positive correlations between variables than the female category. Based on Table 46 there is a high positive correlation among work-flexibility, work-wellbeing, self-regulation, and productivity, respectively correlation values(r) are 0.560, 0.597, 0.656. And also, there is a highly positive correlation between work-flexibility and work-wellbeing as well.

4.6. Regression Analysis

The researcher has conducted a simple linear regression analysis with all independent variables against the dependent variable to identify the connection between them and to evaluate the strength of this connection. The result of the regression analysis was provided in the following sections.

4.6.1. Independent Variable - Work Flexibility

Table 47: Model Summary for work flexibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.557[a]	.311	.309	.36583

a. Predictors: (Constant), Work_Flexibility

b. Dependent Variable: Productivity

Table 47 depicts the summary of the regression analysis between work flexibility and productivity in the teleworking environment. Correlation between these two variables is displayed through the R. Its value is 0.557. R-squared determines what extent the variance of the independent variable explains the variance of the dependent variable. Here R-square is 0.311. That means 31.1% of the variance in productivity in the teleworking environment can be explained by work flexibility.

Table 48: ANOVA table for work flexibility

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.917	1	22.917	171.239	.000[b]
	Residual	50.856	380	.134		
	Total	73.773	381			

a. Dependent Variable: Productivity

b. Predictors: (Constant), Work_Flexibility

According to Table 48:ANOVA table, the F value is 171.239 when the significance level is 0.000. That reveals there is a positive relationship between these two variables and the model is significant. And also, it explains that one can reliably predict the productivity in the teleworking environment by work flexibility.

$F(1,380) = 171.239, p < 0.01$

Table 49: Coefficients table for work flexibility

Coefficients[a]

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | |
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.882	.074		11.866	.000	.736	1.029
	Work_Flexibility	.559	.043	.557	13.086	.000	.475	.643

a. Dependent Variable: Productivity

As stated by Table 49 Coefficients, the B value of work flexibility is 0.559. That means for every unit increase in work flexibility, 0.559 unit increase in productivity in the teleworking environment can be predicted. The beta value is displayed as 0.557. It means there is a positive relationship between these two variables. Hence, in order to increase the employees' productivity in the teleworking environment organization needs to enable more flexible working arrangements.

4.6.2. Independent Variable - Work Wellbeing

Table 50: Model Summary for work wellbeing

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.513[a]	.263	.261	.37821

a. Predictors: (Constant), Work_WellBeing
b. Dependent Variable: Productivity

Table 50 depicts the summary of the regression analysis between work-wellbeing and productivity in the teleworking environment. Correlation between these two variables is displayed through the R. Its value is 0.513. R-squared determines what extent the variance of the independent variable explains the variance of the dependent variable. Here R-square is 0.263. That means 26.3% of the variance in productivity in the teleworking environment can be explained by work-wellbeing.

Table 51: ANOVA table for work wellbeing

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.417	1	19.417	135.742	.000^b
	Residual	54.357	380	.143		
	Total	73.773	381			

a. Dependent Variable: Productivity
b. Predictors: (Constant), Work_WellBeing

According to Table 51:ANOVA table, the F value is 135.742 when the significance level is 0.000. That reveals there is a positive relationship between these two variables and the model is significant. And also, it explains that one can reliably predict the productivity in the teleworking environment by work wellbeing.

$F(1,380) = 135.742, p < 0.01$

Table 52: Coefficients table for work wellbeing

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.082	.067		16.251	.000	.951	1.213
	Work_WellBeing	.381	.033	.513	11.651	.000	.317	.446

a. Dependent Variable: Productivity

As stated by Table 52 Coefficients, the B value of work-wellbeing is 0.381. That means for every unit increase in work-wellbeing, 0.381 unit increase in productivity in the teleworking environment can be predicted. The beta value is displayed as 0.513. It means there is a positive relationship between these two variables. Hence in order to increase the employees' productivity in the teleworking environment organization needs to organize wellbeing programs to increase employees' wellbeing. That means the organization has to take responsibility for the wellbeing of teleworkers.

4.6.3. Independent Variable – Technology

Table 53: Model Summary for technology

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.298[a]	.089	.087	.42056

a. Predictors: (Constant), Technology

b. Dependent Variable: Productivity

Table 53 depicts the summary of the regression analysis between technology and productivity in the teleworking environment. Correlation between these two variables is displayed through the R. Its value is 0.298. R-squared determines what extent the variance of the independent variable explains the variance of the dependent variable. Here R-square is 0.089. That means 8.9% of the variance in productivity in the teleworking environment can be explained by technology. This explains that there is a small positive linear association between these two variables.

Table 54: ANOVA table for technology

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.563	1	6.563	37.108	.000[b]
	Residual	67.210	380	.177		
	Total	73.773	381			

a. Dependent Variable: Productivity

b. Predictors: (Constant), Technology

According to Table 54:ANOVA table, the F value is 37.108 when the significance level is 0.000. That reveals there is a positive relationship between these two variables and the model is significant. And also it explains that one can reliably predict the productivity in the teleworking environment by technology.

$F(1,380) = 37.108, p < 0.01$

Table 55: Coefficient table for technology

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.313	.087		15.145	.000	1.142	1.483
	Technology	.292	.048	.298	6.092	.000	.198	.387

a. Dependent Variable: Productivity

As stated by Table 55 Coefficients, the B value of technology is 0.292. That means for every unit increase in technology, a 0.292 unit increase in productivity in the teleworking environment can be predicted. The beta value is displayed as 0.298. It means there is a medium positive relationship between these two variables. Hence, in order to increase the employees' productivity in the teleworking environment organization needs to provide more technical aspects such as VPN that can easily connect, strong security mechanism, etc.

4.6.4. Independent Variable - Effective Communication

Table 56: Model Summary for effective communication

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.365[a]	.133	.131	.41021

a. Predictors: (Constant), Effective_Communication
b. Dependent Variable: Productivity

Table 56 depicts the summary of the regression analysis between effective communication and productivity in the teleworking environment. Correlation between these two variables is displayed through the R. Its value is 0.365. R-squared determines what extent the variance of the independent variable explains the variance of the dependent variable. Here R-square is 0.133. That means 13.3% of the variance in productivity in the teleworking environment can be explained by effective communication. This explains that there is a small positive linear association between these two variables.

Table 57: ANOVA table for effective communication

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.829	1	9.829	58.407	.000[b]
	Residual	63.945	380	.168		
	Total	73.773	381			

a. Dependent Variable: Productivity

b. Predictors: (Constant), Effective_Communication

According to Table 57:ANOVA table, the F value is 58.407 when the significance level is 0.000. That reveals there is a positive relationship between these two variables and the model is significant. And also it explains that one can reliably predict the productivity in the teleworking environment by effective communication.

$F(1,380) = 58.407$, $p < 0.01$

Table 58: Coefficient table for effective communication

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.173	.088		13.369	.000	1.001	1.346
	Effective_Communication	.377	.049	.365	7.642	.000	.280	.474

a. Dependent Variable: Productivity

As stated by Table 58 Coefficients, the B value of effective communication is 0.377. That means for every unit increase in effective communication, 0.377 unit increase in productivity in the teleworking environment can be predicted. The beta value is displayed as 0.365. It means there is a positive relationship between these two variables. Hence in order to increase the employees' productivity in the teleworking environment organization needs to enable reliable communication methods. And also employees should have to communicate with their supervisors and the team continuously when they are doing teleworking.

4.6.5. Independent Variable - Self Regulation

Table 59: Model Summary for self-regulation

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.568[a]	.322	.320	.36274

a. Predictors: (Constant), Self_Regulation

b. Dependent Variable: Productivity

Table 59 depicts the summary of the regression analysis between self-regulation and productivity in the teleworking environment. Correlation between these two variables is displayed through the R. Its value is 0.568. R-squared determines what extent the variance of the independent variable explains the variance of the dependent variable. Here R-square is 0.322. That means 32.2% of the variance in productivity in the teleworking environment can be explained by self-regulation.

Table 60: ANOVA table for self-regulation

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.774	1	23.774	180.685	.000[b]
	Residual	49.999	380	.132		
	Total	73.773	381			

a. Dependent Variable: Productivity

b. Predictors: (Constant), Self_Regulation

According to Table 60:ANOVA table, the F value is 180.685 when the significance level is 0.000. That reveals there is a positive relationship between these two variables and the model is significant. And also it explains that one can reliably predict the productivity in the teleworking environment by self-regulation.

$F(1,380) = 180.685$, $p < 0.01$

Table 61: Coefficient table for self-regulation

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.820	.077		10.646	.000	.668	.971
	Self_Regulation	.548	.041	.568	13.442	.000	.467	.628
a. Dependent Variable: Productivity								

As stated by Table 61 Coefficients, the B value of self-regulation is 0.548. That means for every unit increase in self-regulation, 0.548 unit increase in productivity in the teleworking environment can be predicted. The beta value is displayed as 0.568. It means there is a positive relationship between these two variables. Hence, in order to increase the employees' productivity in the teleworking environment, they should have self-discipline, self-motivated, and self-control while they doing telework. And also supervisors have to trust their subordinates and motivate them.

4.7. Conclusion

In this chapter, the researcher has explained the data collection methods and data analysis of this research study. Data were collected by an online survey questionnaire which was distributed among the employees who are working in the Sri Lankan IT industry. This questionnaire was created using an online google form tool and distributed via social media, Gmail, and LinkedIn. Before published the survey, reliability analysis was conducted to check the goodness of questions. IBM SPSS statistic subscription 25 software tool is used for data analysis. The demographic analysis was conducted to explain the basic characteristics of the collected data set. After that researcher has conducted the correlation analysis as an inferential analysis to check the relationship between the dependent and independent variables and test the defined hypothesis. Finally, the regression analysis was done to check the impact on a dependent variable by selected independent variables. this analysis proved that all independent variables have an impact on the dependent variable which is the software engineer's productivity in the teleworking environment.

5. CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

5.1. Chapter Introduction

The fourth chapter elaborated on the relevant data analysis in order to examine the stated objectives of this research study. Successfully analyzed the objectives of the study and the hypotheses were tested afterward. This chapter characterizes the concise conclusion of the research by drawing inferences based on the analysis result in the fourth chapter. Moreover, research implications in relation to productivity in the teleworking environments and recommendations to increase productivity are highlighted in this chapter. Apart from that this chapter describes the limitations of this study. Later on, the researcher has proposed some suggestions which need to be addressed in the future work as an extension of this study.

5.2. Research outcomes based on demographic analysis

Demographic analysis is utilized to describe the fundamental characteristics of the respondents in this research study. The demographic analysis was done in Section 4.4. In order to identify the relationship between the demographic variable and the dependent variable Pearson correlation coefficient under bivariate correlate was used. This analysis was done in Section 4.4.2

Based on this demographic analysis in Section 4.4.1.1, the majority of software engineers are male which is 51% out of 382 employees. The rest of the 49% was attributed to female employees. This indicates that these days female employees also play a major role in the Sri Lankan software industry compare to the past. According to the correlation analysis in Section 4.4.2.2, there is a 0.117 correlation coefficient value(r) with a 0.022 two-tailed significance value(p). Since p-value less than 0.05, there is a relationship between gender and productivity in the teleworking environment. When considering the age, the majority of the software engineers belong to the 25 - 29 age group that is 47% out of 382 employees. The second highest responders belong to the 30 - 34 age group which 40% of total respondents. This indicates that the majority of Sri Lankan software engineers belong to the mid-age level. Many startup software companies start with mid-age engineers may be the reason for this. According

to the correlation analysis in Section 4.4.2.1, there is a 0.027 correlation coefficient value with a 0.595 two-tailed significance value between age and teleworking productivity.

In this study, the majority of respondents were single which indicates 52% out of 382 employees. According to the correlation analysis in Section 4.4.2.3, there is a 0.150 correlation coefficient value with a 0.003 two-tailed significance value(p) between marital-status and the teleworking productivity. Since the p-value less than 0.01, there is a relationship between marital status and productivity in the teleworking environment. Due to family distractions, some married employees are unable to work productively when doing teleworking. Conversely, teleworking is a solution for managing office work and family commitments.

As shown in Section 4.4.1.4, out of 382 respondents, 52% of employees are playing a software developer role. Since the majority of employees are male, most of them are doing a software developer role. 21% out of 382 respondents are playing Team/ Tech lead role. To promote as a project manager or architect, employees have to get more than 10-year experience may be the reason for this 21%. In this research, most employees belong to the mid-age level. According to the correlation analysis in Section 4.4.2.5, there is a -0.050 correlation coefficient value(r) with a 0.327 two-tailed significance value between job role and the teleworking productivity. When considering working experience in a company that allows teleworking, most employees belong to the 2-5 years category. Since the IT industry is a rising industry in Sri Lanka, teleworking is not much popular concept among the software companies. Based on this evidence, It can be observed that Sri Lankan IT companies have adopted this concept latterly. According to the correlation analysis in Section 4.4.2.8, there is a -0.073 correlation coefficient value with a 0.153 two-tailed significance value. According to Section 4.4.1.8, out of 382, 73% of employees are working in the companies which allow telework. This statistic is somewhat evident to prove that most companies in the Sri Lanka IT industry, allow telework to their employees. According to the correlation analysis in Section 4.4.2.6, there is a 0.100 correlation coefficient value with a 0.051 two-tailed significance value between offering telework and the teleworking productivity. Hence, there is no relationship between these two variables.

When considering the distance between employees living place and the office, the majority of the responders belong to the 5km - 14km distance group which is 37% of the sample group. In Sri Lanka, most of IT companies are situated in Colombo city. So most employees are trying to live around Colombo city. This also caused traffic in Colombo city. Some people live their own homes when most are living in a rent house or boarding place. According to the correlation analysis in Section 4.4.2.4, there is an -0.077 correlation coefficient value with a 0.131 two-tailed significance value between distance and productivity. Most respondents are taking 31-60 minutes to reach their office in the morning as well as reach their homes in the evening. This is because of the distance between the living place and office and heavy traffic. According to the correlation analysis in Section 4.4.2.4, there is a -0.060 correlation coefficient value with a 0.242 two-tailed significance value between travel time and productivity.

As shown in Section 4.4.1.9, 94% of respondents out of 385, are willing to do telework. That means most of them like to do teleworking since it helps to balance their work-life. Telework offers many benefits to the employees as well as employers. According to the correlation analysis in Section 4.4.2.7, there is a 0.135 correlation coefficient value with a 0.008 two-tailed significance value(r) between willingness and teleworking productivity. Since p-value is less than 0.01, there is a positive relationship between willingness and teleworking productivity. In this study, 48% of employees out of 382 have a positive opinion regarding teleworking, and also 32% of employees have a very positive mindset. Since the IT field is based on technology, employees can work anytime from anywhere. So employees are willing to take that opportunity as a benefit. As shown in Section 4.4.1.10, 65% of employees out of 382, are doing telework on a need basis. That means most IT employees are doing telework to balance their family life while completing their assigned tasks.

5.3. Research implications

The main purpose of this study is to identify the relationship of the software professional's productivity in the teleworking environment with teleworking factors which are work-flexibility, work-wellbeing, technology, effective communication, and self-regulation of employees who work in Sri Lankan IT organizations.

5.3.1. Hypothesis testing for work-flexibility with teleworking productivity

H_{1-1}: There is a relationship between Work Flexibility and the software engineer's Productivity in Teleworking Environment.

Based on the Pearson correlation analysis test stated in Section 4.5.2.1 it is concluded that there is a significantly high positive relationship between work-flexibility and productivity in the teleworking environment and its value(r) is 0.557. Since this is a positive relationship, when providing FWAs greatly, productivity will increase. This is the second-highest correlation value by comparison to the other variables' correlation values. And also as shown in Section 4.6.1, 31.1% of the variance in productivity can be explained by work-flexibility. This indicates that, when employees have the freedom to decide their working time and place, they will be more satisfied with their job and the employer. Then they will self-motivated and try to give their fullest co-operation to achieve their company targets.

5.3.2. Hypothesis testing for work-wellbeing with teleworking productivity

H_{2-1}: There is a relationship between Work wellbeing and the software engineer's Productivity in Teleworking Environment.

Based on the Pearson correlation analysis test stated in Section 4.5.2.2 it is concluded that there is a significantly high positive relationship between work-wellbeing and productivity in the teleworking environment and its value(r) is 0.513. Since this is a positive relationship, productivity can be increased by raising the employee's wellbeing. This is the highest correlation value by comparison to the other variables' correlation values Employers can increase their fellow employee's job satisfaction as well as life satisfaction while diminishing mental health issues by making their work-life balance. Teleworking permits employees to have a work-life balance as well as healthiness by increasing their well-being. This is helpful to increase employees' productivity. And also as shown in Section 4.6.2, 26.3% of the variance in productivity can be explained by work-wellbeing. This indicates that happy and satisfied employees are the most committed and productive ones.

5.3.3. Hypothesis testing for technology with teleworking productivity

H₃₋₁: There is a relationship between Technology and the software engineer's Productivity in Teleworking Environment.

Based on the Pearson correlation analysis test stated in Section 4.5.2.3, it is concluded that there is a significantly low positive relationship between technology and productivity in the teleworking environment and its value(r) is 0.298. Since this is a positive relationship, productivity can be increased by providing highly technological aspects to the teleworkers. And also according to Section 4.6.3, 8.9% of the variance in productivity can be explained by technological aspects. This indicates that the organization will be able to increase productivity by providing high level IT support to the teleworkers. All software engineers have good ICT knowledge and have the capability to handle technological tools. And also most of them are capable of handling security mechanisms. Teleworkers are able to connect to the organization network using VPN, terminal servers, and other available connectivity modes that are provided by the organization with high-security mechanisms.

5.3.4. Hypothesis testing for effective communication with teleworking productivity

H₄₋₁: There is a relationship between Effective Communication and the software engineer's Productivity in Teleworking Environment.

Based on the Pearson correlation analysis test stated in Section 4.5.2.4, it is concluded that there is a significant moderate positive relationship between effective communication and productivity in the teleworking environment and its value(r) is 0.365. Since this is a positive relationship, when there is highly effective communication between the teleworker and the team and supervisors, the productivity of the teleworker will be higher. And also according to Section 4.6.4, 13.3% of the variance in productivity can be explained by effective communication. This indicates that there must be effective communication between the teleworker, the team, and the project manager. otherwise, it is difficult to measure the performance of the teleworker as well as difficult to complete tasks. Without communication, managers hard to recognize the teleworker. With effective communication, teleworkers will be able to build trust in the manager's mind. Always good communication helps to clear

conflict among teleworkers, co-workers, and management. Effective communication increases the job satisfaction of teleworkers as well. Hence it increases productivity.

5.3.5. Hypothesis testing for self-regulation with teleworking productivity

H5-1: There is a relationship between Self-regulation and the software engineer's Productivity in Teleworking Environment.

Based on the Pearson correlation analysis test stated in Section 4.5.2.5, it is concluded that there is a significantly high positive relationship between self-regulation and productivity in the teleworking environment and its value(r) is 0.568. Since this is a positive relationship, when there is high self-regulation in the employees, productivity will be higher. And also as shown in Section 4.6.5, 32.2% of the variance in productivity can be explained by self-regulation. This is the highest value in comparison to the other value. This indicates that self-regulation is the most important factor for a teleworker. Since there is no one around to supervise the teleworker, he/she must be self-controlled, self-motivated, and self-disciplined. Teleworked must be able to handle the tasks with minimal supervision and guidance. When teleworkers' confidence to work without monitoring and he/she is honest with what they do, their productivity will be increased to a large extent.

5.3.6. Summary of correlation analysis

According to the correlation analysis results in Section 4.5.2, highest influencing factor for the teleworking productivity is the self-regulation. Work flexibility and work wellbeing also highly impact on teleworking productivity. Effective communication is the moderate influencing factor while technology has a low impact on teleworking productivity. Figure 23 describes the strength of correlations of each factor with the dependent variable, productivity in the teleworking environment. The colors indicate the strength of the factors where Dark green indicates a High Correlation, Green indicates a Moderate Correlation and Light green indicates a Low Correlation.
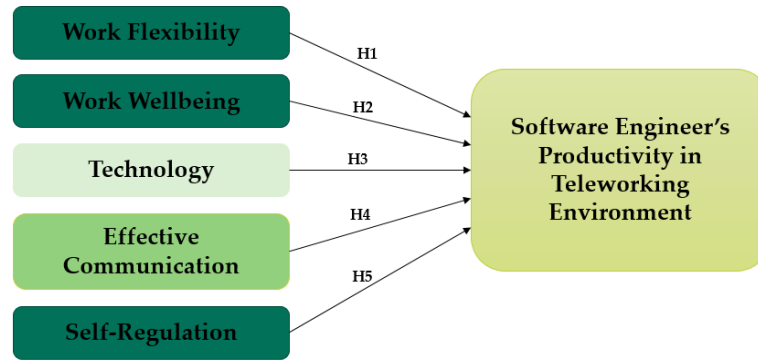
Figure 23: Summary of correlation Levels of Hypotheses

5.4. Recommendations

Recommendation 1: Trust teleworkers and recognize their great work

Manager's trust in their employees is one of the important factors to promote a productive working environment. (Weinert et al., 2014) has said that the most committed teleworkers are the most satisfying ones with their managers. If managers let teleworkers set their own strategies and should not concern about where they work, teleworkers are self-motivated and complete their tasks of high quality, on-time with a relaxed mind. Thus trust helps to increase the self-regulation of teleworkers. According to the correlation analysis described in Section 4.5.2.5, there is a high positive correlation between self-regulation and teleworking productivity. As stated in Section 4.6.5, 32.2% of the variance in productivity in the teleworking environment can be explained by self-regulation. Self-Regulation plays a major role in teleworker's productivity by comparing to the other four factors. So improving self-regulation or teleworkers is highly impact on their productivity. Researchers had proven that self-regulation is the key to success teleworker. Hence managers should have to increase self-regulation by trusting and satisfying them. With that satisfaction teleworkers able to increase their self-motivation, self-efficacy, self-control, and work with more confidence.

Also according to the responses received, the questions such as "Teleworker should be self-motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition.", "Teleworker should be able to complete assigned tasks independently, on-time, and with minimal guidance. ", 90% of the respondents believe that

self-motivation and self-control are assisted with the supervisor's trust in their work which is done individually with minimum supervision.

And also when managers trust their employees, employees also honest with their work. They keep informing their managers about their work progress. These status reports are great assistance to establish trust. Self-management and the credibility of the employee are key to avoid misuse of teleworking. Managers can improve self-regulation of teleworkers by following few practices such as:

- Establish a strong powerful and fair monitoring procedure to monitor teleworkers work and working time
- Ask daily status report from teleworkers
- When the job is successfully done, recognize their work and give rewards since it conduces for teleworker's great job satisfaction
- Celebrate the success as a team
- Give honest feedback to the teleworkers frequently to increase self-motivation, self-efficacy and self-control level of teleworkers

Recommendation 2: Enable more flexible working arrangements

Some researchers have found that FWAs are beneficial for only employee's perspective and it is an additional cost to the organization to manage employees who work as a shift. (Conradie et al., 2018) has stated that using only one FWA is cause to less effective, however, using more that one type of FWAs together is a more effective one. As an example combining flextime and teleworking give a stronger result than using flextime isolated (Conradie et al., 2018).

Based on the Pearson correlation analysis test stated in Section 4.5.2.1 it is concluded that there is a significantly high positive relationship between work-flexibility and productivity in the teleworking environment. As a consequence of regression analysis in Section 4.6.1, 31.1% of the variance in productivity in the teleworking environment can be explained by work flexibility. Work-flexibility plays a major role in teleworker's productivity by comparing to the other three factors except self-regulation. According to this relationship providing flexible time to teleworkers is assist with increasing their work productivity. If employees feel that

their managers expect their work all the time of the day or management expects to work on the exact expected time as the teleworking facility is available or work more than expected time compare to the office time is negatively affects the work-life balance and employee's job satisfaction. This can cause the stress and mental health of the employee. Hence it is directly affected the employees well being. As stated in Section 4.5.2.2, there is a high positive relationship between work-wellbeing and productivity in the teleworking environment and also according to Section 4.6.2, 26.3% of the variance in productivity in the teleworking environment can be explained by work-wellbeing. Not only that as per Table 38 there is a high positive correlation coefficient of 0.571, between work-flexibility and work-wellbeing. Thus increasing work-flexibility also assist with increasing work-wellbeing. So even it is a flexible working arrangement, don't expect more working time from teleworkers.

Also according to the responses received the questions such as "When I have control over my working time & working place, it increases my capability to work more.", "I'm able to manage my time and workload well by prioritizing tasks and setting deadlines.", 81% of respondents believe that telework is more efficient that they have their own strategies like, setting working time, working place by themselves. Not only that, as per the responses received the questions such as "Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments", " When I'm working from home, I feel less stressed since there are fewer office interruptions and I have control of my work time & place", "When I'm working from home, I can take health breaks which is important for musculoskeletal relaxation which helps to reduce musculoskeletal pain (pain in muscles, bones, nerves, etc.)." 84% of the respondents believe that teleworking is always associated with their well-being, both physical and mental health.

Healthier and satisfied employees can give a higher level of productivity and outputs with minimal stress levels (Mcnall et al., 2009). By giving flexibility in their working time, they can care for family members without missing time from work. According to Table 14 and Figure 7 most software engineers are younger. Young workers demand FWAs and work-life balance. Work-life balance contributes to work high productively with less stress.

Improving work flexibility can be achieved by,

- Combine telework with other FWAs.(Eg: combine telework with flextime)

- Encourage teleworkers to make predictable flexible working hours. If teleworker NOT going to be available during normal working hours, inform it to team and the manager

- Enable teleworking policies/rules with including:

  - Send daily work status report by the end of the day. This report should include the working time period, about the task, problems encountered while doing the task if any, etc.

  - Be available via mobile phone or chat platform which use in the company and be a frequent communicator.

  - Teleworkers must attend to the all-important meetings using methods like WebEx, webinar, zoom, etc.

  - Teleworker has to cover the expected working hours within the day. If they work extra hours, allow lieu-leave for these extra hours.

By implementing these kinds of rules, management able to track the teleworker's work while offering work-flexibility to the teleworkers. Training programs for managers and team leaders also a good approach to managing teleworkers since managers are not able to see teleworkers every day.

Recommendation 3: Establish an effective communication platform

Telework completely relies upon the effective communication system that connects managers, employees, and customers (Dissanayake, 2017). shortage of communication between teleworkers, the team, and the manager is one of the significant reasons for the failure of teleworking. (Sikes et al., 2011) has stated that the successful remote worker will be proactive in communicating with co-workers and both internal, external customers. According to the correlation analysis in Section 4.5.2.4, there is a positive relationship between effective communication and productivity in the teleworking environment. Effective communication always assists to reduce social and professional isolation of teleworkers. Social isolation refers to isolation from office colleagues, and friends while professional isolation is fear of recognition due to less supervision when they telework (Kurland & Cooper, 2002) and less support by their team and manager. This isolation causes to teleworker's stress and mental

health. That means it affects to the work-well being also. As stated in Section 4.5.2.2, there is a positive relationship with work-wellbeing and the productivity of teleworkers. Therefore in order to increase the productivity of teleworkers, management must establish a good and effective communication platform.

And also as per the responses received the question "I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.", 43% of respondents believe that they feel isolated when doing telework. So the researcher recommends having an effective communication platform to reduce isolation.

Also according to the responses received the questions such as "Without frequent feedback from supervisors/experts, teleworker may go in the wrong direction towards project implementation and end up with the wrong software.", 79% of respondents believe that telework is more efficient when they have frequent feedback from their managers regarding work as well as communication. It is a great help to prevent the wrong direction towards project implementation.

Managers need to support to the teleworkers through frequent communication when they need help. This will assist with keeping up a trusting relationship between them as well. Real-time communication helps to teleworkers to let management and coworkers know that they are available. When teleworker needs any assistant from coworkers or managers and the other side is not responding, teleworker has to wait. This is time-wasting. Thus keep frequent communication is a key point to complete a task in a productive manner in a teleworking environment when team members rely on each other. Not only that, but effective communication also helps to asses the performance of teleworkers. Feeling connected with their coworkers and colleagues reduce both the social and professional isolation of teleworkers.

To establish a good and effective communication platform,

➢ Teleworkers must keep frequent communication with the team and the manager. When coworkers ask task-related things, teleworker must have to respond as soon as possible

➢ Screen the continuous and efficacy of the teleworker's communication and provide realistic feedback

➢ Organize training sessions for both teleworkers and managers regarding how to be a good team player, how to be prompt and clear in their message, how to be an effective communicator with great communication skills, etc.

➢ Establish instant messaging services like Skype, Lync, WhatsApp, Microsft Teams application which will allow real-time communication

➢ Schedule regular project meetings using DTVC and collaborative communication Softwares like, WebEx, webinar, zoom, skype. That will encourage teleworkers to involve with discussions actively

➢ Support to the teleworkers through frequent communication when they need help.

Recommendation 4: Establish high-level IT support

With the advance of technology and high connectivity networks, telework is an ideal working arrangement for software engineers. Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers. According to the correlation analysis in Section 4.5.2.3, there is a positive relationship between technology and productivity in the teleworking environment. Hence the adequate technology is required to improve teleworking productivity.

Also according to the responses received the questions such as "Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers", "Teleworker needs proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches.", "Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers. ", 93% of respondents believe that telework is more efficient when they have better technical support and reliable connectivity.

A Reliable internet connection with sufficient speed is a great assistance to efficient work and effective communication. Access the projects through personnel laptops is caused by the security breaches since teleworkers connect to the network through the outside unsecured internet connection. Enabling email and chat access to their mobile phones is a great assistance to be available anytime. Therefore if they have this facility, they can respond to the emails quickly without keeping others waiting.

The organization can provide high-level technical support to teleworkers by,

- ➢ Enable employees to effectively perform their job by providing infrastructure support.
  - ✓ This includes the provision of the laptop, broadband, home telephone, and mobile phones.
  - ✓ Network infrastructure such as VPN, web portals, terminal servers, etc) to connect to the organization network and remote servers

- ➢ Provide facility for claim reimbursement of monthly recurring costs for teleworker's internet connection. This approvals reimbursement claiming should be approved by the manager

- ➢ Use collaborative IT tools like Microsoft SharePoint, google drive, Microsoft Teams, which enable collaboratively working facility for teleworkers with their coworkers

- ➢ Keep sharing location with authentication mechanisms will grate help to make trustworthy share and use of software and files

- ➢ Procure laptops with strong security mechanisms like firewall protection to maintain cybersecurity and prevent data security breaches

- ➢ Enable more restrictive policies like requiring change password frequently with can assist in securely keeping organization data

- ➢ Allow teleworkers to utilize mobile technologies is also helpful to keep in touch with their managers and coworkers

Recommendation 5: Set realistic goals for teleworkers

Set achievable goals and deadlines is an important factor to get the job productively done by teleworkers. Teleworking is not much suitable for the tasks which rely on multiple workers. Goals that impossible to achieve and workload which unable to complete will cause teleworkers' stress and dissatisfaction. This course for teleworkers well-being as well as self-regulation. It is difficult to complete the task when they feel stress. Self-motivation and self-control will go away from them when they are stress. Employees can concentrate deeply when there is no stress. As stated in correlation analysis in Section 4.5.2.2, there is a high positive correlation between the wellbeing and the teleworker's productivity. And also according to Section 4.5.2.5, there is a high positive correlation between teleworker's self-regulation and their productivity.

Also according to the responses received the questions such as "I feel that I am more productive when teleworking since it ends up working longer hours than required.", 35% of respondents believe that telework is not productive when they have more work by compare to the office. It couse to their dissatisfaction as well.

Hence, in order to get a high commitment from teleworkers, an organization has to satisfy them. The organization can satisfy teleworkers by,

- Teleworker's duties, expectations, and deadlines should be clearly mentioned these much be realistic. Don't overload work
- Evaluate teleworker's progress towards expected objectives
- Schedule one-to-one meetings with teleworkers to know where they stand on the task and to discuss their needs and concerns

Recommendation 6: Allow telework on need basis

As shown in Figure 13 and Table 20, Out of the total responder count 382, 27% are working in the companies which are not permitting to telework. But according to Table 21 and Figure 14, Out of the total responder count 382, 94% of employees are willing to do telework. As shown in Figure 15 and Table 22, 65% of employees doing telework on a need basis. According to the correlation analysis in Section 4.4.2.7, there is a low but positive correlation between the willingness of doing telework and productivity. Employees take sick leave when they ill and difficult to commute to the office. If the organization allow telework, employees are able to complete their assigned task while staying at home. So telework will reduce absenteeism and increase the wellbeing of employees. Teleworking is helping to manage a good work-life balance and a hybrid arrangement of telework based on the requirement will be a good fit for most of them. In that case, the feeling/knowledge of the ability to telework will provide a stress-free mindset for the employees. According to the correlation analysis in Section 4.5.2.2, there is a positive correlation between work-wellbeing and the teleworker's productivity. By establishing a culture that supports telework and FWAs, the organization will able to increase the satisfaction level and motivation of teleworkers. (T. D. Allen et al., 2015) has stated that every employee hasn't abilities or self-efficacy to do telework productively.

Also according to the responses received the questions such as "I feel that the hybrid arrangement of telework (telework on need basis) positively affects my productivity. ", 90% of respondents believe that telework on a need basis is a good working arrangement and it positively affects productivity as well.

Hence in order to improve employee's skill to be productive in the teleworking environment,

➢ Organize training sessions to improve employee's skills which need to be productive in teleworking environments like, time management skills, skills for manage tasks independently, self-efficacy, self-regulation

➢ Provide hybrid arrangement of telework facility which assist with more work-life balance

5.5. Research Limitations

The researcher has limited to select the most important five teleworking factors to address through this research. There are many factors have to be considered when doing teleworking continuously. The majority of respondents doing teleworking on a need basis. That means the employees are not fully virtual ones. They doing it occasionally when they feel it is most needed. This may be the reason why some study results do not show the desired relationship between the independent variables and the dependent variable. Since the sample size represents all employees in the Sri Lankan IT industry, the sample size plays a significant role in this research. If it is unable to represent the population, then the result and recommendations won't be precise. The researcher has selected 382 IT employees as the sample size for this research. So it would be better if one can select more than 450 employees s sample size in future works. And also, the researcher hasn't measured the value for productivity in this research. Only consider perceived productivity.

5.6. Future Research Directions

There are several ways to extend this research as future work. As mentioned in 5.5, the majority of respondents doing telework teleworking on a need basis. So the result based on this. And also only five teleworking factors addressed through this study. But there are many

factors have to be considered when doing teleworking continuously. All IT employees had to do teleworking due to the COVID-19 pandemic. This is a sudden situation for all ones. So it is better that can investigate which factors mostly need to increase employee productivity in such situations as future work in this research study. Besides that, this research use 382 sample size to collect the data. Hence it would be better if this size can be increased since the sample size and more accurate quantitative data is one of the most important aspects in quantitative research. All conclusions and recommendations are based on these data. So it would be better it can coverup more areas in the Sri Lankan IT industry. Furthermore, there is an issue with measuring the performance of teleworkers since managers couldn't be able to see how they work. Hence it would be better if can develop a model on evaluating the teleworker's performance. This should be fair to both employers and the employees.

5.7. Conclusion

As per the detailed analysis and the discussion through this research, it is proven that teleworking can impact software engineer's productivity high. Even though there were many kinds of past studies related to teleworking and productivity, Some big IT companies like Yahoo, Best Buy, and HP proscribed the teleworking facility due to the lost trust in their employees. This study was focusing on identifying the factors that mostly affect the productivity of software engineers when they telework. This research is concluded that work-flexibility, work-wellbeing, and self-regulation have a high impact on the teleworker's productivity. Consecutively effective communication has a moderate impact on the teleworker's productivity and technology has a low impact on productivity. This analysis gives some ideas about how to perform well as a teleworker. After that, the researcher has suggested some recommendations based on the analysis result. These recommendations for increasing the software engineers' productivity by providing teleworking facilities and how to perform well in teleworking. When employees are satisfied with their job and the company, they always give their fullest commitment to the company. Not only that the image and the trust about the company in the employee's mind can be improved. Furthermore, the limitations of this research and future work on this area are described in this chapter.

REFERENCE

Allen, D. G., Renn, R. W., & Griffeth, R. W. (2003). the Impact of Telecommuting Design on Social Systems, Self-Regulation, and Role Boundaries. *Research in Personnel and Human Resources Management*, *22*(03), 125–163. https://doi.org/10.1016/S0742-7301(03)22003-X

Allen, T. D., Golden, T. D., & Shockley, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest*, *16*(2), 40–68. https://doi.org/10.1177/1529100615593273

Ariasa, G., Vilchesa, D., Banchoff, C., Hararia, I., & Iuliano, P. (2012). *The 7 key factors to get successful results in the IT Development projects*. *5*, 199–207. https://doi.org/10.1016/j.protcy.2012.09.022

Arso, S. S., Sfenrianto, S., & Wahyudi, M. (2018). Employee Performance Measurement in Teleworking Using Balanced Scorecard. *International Journal of Electrical and Computer Engineering*, *8*(6), 5178–5184. https://doi.org/10.11591/ijece.v8i6.pp5178-5184

Asiamah, N., Oteng-Abayie, E. F., & Mensah, H. K. (2017). *General , Target , and Accessible Population : Demystifying the Concepts for Effective Sampling*. *June*.

Beecham, S. (2014). *Motivating Software Engineers Working in Virtual Teams Across the Globe*. 247–273. https://doi.org/10.1007/978-3-642-55035-5

Bloom, N., Liang, J., Roberts, J., & Ying, Z. J. (2018). *Does Working From Home Work? Evidence from a Chinese Experiment*. *April*, 165–218. https://doi.org/10.1093/qje/qju032.Advance

Boell, S. K., Cecez-Kecmanovic, D., & Campbell, J. (2014). Telework and The Nature of Work : An Assessment of Different Aspects of Work and The Role of Technology. *ECIS 2014 Proceedings*, *June*.

Bosua, R., Gloet, M., Kurnia, S., Mendoza, A., & Yong, J. (2013). Telework, productivity and wellbeing. *Telecommunications Journal of Australia*, *63*(1).

Brown, C., Smith, P. R., & Arduengo, N. (2016). *Trusting Telework in the Federal Government Trusting Telework in the Federal Government*. *21*(1), 87–101.

Caillier, J. G. (2014). Do Role Clarity and Job Satisfaction Mediate the Relationship between Telework and Work Effort ? Do Role Clarity and Job Satisfaction Mediate the Relationship between Telework and Work Effort ? *International Journal of Public Administration*, *December*, 193–201. https://doi.org/10.1080/01900692.2013.798813

Campbell, K. M. (2015). *Flexible Work Schedules , Virtual Work Programs , and Employee Productivity*.

Chen, W., & Mcdonald, S. (2014). Do Networked Workers Have More Control? The Implications of Teamwork, Telework, ICTs, and Social Capital for Job Decision Latitude. *SAGE*. https://doi.org/10.1177/0002764214556808

Collins, A. M., Hislop, D., & Cartwright, S. (2016). Social support in the workplace between

teleworkers, office-based colleagues and supervisors. *New Technology, Work and Employment*, *31*(2), 161–175. https://doi.org/10.1111/ntwe.12065

Conradie, W. J., Klerk, J. J. De, & Town, C. (2018). *To flex or not to flex ? Flexible work arrangements amongst software developers in an emerging economy*. 1–12.

Cordero, J. (2018). *The Digital Nomad: A Brief History of Remote Workers*. HighSpeedInternet.Com. https://www.highspeedinternet.com/resources/history-remote-workers

Davis, U. C. (2014). *Defining Telecommuting*. *January 1991*.

Dissanayake, K. (2017). *Teleworking as a mode of working for women in Sri Lanka : Concept , challenges and prospects*. *680*.

Fonner, K. L., & Roloff, M. E. (2010). *Why Teleworkers are More Satisfied with Their Jobs than are Office-Based Workers : When Less Contact is Beneficial*. *38*(4). https://doi.org/10.1080/00909882.2010.513998

Freeman, J. V., & Julious, S. A. (2008). *Descriptive analysis of quantitative data*. 1–116.

Frost Jim. (n.d.). *Statistical Hypothesis Testing Overview - Statistics By Jim*. Retrieved May 23, 2020, from https://statisticsbyjim.com/hypothesis-testing/statistical-hypothesis-testing-overview/

Gajendran, R. S., & Harrison, D. A. (2007). *The Good , the Bad , and the Unknown About Telecommuting : Meta- Analysis of Psychological Mediators and Individual Consequences*. *92*(6), 1524–1541. https://doi.org/10.1037/0021-9010.92.6.1524

Gani, Z., & Toleman, M. (2006). *Success factors and barriers to telework adoption in e-business in Australia and Singapore : the influence of culture and organizational culture*. *1*(3), 81–92.

Graziotin, D., & Fagerholm, F. (2019). Happiness and the Productivity of Software Engineers. *Apress, Berkeley, CA*, 109–124. https://doi.org/10.1007/978-1-4842-4221-6

Greer, T. W., & Payne, S. C. (2014). *Overcoming Telework Challenges : Outcomes of Successful Telework Strategies*. *17*(2), 87–111. https://doi.org/10.1037/mgr0000014

Groen, B. A. C., Triest, S. P. Van, Coers, M., & Wtenweerde, N. (2018). Managing flexible work arrangements : Teleworking and output controls. *European Management Journal*, 1–9. https://doi.org/10.1016/j.emj.2018.01.007

Gunasekare, U. L. T. P. (2015). *Virtual Teams in Sri Lankan Business Process Outsourcing Companies*. *2*(3), 155–160.

Haddon, J. (2018). The impact of employees' well-being on performance in the workplace. *Strategic HR Review*, *17*, 72–75. https://doi.org/10.1108/shr-01-2018-0009

Halpern, D. F. (2005). How time-flexible work policies can reduce stress , improve health , and save money. *John Wiley & Sons*, *168*, 157–168. https://doi.org/10.1002/smi.1049

Hox, J. J., & Boeije, H. R. (2005). Data Collection, Primary vs. Secondary. *Encyclopedia of*

Social Measurement, *1*.

HU, C.-P., & CHAN, Y.-Y. (2017). John W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. *Social and Administrative Sciences*, *4*(2), 3–5.

In, J. (2017). *Introduction of a pilot study*. *70*(6), 601–605.

Krejcie, R. V, & Morgan, D. (1970). *Determining Sample Size for Research Activities*. 607–610.

Kurland, N. B., & Cooper, C. D. (2002). Manager control and employee isolation in telecommuting environments. *Journal of High Technology Management Research*, *13*, 107–126.

Lavrakas, P. (2013). Alternative Hypothesis. In *Encyclopedia of Survey Research Methods*. Sage Publications, Inc. https://doi.org/10.4135/9781412963947.n14

Linden, M. (2014). *Telework research and practice : Impacts on people with disabilities*. *48*, 65–67. https://doi.org/10.3233/WOR-141857

Mcclelland, M., Geldhof, J., Morrison, F., Gestsdóttir, S., Cameron, C., Bowers, E., Duckworth, A., Little, T., & Grammer, J. (2018). Self-Regulation. *Handbook of Life Course Health Development*. https://doi.org/10.1007/978-3-319-47143-3

McGaghie, W. C.; Bordage, G. . and J. A. S. (2001). *Problem Statement, Conceptual Framework, and Research Question*. http://goo.gl/qLIUFg

Mcnall, L. A., Masuda, A., & Style, C. (2009). Flexible Work Arrangements , Job Satisfaction , and Turnover Intentions : The Mediating Role of Work-to- Family Enrichment. *The Journal of Psychology*, *May 2014*. https://doi.org/10.1080/00223980903356073

McNeely, L. (2019). *Benefits and Challenges of Remote Workers*. https://www.lucidchart.com/blog/benefits-and-challenges-of-remote-workers

Messenger, J. C. (2017). Working Anytime, Anywhere: The Evolution of Telework and its Effects on the World of Work. *IUSLabor*.

Messenger, J. C. (2019). *Introduction : Telework in the 21st century – an evolutionary perspective*.

Messenger, J. C., & Gschwind, L. (2016). *Three generations of Telework : New ICTs and the (R) evolution from Home Office to Virtual Office*. 195–208.

Meulen, N. van der. (2017). *Working from home? Research finds employee self-regulation is the key to success*. https://www.hrzone.com/engage/employees/working-from-home-research-finds-employee-self-regulation-is-the-key-to-success

Meyer, A. N., Fritz, T., Murphy, G. C., & Zimmermann, T. (n.d.). *Software Developers ' Perceptions of Productivity Categories and Subject Descriptors*. *2*, 19–29.

Morgan, R. E. (2004). Teleworking: an assessment of the benefits and challenges. *European Business Review Iss Personnel Review Iss Management Decision*, *16*(4), 344–357. https://doi.org/http://dx.doi.org/10.1108/09555340410699613

Muhammad, S., & Kabir, S. (2016a). *Methods of data collection. July 2016.*

Muhammad, S., & Kabir, S. (2016b). *Sample and sampling designs. July.*

Murphy-hill, E., Jaspan, C., Sadowski, C., Shepherd, D., Phillips, M., Winter, C., Smith, E., & Jorde, M. (n.d.). *What Predicts Software Developers ' Productivity ?* 1–23.

Nakrošienė, A., Bučiūnienė, I., & Goštautaitė, B. (2019). Working from home : characteristics and outcomes of telework. *International Journal of Manpower.* https://doi.org/10.1108/IJM-07-2017-0172

Nilles, J. M. (1975). *Telecommunications and Organizational Decentralization. C*(10), 1142–1147.

Oliveira, E., Conte, T., Cristo, M., & Mendes, E. (2016). *Software Project Managers ' Perceptions of Productivity Factors : Findings from a Qualitative Study.*

Onyemaechi, U., Peter Chinyere, U., & Emmanuel, U. (2018). Impact of Telecommuting on Employees ' Performance : A Focus on Telecommunication Out-Fits in Owerri , Imo State. *Journal of Economics and Management Sciences*, *Vol. 1*, *No*(December). https://doi.org/10.30560/jems.v1n3p54

Perera, H. S. . (2010). Employees ' Perception On Teleworking In Sri Lankan Software Industry. *Indian Journal of Management*, 39–46.

Roxana Trigueros, Med Juan, F. H. S. (2018). *Qualitative and Quantitative Research Instruments. March 2017.*

Russell, H., Connell, P. J. O., & Mcginnity, F. (2007). *The Impact of Flexible Working Arrangements on Work-Life Conflict and Work Pressure in Ireland. 189.*

Sa´nchez, A. M., Pe´rez, M. P., Carnicer, P. de L., & Jime´nez, M. J. V. (2007). Teleworking and workplace flexibility : a study of impact on firm performance. *Personnel Review*, *36*(42–64). https://doi.org/10.1108/00483480710716713

Salkind, N. (2012a). Directional Hypothesis. In *Encyclopedia of Research Design*. SAGE Publications, Inc. https://doi.org/10.4135/9781412961288.n114

Salkind, N. (2012b). Nondirectional Hypotheses. In *Encyclopedia of Research Design*. SAGE Publications, Inc. https://doi.org/10.4135/9781412961288.n270

Scholarios, D., & Marks, A. (2004). *Work-life balance and the software worker. 14*(2), 54–74.

Sikes, N., Mason, K., & Von Lehmden, S. (2011). Telecommuting advantages and challenges for IT management and staff. *SIGMIS CPR 2011 - Proceedings of the 2011 ACM SIGMIS Computer Personnel Research Conference*, 20–25. https://doi.org/10.1145/1982143.1982150

Smith, S. A., Patmos, A., & Pitts, M. J. (2015). Communication and Teleworking : A Study of Communication Channel Satisfaction , Personality , and Job Satisfaction for Teleworking Employees. *International Journal of Business Communication*, 1–25. https://doi.org/10.1177/2329488415589101

Sthle, L., & Wold, S. (1989). Analysis of variance (ANOVA). In *Chemometrics and Intelligent Laboratory Systems* (Vol. 6, Issue 4, pp. 259–272). https://doi.org/10.1016/0169-7439(89)80095-4

Suh, A., & Lee, J. (2017). *Understanding teleworkers ' technostress and its influence on job satisfaction*. 140–159. https://doi.org/10.1108/IntR-06-2015-0181

Taskin, L., & Bridoux, F. (2010). Telework: A challenge to knowledge transfer in organizations. *International Journal of Human Resource Management*, *21*(13), 2503–2520. https://doi.org/10.1080/09585192.2010.516600

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, *2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Trizano-hermosilla, I., & Alvarado, J. M. (2016). *Best Alternatives to Cronbach ' s Alpha Reliability in Realistic Conditions : Congeneric and Asymmetrical Measurements*. *7*(May), 1–8. https://doi.org/10.3389/fpsyg.2016.00769

Trochim, W. M. K. (2020). *Descriptive Statistics*. Research Methods Knowledge Base. https://socialresearchmethods.net/kb/descriptive-statistics/

Weinert, C., Maier, C., & Laumer, S. (2015). Why are teleworkers stressed ? An empirical analysis of the causes of telework-enabled stress. *Internationalen Tagung Wirtschaftsinformatik*, 1407–1421.

Weinert, C., Maier, C., Laumer, S., & Weitzel, T. (2014). Does Teleworking Negatively Influence IT Professionals ? An Empirical Analysis of IT Personnel ' s Telework-enabled Stress. *ACM*, 139–147.

Yoshida, C. (2018). *Applicability of Teleworking in Software Distributed Development*. *September*, 350–364. https://doi.org/10.20472/BMC.2018.008.023

Zikmund, Babin, Carr, G. (n.d.). *Business Research Method* (G. Zikmund, Babin, Carr (ed.); 8th editio).

APPENDIX

APPENDIX A – Pre Survey

Questions asked from the **Lead Engineers / Managers**

1. Do you think that teleworking has an impact on the developer's productivity?
   a) Yes   b) No

2. What are the factors/aspects that you consider before you allow teleworking?

3. Are you hesitating to allow teleworking? Could you please tell me the reason for your answer?

4. What is your perception regarding teleworking?

5. What do you think about the following factors? How far they affect productivity in the teleworking environment? Can you tell each ones' importance?

   - Work Flexibility
   - Work in Exclusion
   - Work wellbeing
   - Technology
   - Company Culture
   - Effective Communication
   - Task Refinement
   - Self-regulation
   - Learning and development

Questions asked from the **Engineers**

1. Does telework have an impact on your productivity?
   a) Yes   b) No

2. Why do you need to do teleworking?

3. What factors/aspects need you to be succeed in teleworking?

4. What are the difficulties you faced when you are doing teleworking?

5. What do you think about following factors? How far they affect to the productivity in the teleworking environment? Can you tell each ones' importance?

- Work Flexibility
- Work in Exclusion
- Work wellbeing
- Technology
- Company Culture
- Effective Communication
- Task Refinement
- Self-regulation
- Learning and development

Please fill the following questionnaire based on how Teleworking factors affect to the Software Developer's productivity.

PART A - Demographic

1. Which category below includes your age?

   - ✓ 20 – 24
   - ✓ 25 – 29
   - ✓ 30 – 34
   - ✓ 35 – 39
   - ✓ Over 40

2. What is your gender?
   - ✓ Male
   - ✓ Female

3. What is your marital status?

   - ✓ Single
   - ✓ Married, no children
   - ✓ Married, have children below 5Y
   - ✓ |Married, have children above 5Y

4. How many km do you travel to the office?
   - ✓ less than 5km
   - ✓ Between 5km - 14km
   - ✓ Between 15km - 24km
   - ✓ Between 25km - 34km
   - ✓ Between 35km - 44km
   - ✓ Between 45km - 54km
   - ✓ more than 55km

5. How long does it take you to get to work on an average day?
   - ✓ Less than 30 minutes
   - ✓ Between 31 - 60 minutes
   - ✓ Between 61- 90 minutes
   - ✓ Between 91 - 120 minutes
   - ✓ More than 121 minutes

6. Which best describes your role?
   - ✓ Software/ System Engineer
   - ✓ QA Engineer |Team / Tech Lead

- ✓ Project Manager
- ✓ Solution and Technical Architect
- ✓ Management Information Systems/IT Management
- ✓ System and Network Administration
- ✓ Other

7. Does your current employer offer teleworking facility?
   - ✓ Yes
   - ✓ No

8. If not, and you were given the opportunity, would you Telework?
   - ✓ Yes
   - ✓ No

9. For how long have you been working in an organization which allows teleworking?
   - ✓ 0-1 Year
   - ✓ 2-5 Years
   - ✓ 6-10 Years
   - ✓ More than 10 years

10. How often do you telework?
    - ✓ At least once a week
    - ✓ Once every two weeks
    - ✓ Occasionally for special projects
    - ✓ On need basis

11. What is your opinion on Teleworking? I have .... mind regarding telework.
    - ✓ Very negative
    - ✓ Negative
    - ✓ Neutral
    - ✓ Positive
    - ✓ Very positive

PART B

The objective of these questions is to measure the factors which most affect software developers' productivity in the teleworking environment.

12. It would be better if the company can provide opportunities to work from home when an employee is not able to report to work for a reliable reason.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

13. When I have control over my working time & working place, it increases my capability to work more.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

14. Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

15. I'm able to manage my time and workload well by prioritizing tasks and setting deadlines.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

16. When I'm working from home, I feel very comfortable and more refreshed.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

17. When I'm working from home, I feel less stressed since there are fewer office interruptions and I have control of my work time & place
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

18. When I'm working from home, I can take health breaks which is important for musculoskeletal relaxation which helps to reduce musculoskeletal pain (pain in muscles, bones, nerves, etc.).
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

19. I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

20. Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

21. Teleworker needs cloud computing systems to make trustworthy share and use of software and files.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

22. Teleworker needs proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

23. Teleworker needs adequate training in the use of IT tools and quick technical support.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

24. Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

25. Teleworker should be a good team player and communicate frequently with supervisors and fellow workers.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

26. Communication is an essential way to build trust between managers and teleworkers. With this trust, I feel that supervisors recognize and appreciate my work.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

27. Teleworker should attend meetings using methods such as WebEx or webinars.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

28. Teleworker has to interpret the content of audio/emails/chat clearly to get the exact requirement since teleworker isn't able to interpret the body language.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

29. Without frequent feedback from supervisors/experts, teleworker may go in the wrong direction towards project implementation and end up with the wrong software.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

30. Teleworker should be self-motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

31. Teleworker should be able to be productive with supervision as well as when no-one is checking up on him/her.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

32. Teleworker should be able to complete assigned tasks independently, on-time and with minimal guidance.
    - ✓ Strongly Agree
    - ✓ Agree
    - ✓ Neither Agree or Disagree
    - ✓ Disagree
    - ✓ Strongly Disagree

33. Teleworker should be highly focused and have the ability to handle potential family/ home distractions.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

34. Teleworking allows me to save working hours by stopping me from driving in heavy traffic.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

35. I feel that I am more productive when teleworking since it ends up working longer hours than required.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

36. I feel that the hybrid arrangement of telework (telework on need basis) positively affects my productivity.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

37. Teleworking makes me feel that I may able to finish my work on time.
   - ✓ Strongly Agree
   - ✓ Agree
   - ✓ Neither Agree or Disagree
   - ✓ Disagree
   - ✓ Strongly Disagree

PART C – Open-ended Question

38. Please indicate your experience or suggestions based on teleworking and your productivity while doing teleworking.

APPENDIX C – Final Survey Result Summary

Variable	Question	Nubmer of Responses				
		Strongly Agree	**Agree**	**Neither Agree or Disagree**	**Disagree**	**Strongly Disagree**
Work Flexibility	12. It would be better if the company can provide opportunities to work from home when an employee is not able to report to work for a reliable reason.	66.23%	32.98%	0.79%	0.00%	0.00%
	13. When I have control over my working time & working place, it increases my capability to work more.	40.58%	41.36%	16.75%	0.52%	0.79%
	14. Teleworking would enable a better work-life balance which arouses a positive attitude towards work since I will be able to manage office work as well as personal commitments	42.67%	48.43%	7.07%	1.31%	0.52%
	15. I'm able to manage my time and workload well by prioritizing tasks and setting deadlines.	28.80%	52.36%	18.06%	0.79%	0.00%
Work Wellbeing	16. When I'm working from home, I feel very comfortable and more refreshed.	37.96%	40.31%	18.85%	2.88%	0.00%
	17. When I'm working from home, I feel less stressed since there are fewer office interruptions and I have control of my work time & place	35.08%	42.93%	14.66%	6.81%	0.52%
	18. When I'm working from home, I can take health breaks which is important for musculoskeletal relaxation which helps to reduce musculoskeletal pain (pain in muscles, bones, nerves, etc.).	40.31%	45.03%	10.47%	3.40%	0.79%
	19. I do not feel lazy when I work with less social and professional interactions since I am able to adjust to this relative isolation.	16.75%	41.88%	23.82%	15.97%	1.57%
Technology	20. Teleworker needs collaborative IT tools (network infrastructure such as VPN, web portals, terminal servers, etc...) to connect to the organization network and remote servers	55.76%	42.15%	1.57%	0.52%	0.00%
	21. Teleworker needs cloud computing systems to make trustworthy share and use of software and files.	32.46%	47.38%	17.02%	3.14%	0.00%
	22. Teleworker needs proper security mechanisms such as strong encryption methods, authenticate remote access, etc. to prevent data security breaches.	45.03%	44.76%	8.64%	1.57%	0.00%

	23. Teleworker needs adequate training in the use of IT tools and quick technical support.	25.92%	48.43%	21.20%	4.45%	0.00%
	24. Technology-based on high connectivity is an essential aspect to stay in touch with managers and co-workers.	40.84%	52.88%	5.50%	0.52%	0.26%
Effective Communication	25. Teleworker should be a good team player and communicate frequently with supervisors and fellow workers.	46.86%	46.60%	5.76%	0.79%	0.00%
	26. Communication is an essential way to build trust between managers and teleworkers. With this trust, I feel that supervisors recognize and appreciate my work.	42.15%	49.21%	8.64%	0.00%	0.00%
	27. Teleworker should attend meetings using methods such as WebEx or webinars.	41.88%	49.74%	8.12%	0.26%	0.00%
	28. Teleworker has to interpret the content of audio/emails/chat clearly to get the exact requirement since teleworker isn't able to interpret the body language.	38.22%	50.79%	9.95%	1.05%	0.00%
	29. Without frequent feedback from supervisors/experts, teleworker may go in the wrong direction towards project implementation and end up with the wrong software.	27.49%	52.36%	16.75%	3.14%	0.26%
Self-Regulation	30. Teleworker should be self-motivated, self-disciplined and confident working without manager supervision, peer monitoring and peer-competition.	45.81%	44.24%	9.42%	0.52%	0.00%
	31. Teleworker should be able to be productive with supervision as well as when no-one is checking up on him/her.	43.19%	46.07%	8.90%	1.83%	0.00%
	32. Teleworker should be able to complete assigned tasks independently, on-time and with minimal guidance.	47.12%	42.15%	8.64%	2.09%	0.00%
	33. Teleworker should be highly focused and have the ability to handle potential family/ home distractions.	39.27%	47.91%	12.57%	0.26%	0.00%
Productivity	34. Teleworking allows me to save working hours by stopping me from driving in heavy traffic.	58.38%	32.46%	8.12%	0.79%	0.26%
	35. I feel that I am more productive when teleworking since it ends up working longer hours than required.	24.35%	43.72%	22.51%	8.64%	0.79%
	36. I feel that the hybrid arrangement of telework (telework on need basis) positively affects my productivity.	43.72%	46.86%	8.12%	0.79%	0.52%
	37. Teleworking makes me feel that I may able to finish my work on time.	21.99%	52.36%	21.73%	3.40%	0.52%

APPENDIX D – Company List

List of software companies utilized for this study

#	Company Name
1	Virtusa (Pvt) Ltd
2	Inova IT Systems (Pvt) Ltd
3	Dialog Axiata PLC
4	Visolit (99X Services (Pvt) Ltd.
5	Softcodeit Solutions (Pvt) Ltd
6	eBuilder Technology Centre (Pvt) Ltd
7	Efutures (Pvt) Ltd
8	Creative Software (Pvt) Ltd
9	Embla Software Innovation
10	OrangeHRM (Pvt) Ltd
11	Eyepax IT Consulting (Pvt) Ltd
12	Codegen International (Pvt) Ltd
13	DMS Software Engineering (Pvt) Ltd
14	Wiley Global Technology Pvt. Ltd.
15	99X Technology (Pvt) Ltd
16	Hitachi Digital Payment Solutions Ltd
17	DirectFN Sri Lanka
18	Infor (Pvt) Ltd
19	IronOne Technologies (Pvt) Ltd
20	hSenid Software International
21	CAM Management Solutions (CAMMS)
22	IFS R and D International (Pvt) Ltd
23	WSO2
24	Nimbus Venture (Pvt) Ltd
25	Pearson Lanka (Pvt) Ltd
26	iTelaSoft (Pvt) Ltd
27	Cake Labs
28	Digiteq Solutions (Pvt) Ltd
29	Geveo Australasia (Pvt) Ltd
30	Mitra Innovation
31	LB Finance PLC