International Journal of Information Systems and Social Change
Volume 14 • Issue 1

Assessing the Impact of Human Error Assessment on Organization Performance in the Software Industry

Shampave Paramanantham, Informatics Institute of Technology, Sri Lanka*
Sidath Liyanage, University of Kelaniya, Sri Lanka

ABSTRACT

The influence of human errors on organizations is wide-ranging concerning customer service, productivity, teamwork, quality, execution, decision-making, and loss (Irmi.com, 2018). When the employee makes an error, this may prompt an operational failure, effectively affecting whatever is being assessed. There is a commonly accepted connection between human errors and organizational performance. However, the theory is all hypothesis without confirmation since there is minimal literature writing in this research. Data was gathered from 365 employees of IT export companies in Sri Lanka. 5 people working as project managers in IT export companies were interviewed to get their opinion about human errors. The findings show that human errors such as skill-based, design, quality testing, and maintenance errors can significantly influence performance outcomes, namely sales growth, return on investment, customer satisfaction, innovation development, and product and service quality.

KEYWORDS

Colombo, Design Errors, Human Errors, Maintenance Errors, IT Export Companies, Organization Performance, Quality Testing Errors, Skill-Based Errors, Sri Lanka

INTRODUCTION

Humans make mistakes. That is the nature of the human. Sometimes those mistakes lead to a colossal disaster. Human errors occurred in ancient times. Some mistakes which occurred by humans in ancient times changed history. As per the research, human errors are the root cause of 70% to 90% of accidents in organizations (Ganguly, 2011a). Organizations are made up of humans and are the main reason for a successful business and better organizational performance. At the same, their mistakes lead to the bad performance of the organization.

Human errors can initiate at the personal level. In this current situation, organizations do not have a clear idea of the reason for the downfall of their organizational performance. Human errors are also one of the leading causes of failure. All humans make mistakes in their lifetime. At one point, all the humans are making mistakes within the organization. Those mistakes do not depend on age

DOI: 10.4018/ijissc.314563 *Corresponding Author

diversity or personal characteristics. Some small mistakes can create severe problems. To change organizational performance, these human errors need to be reduced. There are many examples of loss of money within the organization due to human error, and the organization's name went down. According to a StorageCraft survey (News and News, 2018), approximately 30% of IT professionals stated that human errors are the main reason for data loss. On the other hand, BakerHostetler reports (Bakerhostetler, 2016) mentioned that nearly 50% of incidents in organizations were held because of human error. In early 2017, the S&P company in the U.S.A faced a massive loss of approximately $160 million because Amazon Web Services was down for nearly 4 hours (Deltaxml, 2018). This happened due to human error.

This study is based on human errors occurring in everyday day-to-day life. It needs a critical evaluation of the factors affecting human error assessment and reduction of human errors to improve organization performance. In this study, a particular preference gave to Software development companies in Colombo that are doing exports. When the clients are in other countries, there are a lot of chances for mistakes. Sometimes there will be miscommunication. Human errors are a vital force in the software industry. Sometimes best developers also make careless mistakes, leading to a big failure time and money lost, which cannot be returned. This will affect organizational performance. So, the study included all age diversity people who are working as a developer. This research study entirely focused on problems occurring to human errors in the organization.

This study identified four hypotheses:

1. Relationship between skill-based errors and organization performance.
2. Relationship between design errors and organization performance.
3. Relationship between quality testing errors and organization performance.
4. Relationship between maintenance errors and organization performance.

After discussing organizational performance and human errors, analyzed whether there is any relationship between corporate performance and hypotheses. To do that, we distributed surveys and conducted some interviews within a particular time. Then we discussed limitations and future enhancement and conclusion with some recommendations to avoid human errors.

REVIEW OF LITERATURE

Afraid of failing is the most significant barrier to get success. "Early elimination of mistakes will improve software quality and reduce overall development cost." (Misnevs and Demiray, 2017b) Accepting this statement, many organizations are trying to reduce human errors to increase organizational performance, but human errors still play a significant role in organizational performance. Maxion and Reeder (2005) focused on software defect prevention by boosting developer self-regulating skills. Paul et al. (2010) discussed safety domains for road transport and future directions. As per Horberry et al. (2010), human factors must be considered to improve work performance during maintenance. Fuqun and Bin (2017) differentiated people with human error-proneness and developed a conceptual model to show the relations between coincident faults and performance levels in the software industry.

Organization Performance

The organization comes from the word "organism, "a system composed of parts with dependent personalities. Koontz and O'Donnell said, "It is the grouping of activities necessary to attain enterprise objectives and assignment each grouping to a manager with authority necessary to supervise it." To perform well, organizations need a systematic plan. Per Mitchell (1983), understanding performance is a collection of behavior, people, or tasks and overtime. Henri (2004) mentioned organizational

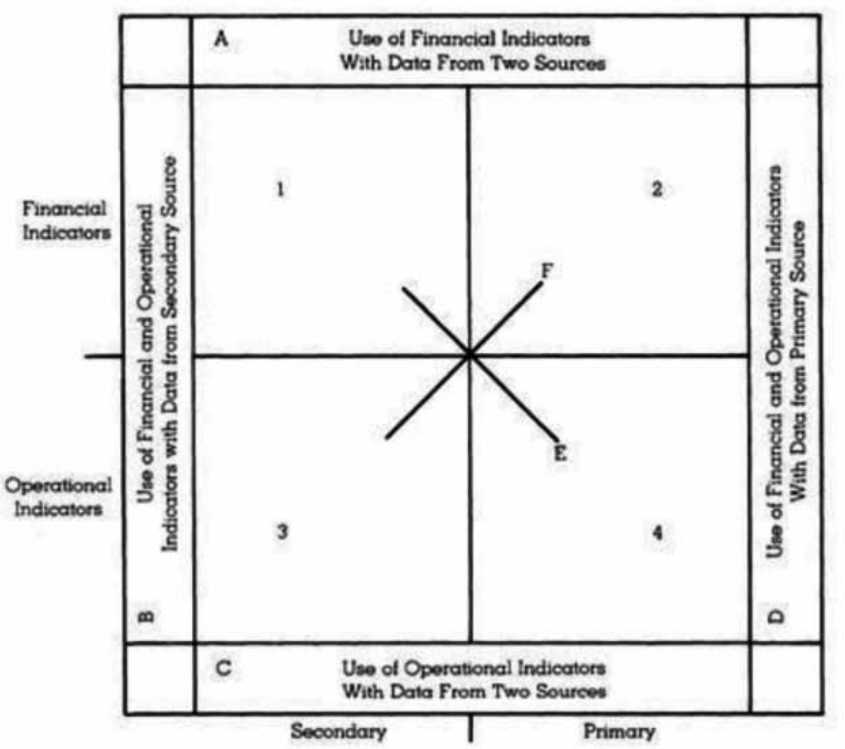
performance means "a construct perspective in which the focus is on the definition of the concept in terms of assessment and conceptualization." Chakravarthy (1986) identifies profitability, multi-stakeholder satisfaction, financial-market, and transformation quality of the firm as the primary intention of assessment.

"A dynamic process of creation, acquisition, and integration of knowledge aimed at developing the resources and capabilities that allow the organization to achieve better performance" (Lopez, et al. 2006: 217). On the other hand, Senge (1990) stated it as "a continuous testing of experience and its transformation into knowledge available to the whole organization and relevant to their mission." "Organizational performance encompasses three specific areas of firm outcomes: (a) financial performance, (b) product-market performance, and (c) shareholder return" (Richard et al., 2009, p.722).

"Performance measures should not be specific to the research question but be sufficiently robust to cover the domain of organizational performance." (Richard et al. 2009, p.737). Organizational Performance can be evaluated by the effectiveness and efficiency of goal achievement in a firm (Robbins and Coulter, 2002). Per Schermerhorn et al. (2002), performance means the quantity and quality of an in- dividual or teamwork achievement. According to Hancott (2005), organization performance efficiency and effectiveness are the same, which cannot be interchangeable. And also points out that since the mid-1900, profit growth rate, net or total assets growth rate, return on sales, shareholder return, growth in market share, number of new products, and return on net assets are the indicators to measure organizational performance. On the other hand, in 1990, return on capital and net assets were performance measurements.

As per Venkatraman and Ramanujam (1986), organization performance can be obtained from primary and secondary sources. So, to measure organization performance, they created (Figure 1) a scheme with ten basic approaches. On the other hand, there are many problems related to taking

Figure 1. A scheme for measuring organization performance (Source: Venkatraman & Ramanujam (1986, p.805))



objective measures in a research survey, particularly in the actual examples of work where inductions are made about people (Ketokivi & Schroeder 2004). As per Dess and Robinson (1984, p.266), challenging to get accurate data from surveys as organization performance datasets are always confidential, leading to significant measurement errors.

Human Errors

"Human factors refer to environmental, organizational and job factors, and human and individual characteristics, which influence behavior at work in a way which can affect health and safety" (Hse.gov.uk, 2018). "Human error is often cited as a major contributing factor or cause of incidents and accidents. Many people accept human error as the category of potential causes for unsatisfactory activities or outcomes. A belief is that the human element is unreliable and that solutions to the human error problem reside in changing the people or their role in the system" (Woods et al., n.d.). As a result of technology says, 60-90% of significant accidents happen because of human error in the wrong decision, lack of knowledge, misinterpretation, and silly mistakes (Helander, 2006).

Error Classification

"Errors are the manifestations of brain bottlenecks." (Reason, 1990). Mainly, errors occur due to lack of experience, knowledge, misunderstanding, carelessness, workforce, stress, shortcuts, forgetfulness, etc. Dr. David divided the errors into 3 (Woods et al., n.d.). They are:

1. Skill-based error
2. Rule-based error
3. Knowledge-based error

Errors can be divided according to (Huang et al., 2014):

1. Personality traits
2. Cognitive styles
3. Performance levels

As per Prof. Soumen Ganguly (Ganguly, 2011a), human failures are two types. The first is unintentional errors that occur because of unplanned situations, and the second is intentional errors that occur due to deviations from the procedures or rules.

Human Variability and How Human Errors Affect Organization Performance

"A positive attitude held by the employee towards the organization and its values. An engaged employee is aware of the business context and works with colleagues to improve performance within the job for the benefit of the organization. The organization must work to nurture, maintain and grow the engagement, which requires a two-way relationship between employer and employee" (Robinson et al. 2004, p.9). Individuals play the most crucial role in fulfilling organizational goals. Individuals provide a lot of contributions to their organization, like knowledge, skills, loyalty, effort, competencies, ability, time, capacity, etc. In an organization, individual differences are significant. As per Freud (1899), human nature and society are opposite. Jung (1976) stated that everyone is born with specific adaptive approaches for concatenating the relationship between outward and inward, namely, different people may show more or less extroverted toward others.

An individual's behavior and personality will not just affect that person. Still, all people who surround him and the identity of the individual are a combination of personality traits and characteristics. That helps to increase productivity and organization performance. Organizations will face unnecessary costs and poor productivity when individuals fail to fulfill organizational needs or

perform poorly. So, there must be a perfect mixture and balance between both. If not, it must initiate a change.

"Every person needs to be more aware of the consequences of their mistakes, and do the very best they can do" (Ganguly, 2011a). Software development is a complex and flexible cognitive activity. Systematic knowledge about human errors is the basis for preventing errors; moreover, the amount of such knowledge deposited in the long-term memory of programmers is an essential determinant of their metacognitive monitoring ability. Such systematic knowledge should contain error modes and the underlying process governing human thoughts and actions (Nelson TO, Narens L. Metamemory, 1990-1999).

As Edmondson (1996, p. 25) has put it: "Given that human error will never disappear from organizational life, an important management issue thus becomes the design and nurture of work environments in which it is possible to learn from mistakes and to avoid making the same ones in the future collectively."

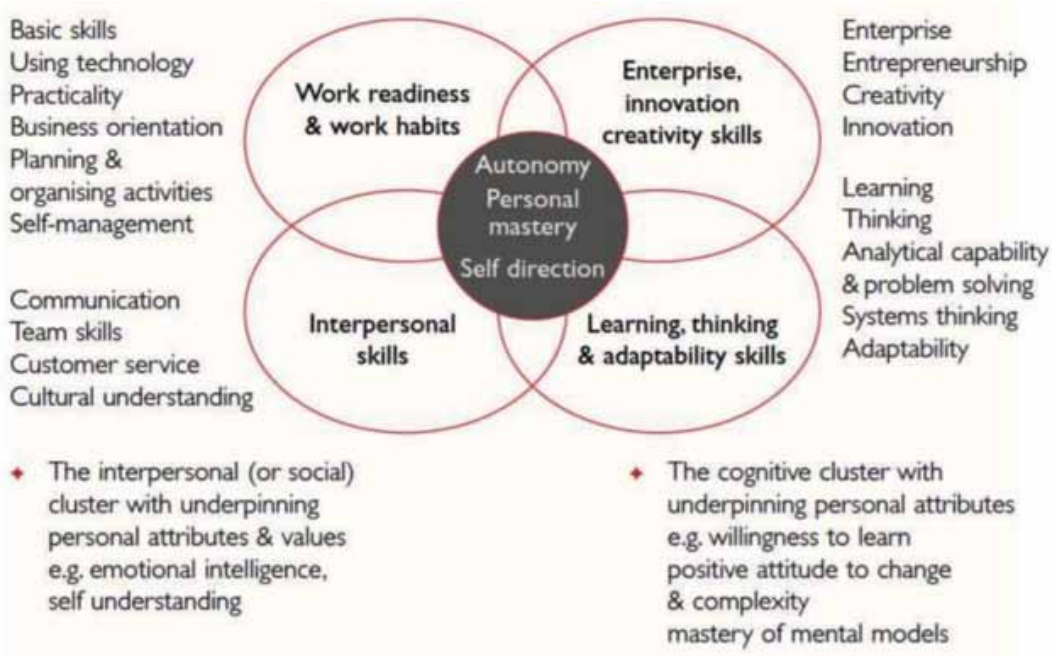
Relationship Between Skill-Based Error and Organization Performance

"Generic skills are identified to be the most critical skills in the current global market, especially in this fast-moving era of technology." (Malaysia Ministry of Higher Education 2006)

According to the developmental structure which facilitates ongoing development, Kearns (2001) developed a framework (Figure 2) to show the possible skills in an organization. Skill-based errors happen when there is a lack of the above skills or diverting from their tasks. These types of errors can occur to the most talented and experienced employees. Skill-based error is consistently executing day-to-day activities determined by psychologically programmed directives from formally stored or made thought patterns (Henneman and Gawlinski 2004).

Action inconsistency may pay off in a self-assertive, unforeseen, conflicting takeoff from arranged results and prompt customer debate or security breaks (Cheyne et al. 2006). These error types are called skill-based and related to slips, lapses from abandon, and carelessness. Lapses are usually identified

Figure 2. Possible skills of an employee in the organization (Source: Kearns (2001, p.52))



as memory failures committed covertly and involve deviations between the actual performance of the work and work intent (Henriksen and Dayton 2006). Attentive lapses and memory failures, frequently considered lacking-mindedness, are familiar routine incidents for many individuals (Carriere et al. 2008). Cheyne (Cheyne et al. 2006) mentioned that transitory awake of minimal awareness when performing processes can have comparatively penetrating results on an employee's performance and mentally make his well-being. According to the psychology community, memory failures may occur in storage failure, encoding or input failure, and retrieval or output failure (Reason and Hobbs, 2003). As day-to-day activities that are less noticed by the reactive mind are cognitively distributed as "lower levels" in an individual brain (Sunyoto and Minato 2003), these failures may happen when the typical pattern is collapsed. For example, a delay or even a collapse by a telephone call. In skill-based errors, slips are always replaceable with lapses. As per (Sasou and Reason 1999), slips are defined as "errors in the action process of a single individual and are likely to be divorced from the activities of the team as a whole." On the other hand, Zhang et al. (2004) stated that a slip is "when the knowledge is correct, but a failure occurs" because an expectations information of an individual was mistaken. Per the definitions, slips in processes happen due to attention captured momentarily via work occupation or distraction (Henriksen and Dayton, 2006).

Weeks (2004) mentioned that if there is a link between organizational performance and the employees' generic skills, that must be hidden instead of demonstrated. Galindo-Rueda and Haskel (2005) also researched the influence of skills on organization performance and resembled this to influence skills to possess on retribution. However, many case studies and employer surveys (e.g. UK Employer Skills Survey 2011 & 2010) justify the significance of skills for organizational performance. To show the relationship between organizational performance and skills, Hogarth and Wilson (2007) stated that different estimates of organizational performance were examined, such as sales growth, profit, and market shares. In addition, skill stock measures and deficiencies found that skills impact organization performance (Constable 2012; Hogarth & Wilson 2001). In summary, all the above findings give evidence of a relationship between organizational performance and skills.

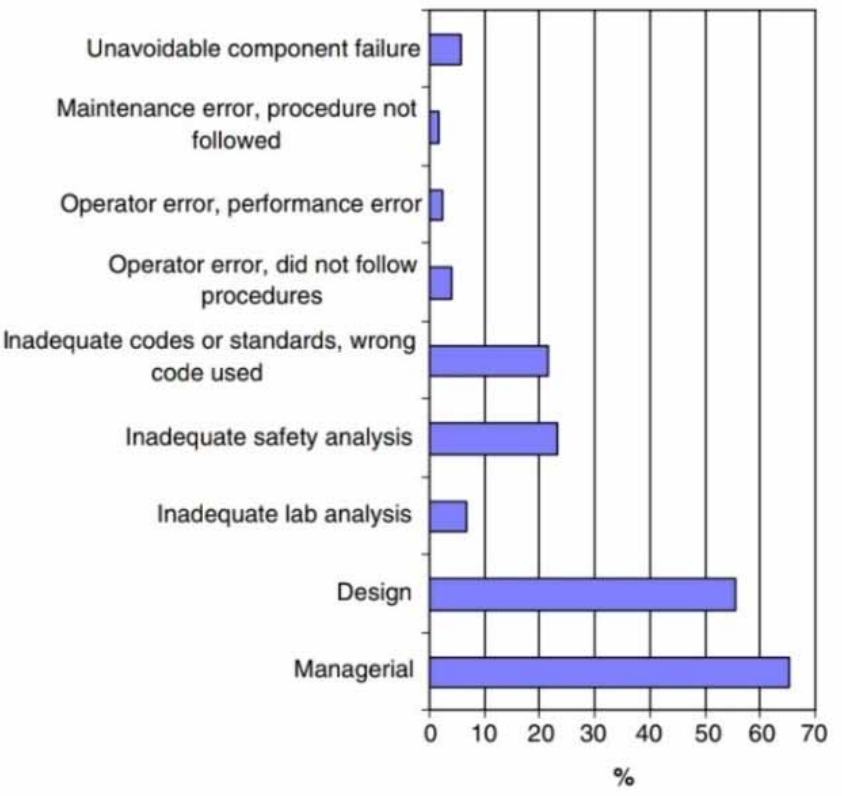
Relationship Between Design Error and Organization Performance

"Good design satisfies customers and communicates the purpose of the product to its market. The objective of a good product design is to satisfy the customer by meeting their actual needs or expectation. Therefore, this enhances the organization's competitiveness; product design can be seen as starting and ending with the customer" Slack et al. (2007, pp120). Failure to fulfill the design feature or specifications will end in design errors.

"During analysis of incident records, a design error is deemed to have occurred, if the design or operating procedures are changed after an incident has occurred" (Taylor, 1975). Design errors differ in the natural world and seriousness. Those are forcefully associated with safety, and those errors are known to end up in severe accidents (Burt 2004; Chapman 1998; Hauck 1983; Yates and Lockley 2002; Martin and Macleod 2004; Ransom 2008). As per Yates and Lockley (2002), structural research overloading, work failures, and temporary strength quality are the mass contributors to damage to people. The Tay Bridge crumple in 1879 killed 75 individuals because the cross supporting and fastenings were inadequately intended to maintain the hurricane's power (Burt 2004; Martin and Macleod 2004). Since this incident, changes to building practice have been actualized and entirely clung to AS-1170.1, Australia International Limited Standards (1989). Worries over avoiding dynamic auxiliary falls of a disastrous sort have brought about arrangements empowering more basic congruity and repetition (Feld and Carper, 1996).

Haastrup (1984) conducted research (Drogaris, 1993) with 121 accident reports in the European Joint Research Centre MARS database, which says (Figure 3) that 50% of accidents occur from design errors. According to Taylor (1975, 1976), 35% of design errors occurred in US nuclear regulatory commission. And that increased by 11% in the 1980s.

Figure 3. Causes of 121 chemical industry accidents reported to the MARS accident database (Source: Drogaris (1993))



Design errors can negatively affect safety performance, cost, and schedule. Design errors must be reduced and preventable to improve project and organizational performance. This helps to improve safety also. Robinson-Fayek et al.'s (2003) researched that the engineering and survey forms for a designing project added to 68% of enhanced costs, with 78% of this aggregate owing to those design errors. Farrington (1987) stated that design errors rated 79.1% of the quality deviations total cost that needs to finish the projects.

Relationship Between Quality Testing Errors and Organization Performance

According to Reeves and Bednar (1994), quality in an organization is defined as excellence, value, matching customer expectations, and specification conformity. The quality system is always described as the organizational structure, processes, procedures, responsibilities, and resources to implement quality management. Seddon (1997) stated that "system quality is concerned with whether there are bugs in the system, the consistency of user interface, ease of use, quality of documentation, and sometimes, quality and maintainability of program code" (p. 246). Testing is the way toward assessing a system or components with the plan to discover whether it fulfills the predetermined necessities or not. In essential words, testing is executing a framework to recognize any holes, blunders, or missing conditions despite the fundamental prerequisites. Testing is the way toward realizing abandons, where a deformity is any change between actual and expected outcomes.

Software testing is essential because, as humans, we all make mistakes. Although some of these mistakes are unimportant, some errors are hazardous and expensive to recover. "A human being can make an error (mistake), which produces a defect (fault, bug) in the program, code, or document.

If a defect code is executed, the system may fail to do what it should, causing a failure" (Farooq, 2018). "A mistake in coding is called Error, error found by tester is called Defect, defect accepted by development team then it is called Bug, build does not meet the requirements then it is Failure" (tfortesting, 2012). History knows numerous examples of incidents that caused comparable harm in software. However, testing stands out among the most debated points in programming advancement. Numerous item proprietors question its incentive as a different procedure, putting their organizations and items in question while endeavoring to spare an additional penny.

Conveying quality service is essential for business achievement that prompts lower cost (Grant, 1989), higher profitability, higher revenues (Reicheld and Sasser, 1990), long-term economic returns (Anderson et al., 1994), increased repurchase intentions (Soteriou and Chase, 2000) and increased customer satisfaction. As per Torn, it brings down software quality outcomes in high expenses because software is not filling its planned need, not being composed as indicated, is inclined to blunders, has few security arrangements, and is not vigorous (Torn, 1990). According to Anderson, quality testing impacts organizational performance as the quality of services and products has been observed to be the most critical factor deciding the long-term achievement of an organization (Anderson and Zeithaml, 1984).

Relationship Between Maintenance Errors and Organization Performance

Maintenance error happens essentially because of wrong preventive activities or repairs. A few mischance examinations have deficient or broken support as one of the fundamental supporters of unforeseen occasions in different wellbeing bare spaces, including the railroad, seaward oil boring, substance, petrochemical, avionics, and atomic businesses (Department of Transport 1989, Pate-Cornell 1993, Marx and Graeber 1994, p. 88, Wright 1994, Reason 1997, Hale et al. 1998, Kletz 2003, Reason and Hobbs 2003, Perin 2005, Baker 2007, Sanne 2008a).

Human errors in maintenance are one of the main issues which, in the past, have not been given the measure of consideration that it merits (Mfundo et al., 2020). Human factors amid maintenance are critical to consider because they identify with enhanced work execution and the enhanced well-being, security, and prosperity of the workforce and the network (Horberry et al., 2010).

The examination of components in charge of maintenance errors and the performance of a unit has, by and large, added to accomplishing higher authoritative execution. Reiman and Oedewald (2006) have considered the safety impacts of late actualized changes in four Nordic NPP maintenance firms. Their examination of chosen changes demonstrated that these progressions confronted a lot of hindrances and had unexpected or unintended results or reactions to hierarchical practices and culture. Cost decrease, the charm of the productivity of maintenance processes, and developing and maintaining competence were the objectives of most of the inspected changes. The maintenance workforce and the action of the maintenance capacity can help the whole organization to be better mindful of the limits of safe movement, the condition of the specialized equipment, and the adequacy of current practices and originations in making safety (Reiman, 2010).

RESEARCH METHOD

Design

This study conducted a concurrent transformative mixed-method strategy using triangulation to determine convergence validity, which is a procedure for collecting, analyzing, and mixing both quantitative and qualitative data at some stage of the research process within a single study to understand a research problem more thoroughly. The main reason for applying this strategy is that it is difficult to get accurate data from surveys as organization performance datasets are always confidential, leading to significant measurement errors. This reason supported the need for qualitative and quantitative work for this research.

The study followed two methods that are:

1. Interview
2. Survey

During the data collection, participants were told about the purposes of the study. At the same time, they were reassured that their answers were regaled as confidential and utilized only for academic objectives and this particular research. Participants were not injured or harmed, both physically and mentally, during the research process. In disparity, we tried to create and support an environment of comfort.

Setting and Participants

Interview

The purposive sampling method was used to develop the research sample under discussion. In the current study, the selected model members a special relationship with the phenomenon under investigation, sufficient and relevant work experience in the field of IT Export Company, as well as proven management level background and understanding of raw data concerning destinations. Within this context, the participants of this study were project managers of 5 famous IT export companies in Sri Lanka. Interviews were held in March and April of 2019 with the Project managers of the IT companies mentioned above to gain acceptance of their participation in the research. The interviews took place at their offices and lasted approximately 25 to 30 minutes. The interviews, notes, and recordings, helped to analyze the gathered data. During the conduction of the interview, respondents were free to express their views. Finally, it should be noted that the conversations flowed smoothly and pleasantly.

Survey

Quantitative research was carried out for software organizations doing exports in Sri Lanka. So, a target population is software organizations doing exports in Sri Lanka. The sampling method for the study stratified systematic simple random sampling. Totally 147 Software organizations that are doing exports are there in Sri Lanka. (Including all large (23), medium (34), and small (90) organizations). As well as these organizations include software export companies wholly owned by Sri Lankan companies (60%) and companies set up through joint ventures or FDIs (40%). (Sri Lanka Export Development Board, 2011). According to ICT Export Value Survey (2011), the total Software exports organization workforce is 10,967 (Including Software Engineers – 37%, Tech leads– 11%, and Quality Assurance Engineers – 14%). As per National ICT Workforce Survey (2010), the workforce in software organizations can be divided into 14 job categories: software engineers, Consultants, Businesses Analysis, and so on. Furthermore, three job categories will be selected for the sample after categorizing the jobs in software companies. Therefore, the sample for the study will consist of 147 software export organizations covering three job categories with specific sampling (Refer to Table 1).

Correlation analysis is the best method to analyze the statistics because it will show the strength of the relationship between 2 variables. Therefore, Correlation analysis was used to study statistics. At the same time, performed hypothesis testing with the Chi-Square test method because it helps to

Table 1. Sampling

Job category	No.
Software Engineers	219
Tech Leads	73
Quality Assurance Engineers	73

identify the relationship between the dependent variable and 2/ more independent variables. Also, the descriptive statistics were analyzed to gather the graphic details of the respondent like gender, age, educational level, position title, and no. of work experience.

DATA ANALYSIS AND DISCUSSION

Interview

It is tough to get accurate data from surveys as organization performance datasets are always confidential, leading to significant measurement errors. So, an interview session was conducted to investigate organizational performance at the management level and those with sufficient work experience in the field of IT Export Company, as well as proven management level background and understanding of raw data concerning destinations. Within this context, the participants of this study were project managers of 5 famous IT export companies in Sri Lanka. Interviews were held in March and April of 2019 with the Project managers of the IT companies mentioned above to gain acceptance of their participation in the research. The interviews took place at their offices and lasted approximately 25 to 30 minutes.

Themes and Codes Between Cases

The analysis of all qualitative data resulted in several themes regarding each issue. Specifically, the responses of the participants regarding their experiences were grouped into themes. Most interviewees stated that it is pretty challenging to talk about errors. Also, they said that human errors are categorized as developing, leadership, maintenance, testing, and design errors. Although the organizations started early do have a clear vision or mission statement regarding errors and were there, a general rationale and conscious approach toward these errors, the organization created a few months ago has a vision or mission statement regarding errors. This clearly shows that mistakes have a significant impact on organizational performance as well as, and some organizations are using consultants and domain experts in their projects. Those people work very closely with the product support team, who have a lot of knowledge about the product and domain. From this, those organizations are trying to reduce human errors. Also, some organizations are using test systems. Whenever their clients have feedback, they always put it in those test systems; if that is approved only, they go for life. That means there is no timeline to get feedback. This reduces the errors.

Survey

The online survey was distributed among more than 400 respondents working in IT export companies in Sri Lanka. Among that, 365 responded to the questionnaire. This data analysis was utilized to show every individual response inside the sample size and to break down the responses inside the sample size as statistical data analysis for further testing. All the data were 100% finished, which implies there were no missing units and all usable reactions. The online review was controlled presumably from February to April. Table 2 clearly shows a profile of those 365 respondents, which describes their 1) gender, 2) age, 3) education level, 4) position title, and 5) work experience in frequency and percentage.

Analyzing the Responses to Variables

In this research, software engineers, quality assurance engineers, and tech leads working in IT export companies in Sri Lanka were asked to assess the impact of human errors on their organizational performance. As mentioned above, an online survey was created and distributed among those people to determine the impact of human errors. According to the responses, results were calculated using SPSS software. The below sections give a detailed description of the collected data.

Table 2. Frequency and percentage of the respondent

Variable	Frequency	Percentage
Gender		
Female	91	24.93
Male	274	75.07
Age		
18 - 25	77	21.10
26 - 35	221	60.55
>35	67	18.36
Education Level		
Degree	289	79.18
Diploma	17	4.66
PhD	1	0.27
Postgraduate	58	15.89
Position Title		
Quality Assurance Engineer	73	20.00
Software Engineer	219	60.00
Tech Lead	73	20.00
Work Experience		
< 1 year	24	6.58
1 – 2 years	53	14.52
2 - 5 years	158	46.03
5 – 10 years	87	23.84
10 – 25 years	29	7.95
>25 years	4	1.10

Source: Developed for this research (from survey results)

Independent Variables: Human Errors

In the survey, respondents were requested to point out the critical elements of human errors that affected their organizational performance. A five-point Likert scale (1= strongly agree, 2= agree, 3= neutral, 4= disagree, 5= strongly disagree) was used to answer the questions. Table 3 shows the perceptions of the contribution of skill-based errors to organizational performance, and table 4 shows the perceptions of the contribution of design errors to organizational performance. Table 5 shows the perceptions of the contribution of quality testing errors to organizational performance, and table 6 shows the perceptions of the contribution of maintenance errors to organizational performance.

Table 6 shows the means of impact of perceptions towards the contribution of maintenance errors on organizational performance. Responses regarding the most critical maintenance error components mean shown between 2.84 to 3.05 on a five-point scale. The difference in means for maintenance errors is 0.21 (3.05-2.84), and the average mean is approximately 2.96. In Table 6, item 1 (mean 2.84) and item 2 (mean 2.93) clearly show respondents agreed highly that sometimes they jump to install the software. Sometimes they do not have a clear idea about specific software settings, and as per item 5 (mean 2.94), respondents agreed that sometimes they forget to keep track of earlier versions

Table 3. Perceptions of the contribution of skill-based errors to organizational performance

Item	Mean	Standard Deviation
1. I'm not a person who always keeps track of activity plans and execute those plans in a particular order	3.33	1.25
2. Before starting doing a particular task, sometimes I forget to make sure whether I have the proper knowledge to do that task	3.43	1.19
3. Sometimes, when executing a specific task, I do not concentrate only on that task	3.06	1.30
4. I don't have excellent knowledge of my organization's all products and services	3.33	1.28
5. I'm not a person who always listens and understands customer requirements very effectively	3.56	1.27

Source: Developed for this research (from survey results)

Table 4. Perceptions of the contribution of design errors to organizational performance

Item	Mean	Standard Deviation
1. Sometimes, I try to start designing the system before getting adequate specifications and detail	3.16	1.25
2. Sometimes, I do not get a clear understanding of the internal and external needs of the customer	3.27	1.19
3. Sometimes, I start designing before analyzing the adequate design procedures	3.18	1.26
4. Sometimes, I start designing the system according to customer specifications without analyzing the risks	3.22	1.23
5. Sometimes, I do not think and recognize practical constraints before designing	3.21	1.27
6. Sometimes, when designing, forget to think about the user-friendly concept	3.37	1.24

Source: Developed for this research (from survey results)

Table 5. Perceptions of the contribution of quality testing errors to organizational performance

Item	Mean	Standard Deviation
1. Sometimes, I miss 1 or 2 steps when testing a software	2.81	1.28
2. Sometimes, I'm in a tense environment when testing a software	2.88	1.23
3. I do not use different software environments to test the system in an effective way	3.04	1.34
4. When updating a system, sometimes I fail to check some features because they worked earlier	2.79	1.32

Source: Developed for this research (from survey results)

of the system. At the same time, respondents agreed that they sometimes fail to get complete details about the machine where they will maintain the system (mean 3.02). Sometimes before installing software, they do not consider safety domains (mean 3.05). Overall, respondents rated comparatively higher for all five maintenance error elements. This illustrates maintenance errors positively influence organizational performance, which needs to be considered.

Table 6. Perceptions of the contribution of maintenance errors to organizational performance

Item	Mean	Standard Deviation
1. Sometimes, jump to install the software	2.84	1.31
2. I do not have a clear idea about specific software settings	2.93	1.37
3. Sometimes, I do not consider safety domains before installing a software	3.05	1.35
4. Sometimes, I forget to get complete details about the machine where I'm going to maintain the system. Like free space, ram size ext.	3.02	1.36
5. Sometimes, I forget to keep track of earlier versions of the system	2.94	1.41

Source: Developed for this research (from survey results)

Dependent Variable: Organization Performance

The dependent variable of this study is organizational performance, which can be identified from financial or non-financial indicators. Data for financial performance is very confidential. So, respondents may be reluctant to publish financial data. For that reason, qualitative research was conducted and mentioned in the above sections. But one question was designed to know their organization's approximate sales growth rate.

Figure 4 shows that within 365 responses, 218 respondents stated they were unsure about their organization's current approximate sales growth rate. Surveyed organizations with an approximate sales growth rate of <10% made up the 41 respondents between 10% to 20%, and >50% made up the smallest number of respondents, which means 31. An approximate sales growth rate of 20% to 50% made up the 44 respondents.

Table 7 shows the standard deviation and means of market performance. Responses regarding the most critical market performance components mean shown from 3.37 to 3.57 on a five-point scale. The difference of means for design errors is 0.20 (3.57-3.37), and the average mean is approximately 3.47. The above table shows respondents agreed that IT export companies have reasonable customer satisfaction (mean 3.57) and sometimes produce innovative products (mean 3.37). At the same time quality of products and services got a mean of 3.05 which means rarely is there an improvement in outcomes.

Figure 4. Approximate sales growth rate

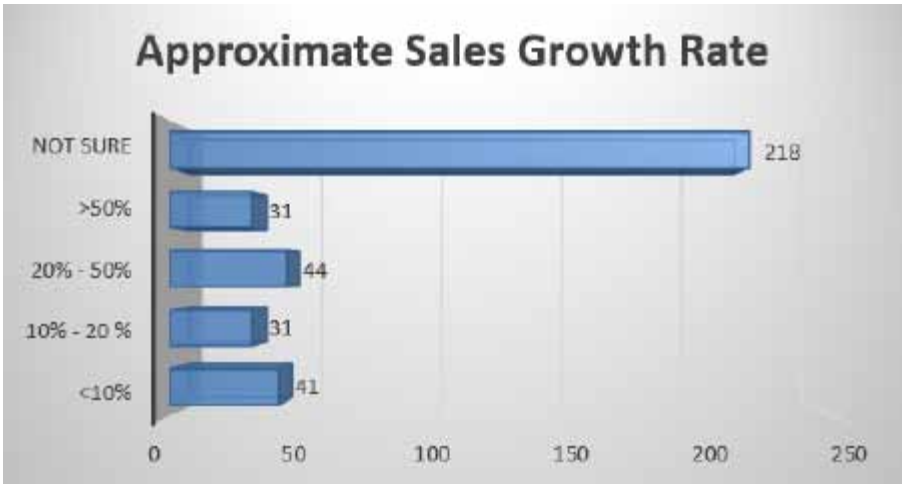


Table 7. Perceptions toward market performance

Item	Mean	Standard Deviation
1. Quality of products and services	3.48	1.28
2. Customer satisfaction	3.57	1.23
3. Innovative products	3.37	1.31

Source: Developed for this research (from survey results)

Exploratory Statistics

Missing Data

As the online survey was done through google forms, it must be validated because there is a high probability that respondents miss questions to answer. An exploratory analysis in Table 8 was done to analyze the data. The results indicate that all 365 responses collected within the population had 0% missing and 100% valid data.

Outlier Detection

Furthermore, all the 365 records were utilized besides data analysis. Because of that, all the variables inside the selected dataset have no outliers.

Goodness of Measures

Factor analysis and reliability testing were done to ensure the validity and reliability of the different statistical measures used in this study. Correlation regression was used for the approval technique to enable the specialist to see regardless of whether the decreased sets of things were like the ideas that were at first demonstrated. Reliability analysis was utilized once the factors were approved and tested for inner consistency.

Correlation Regression

Correlation Between Dependent and Independent Variables

The correlation was calculated using the Pearson correlation coefficient to validate the relationship between human errors and organization performance. If $p < 0.05$, then the null hypothesis will be rejected.

Table 9 calculations show a strong relationship between human errors and organizational performance.

Table 8. Missing Data

	Valid data		Missing data		Total	
	N	Percentage%	N	Percentage%	N	Percentage%
Skill-based errors	365	100%	0	0%	365	100%
Design errors	365	100%	0	0%	365	100%
Quality Testing errors	365	100%	0	0%	365	100%
Maintenance errors	365	100%	0	0%	365	100%

Source: Developed for this research (from survey results)

Table 9. Correlation between dependent and independent variables

	Valid data		Missing data		Total	
	N	Percentage%	N	Percentage%	N	Percentage%
Skill-based errors	365	100%	0	0%	365	100%
Design errors	365	100%	0	0%	365	100%
Quality Testing errors	365	100%	0	0%	365	100%
Maintenance errors	365	100%	0	0%	365	100%

Source: Developed for this research (from survey results)

Correlation Between Independent Variables

Table10 shows the values of correlation between the independent variables.

Reliability Analysis

After the validation, the internal consistency of variables must be tested. The reliability measure was executed to check the stability over different conditions. Based on 365 survey responses, Cronbach's Alpha reliability was conducted. Table 11 shows that all variables have more than 70% of Cronbach's Alpha coefficients. Especially 3 of the variables have more than 80% of Cronbach's Alpha coefficients. The maintenance errors variable registered the highest Alpha value of 0.88, and the skill-based errors variable reported the lowest Alpha value of 0.76.

Chi-Square Analysis

The Chi-square analysis is used to identify the relationship between more than one categorical variable. Pearson's chi-square analysis determines the difference between observed and expected frequencies for those categorical variables. The chi-square test was conducted to check the relationship between the dependent variable and independent variables formulated as a hypothesis in Table 12 (List of hypotheses), and the table shows the results. According to the table, Asymp.Sig. (2-tailed) values or

Table 10. Correlation between independent variables

		Skill based Errors	Design Errors	Quality Testing Errors	Maintenance Errors
Skill based Errors	Pearson correlation	1			
	Sig. (2-tailed)				
Design Errors	Pearson correlation	.79	1		
	Sig. (2-tailed)	.000			
Quality Testing Error	Pearson correlation	.59	.70	1	
	Sig. (2-tailed)	.000	.000		
Maintenance Errors	Pearson correlation	.61	.69	.84	1
	Sig. (2-tailed)	.000	.000	.000	

Source: Developed for this research (from survey results)

Table 11. Reliability analysis

Variables	Reliability (alpha)
Skill-based errors	0.76
Design errors	0.87
Quality Testing errors	0.83
Maintenance errors	0.88

Source: Developed for this research (from survey results)

Table 12. Chi-Square Test

Human Errors in Software Organization	Pearson Chi-Square Value	Asymp. Sig. (2-tailed) P value	Results	
Skill based errors	788.32	.000	Reject H0	There is a relationship between Skill-based errors and organizational performance
Design errors	1171.79	.000	Reject H0	There is a relationship between Design errors and organizational performance
Quality Testing errors	762.28	.000	Reject H0	There is a relationship between Quality Testing errors and organizational performance
Maintenance errors	869.06	.000	Reject H0	There is a relationship between maintenance errors and organization performance.

p-values were mentioned as 0.000. If $p<0.05$, there must be a significant relationship between the dependent and independent variables. That means all null hypotheses are rejected.

Hypotheses Testing

The Pearson correlation coefficient was checked to identify the relationship between human errors and organizational performance. Correlation between dependent and independent variables was measured, and P values were calculated. At the same time, Pearson's Chi-Square test was used to examine the relationship between two or more variables measured on a categorical scale. All five hypotheses were checked using Chi-Square, and all the P values were calculated.

Testing Hypothesis 1

Table 13 shows the alternative (Ho1) and null (Ha1) hypotheses for skill-based errors.

The chi-square and correlation coefficient tests were conducted to reject the null hypothesis. Table 14 clearly shows the Chi-square values of each item in skill-based error. As per the table, all

Table 13. Hypothesis for Skill-based errors

Hypothesis
Ho 1 - There is no relationship between skill-based errors and organization performance. Ha 1 - There is a relationship between skill-based errors and organization performance.

Table 14. Chi-Square Test for Hypothesis 1

Item	Pearson Chi-Square Value	Asymp. Sig. (2-tailed) P value
1. I'm not a person who always keeps track of activity plans and execute those plans in a particular order	191.43	0.000
2. Before starting doing a particular task, sometimes I forget to make sure whether I have the proper knowledge to do that task	263.17	0.000
3. Sometimes, when executing a specific task, I do not concentrate only on that task	190.73	0.000
4. I don't have excellent knowledge of my organization's all products and services	151.39	0.000
5. I'm not a person who always listens and understands customer requirements very effectively	194.40	0.000

Source: Developed for this research (from survey results)

the P values are less than 0.05 (P<0.005). According to table 16, the Correlation coefficient P-value for skill-based error is 0.000.

Testing Hypothesis 2

Table 15 shows the alternative (Ho2) and null (Ha2) hypotheses for design errors.

The chi-square and correlation coefficient tests were conducted to reject the null hypothesis. Table 16 shows the Chi-square values of each item in design errors. As per the table, all the P values are < 0.05, and according to table 16, the Correlation coefficient P-value for design error is 0.000.

Table 15. Hypothesis for Design errors

Hypothesis
Ho 2 - There is no relationship between design errors and organization performance. Ha 2 - There is a relationship between design errors and organization performance.

Table 16. Chi-Square Test for Hypothesis 2

Item	Pearson Chi-Square Value	Asymp. Sig. (2-tailed) P value
1. Sometimes, I try to start designing the system before getting adequate specifications and detail	228.72	0.000
2. Sometimes, I do not get a clear understanding of the internal and external needs of the customer	281.34	0.000
3. Sometimes, I start designing before analyzing the adequate design procedures	246.88	0.000
4. Sometimes I start designing the system according to customer specifications without analyzing the risks	261.03	0.000
5. Sometimes, I do not think and recognize practical constraints before designing	267.87	0.000
6. Sometimes, when designing, forget to think about user-friendly concept	257.39	0.000

Source: Developed for this research (from survey results)

Testing Hypothesis 3

Table 17 shows the alternative (Ho3) and null (Ha3) hypotheses for quality testing errors.

The chi-square and correlation coefficient tests were conducted to reject the null hypothesis. Table 18 shows the Chi-square values of each item in quality testing errors. As per the table, all the P values are < 0.05, and according to table 10, the correlation coefficient P-value for quality testing error is 0.000.

Testing Hypothesis 4

Table 19 shows the alternative (Ho4) and null (Ha4) hypotheses for maintenance errors.

The chi-square and correlation coefficient tests were conducted to reject the null hypothesis. The above table 20 shows the Chi-square values of each item in maintenance errors. As per the table, all the P values are < 0.05, and according to table 12, the Correlation coefficient P-value for maintenance error is 0.000.

Summary of Hypotheses Testing Results

All four hypotheses identified was tested using various statistical analyses. To reject the null hypotheses, some measures were created, and those are mentioned below:

1. Correlation coefficient – $P < \alpha$ where $\alpha = 0.05$ [P value should be lesser than 0.05]
2. Chi-Square – P value should be lesser than 0.05

Table 17. Hypothesis for Quality testing errors

Hypothesis
Ho 3 - There is no relationship between quality testing errors and organization performance. Ha 3 - There is a relationship between quality testing errors and organization performance.

Table 18. Chi-Square Test for Hypothesis 3

Item	Pearson Chi-Square Value	Asymp. Sig. (2-tailed) P value
1. Sometimes, I miss 1 or 2 steps when testing a software	214.73	0.000
2. Sometimes, I'm in a tense environment when testing a software	201.72	0.000
3. I do not use different software environments to test the system in an effective way	197.86	0.000
4. When updating a system, sometimes I fail to check some features because they worked earlier	193.35	0.000

Source: Developed for this research (from survey results)

Table 19. Hypothesis for Maintenance errors

Hypothesis
Ho 4 - There is no relationship between maintenance errors and organization performance. Ha 4 - There is a relationship between maintenance errors and organization performance.

Table 20. Chi-Square Test for Hypothesis 4

Item	Pearson Chi-Square Value	Asymp. Sig. (2-tailed) P value
1. Sometimes, jump to install the software	200.94	0.000
2. I do not have a clear idea about specific software settings	231.67	0.000
3. Sometimes, I do not consider safety domains before installing a software	211.98	0.000
4. Sometimes, I forget to get complete details about the machine where I'm going to maintain the system. Like free space, ram size ext.	233.83	0.000
5. Sometimes, I forget to keep track of earlier versions of the system	249.77	0.000

Source: Developed for this research (from survey results)

As per the above measures, all null hypothesis was rejected. That means there is a significant relationship between the independent and the dependent variables.

Hypothesis 1:
Ho1 - Null hypothesis rejected.
Ha1 - There is a significant relationship between skill-based errors and organization performance.
Hypothesis 2:
Ho2 - Null hypothesis rejected.
Ha2 - There is a significant relationship between design errors and organization performance.
Hypothesis 3:
Ho3 - Null hypothesis rejected.
Ha3 - There is a significant relationship between maintenance errors and organization performance.
Hypothesis 4:
Ho4 - Null hypothesis rejected.
Ha4 - There is a significant relationship between quality testing errors and organization performance.

LIMITATIONS

1. Additional interviews would give richer data for research.
2. No fieldwork or observation sessions were held out due to the limitation of time.
3. Self-reporting bias usually occurs in surveys when the participants misreport their accurate information to create better, even if the analysis does not recognize them by name.
4. The demographic information gathered from the survey did not recognize their companies and name satisfactorily.
5. This research concentrates on human errors and has ignored other factors that impact organizational performance.

CONCLUSION AND RECOMMENDATION

Human errors have been recognized as the most critical issue in organizations, leading to a downfall. The literature indicates that even minor human errors can lead to severe problems in organizational performance, and 50% of incidents in organizations are held because of human error. An impressive number of contextual analyses, studies, and recounted proof affirm human errors. Yet the exact current investigation into the connection between human errors and organizational performance is somewhat lacking and not rational. Moreover, there is no authentic, accurate proof of the impact of

human errors on organization performance, and there has been far less accentuation in this research area in Sri Lankan IT export.

All four hypotheses, such as skill-based, design, quality testing, and maintenance errors created, are re-stated and summarized as there is a significant relationship between human errors and organization performance according to the empirical evidence. As mentioned in the introduction, this research states that there is a statistical relationship between human errors and organizational performance, and the impacts of these human errors cannot be underrated. According to research results, there is empirical evidence that human errors such as skill-based, design, quality testing, and maintenance errors positively influence organization performance measures, including innovation development, customer satisfaction, and product and service quality. This shows that human errors are one of several factors contributing to organizational success. Finally, this innovative research has proved that human errors must be minimized to increase organizational performance. To reduce these kinds of human errors, the organization must have a vision or mission statement regarding errors. There must be a general rationale and conscious approach toward these errors. Organizations can ensure that they give training sessions and give a brief explanation about their products, services, and company structure for all the new staff. As well as, team leads have to make sure that they keep track of their work. Organizations can hire staff for the UI/UX design role or expertise to minimize design-based errors. It is better to have domain experts or consultants in their teams. Developers must be skilled in working under pressure and handling time management. Also, whenever their clients have any feedback, they always put it in those test systems, and if that is approved only, they go live. That means there is no timeline to get feedback. This reduces the errors.

FUTURE ENHANCEMENT

1. Future research could utilize field works to measure the impact of human errors.
2. Future research could utilize other observation approaches to measure the impact of human errors.
3. Future research could utilize more interviews with different IT export companies to get better organizational performance statistics.
4. Future studies could investigate a broader range of human errors to understand other human errors.
5. Future research may satisfy a research design that utilizes triangulation of replies to evaluate the exactness and improve trust in study results.

ABBREVIATION

FDI: Foreign Direct Investment
HEA: Human Error Assessment
OP: Organization Performance
ANOVA: Analysis of Variance
ROI: Return of Investment
QA: Quality Assurance
QC: Quality Control
HE: Human Errors

ACKNOWLEDGMENT

I want to thank my fellow researcher Dr. Sidath Liyanage, who ceaselessly guided me all through the task and the report. His boundless experience and direction helped me all through the task. I might want to exceptionally express gratitude toward him for his understanding and confidence in me amid my disappointments.

CONFLICT OF INTEREST

The authors of this publication declare there is no conflict of interest.

FUNDING AGENCY

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Anderson, C. R., & Zeithaml, C. P. (1984). Stage of the product life cycle, business strategy, and business performance. *Academy of Management Journal*, *27*(1), 5–24. doi:10.2307/255954

Anderson, E. W., Fornell, C., & Lehmann, D. R. (1994). Customer satisfaction, productivity and profitability. *Journal of Marketing*, *58*, 53–66. doi:10.1177/002224299405800304

Argyris, C. (1977). Double-loop learning in organizations. *Harvard Business Review*, *55*(5), 115–125.

Board, S. L. E. D. (Ed.). (2010). *ICT Export Value Survey*.

Chakravarthy, B. (1986). Measuring strategic performance. *Strategic Management Journal*, *7*(5), 437–458. doi:10.1002/smj.4250070505

Cornell, M. E. P. (1993). Learning from the piper alpha accident: A post mortem analysis of technical and organizational factors. *Risk Analysis*, *13*(2), 215–232. doi:10.1111/j.1539-6924.1993.tb01071.x

Dhillon, B. (2014). Human error in maintenance: An investigative study for the factories of the future. *IOP Conference Series. Materials Science and Engineering*, *65*, 12031–12031. doi:10.1088/1757-899X/65/1/012031

Ganguly, P. (2011a). Human error Vs. Work place Management in modern organizations. *IRACST - International Journal of Research in Management and Technology (IJRMT)*, *1*(1), 13–17.

Gorla, N., Somers, T., & Wong, B. (2010). Organizational impact of system quality, information quality, and service quality. *The Journal of Strategic Information Systems*, *19*(3), 207–228. doi:10.1016/j.jsis.2010.05.001

Grant, R. A. (1989). Building and testing a modhenrel of an information technology's impact. In DeGross, I., J., Henderson, C., J., Konsynski, and R., B., (eds), *Proceedings of the Tenth International Conference on Information Systems*, pages 173–184.

Hale, A. R., Heming, B. H. J., Smit, K., Rodenburg, F. G. T., & van Leeuwen, N. D. (1998). Evaluating safety in the management of maintenance activities in the chemical process industry. *Safety Science*, *28*(1), 21–44. doi:10.1016/S0925-7535(97)00061-1

Huang, F., & Liu, B. (2017). Software defect prevention based on human error theories. *Chinese Journal of Aeronautics*, *30*(3), 1054–1070. doi:10.1016/j.cja.2017.03.005

Huang, F., Liu, B., Song, Y., & Keyal, S. (2014). The links between human error diversity and software diversity: Implications for fault diversity seeking. *Science of Computer Programming*, *89*, 350–373. doi:10.1016/j.scico.2014.03.004

Jones, G. R. (2000). *Organizational theory*. Prentice Hall.

Kletz, T. (2003). *Still going wrong! Case histories of process plant disasters and how they could have been avoided*. Butterworth-Heinemann.

Lee, Y. S. and K, Y. (2003). Analysis of human error and organizational deficiency in events considering risk significance. *Nuclear Engineering and Design*, 61–67.

Lopez, S. P., Peon, J. M. M., & Ordas, C. J. V. (2006). Human resource management as a determining factor in organizational learning. *Management Learning*, *37*(2), 215–239. doi:10.1177/1350507606063443

Marx, D. A., & Graeber, R. C. (1994). Human error in aircraft maintenance. Aviation psychology in practice. Ashgate.

Maxion, R., & Reeder, R. (2005). Improving user-interface dependability through mitigation of human error. *International Journal of Human-Computer Studies*, *63*(1-2), 25–50. doi:10.1016/j.ijhcs.2005.04.009

Misnevs, B., & Demiray, U. (2017b). The Role of Communication and Meta-communication in Software Engineering with Relation to Human Errors. *Procedia Engineering*, *178*, 213–222. doi:10.1016/j.proeng.2017.01.100

Mitchell, T. (1983). The effects of social, task and situational factors on motivation. In J. Landy, S. Zedeck, & J. Cleveland (Eds.), *Performance Measurement and Theory*.

2010. *National ICT Workforce Survey. MG Consultants (Pvt) Ltd*, pp. 10–17.

News, I., & News, I. (2018). *Data Loss Statistics - Infographic*. StorageCraft Technology Corporation.

Perin, C. (2005). *Shouldering risks: the culture of control in the nuclear power industry*. Princeton University Press.

Reason, J. (1990). *Human error*. Cambridge University Press. doi:10.1017/CBO9781139062367

Reason, J. (1997). *Managing the risks of organizational accidents.*

Reeves, C. A., & Bednar, D. A. (1994). Defining quality: Alternatives and implications. *Academy of Management Review*, *9*(3), 419–445. doi:10.2307/258934

Reicheld, F. F., & Sasser, E. (1990). Zero defections: Quality comes to services. *Harvard Business Review*, *68*, 105–111. PMID:10107082

Reiman, T. (2007). Assessing organizational culture in complex sociotechnical systems - methodological evidence from studies in nuclear power plant maintenance organizations. VTT Publications, 627.

Reiman, T. (2010). Understanding maintenance work in safety-critical organisations - managing the performance variability. *Theoretical Issues in Ergonomics Science*, *12*(4), 339–366. doi:10.1080/14639221003725449

Reiman, T., & Oedewald, P. (2006). Assessing the maintenance unit of a nuclear power plant - identifying the cultural conceptions concerning the maintenance work and the maintenance organization. *Safety Science*, *44*(9), 821–850. doi:10.1016/j.ssci.2006.05.004

Reiman, T., & Oedewald, P. (2007). Assessment of complex sociotechnical systems - theoretical issues concerning the use of organizational culture and organizational core task concepts. *Safety Science*, *45*(7), 745–768. doi:10.1016/j.ssci.2006.07.010

Reiman, T., & Oedewald, P. (2009). Evaluating safety critical organizations. Focus on the nuclear industry. Swedish Radiation Safety Authority.

Salmon, P., Lenné, M., Stanton, N., Jenkins, D., & Walker, G. (2010). Managing error on the open road: The contribution of human error models and methods. *Safety Science*, *48*(10), 1225–1235. doi:10.1016/j.ssci.2010.04.004

Sanne, J. M. (2008a). Framing risks in a safety-critical and hazardous job: Risk taking as responsibility in railway maintenance. *Journal of Risk Research*, *11*(5), 645–657. doi:10.1080/13669870701715550

Sanne, J. M. (2008b). Incident reporting or storytelling? Competing schemes in a safety-critical and hazardous work setting. *Safety Science*, *46*(3), 1205–1222. doi:10.1016/j.ssci.2007.06.024

Seddon, P. B. (1997). A respecification and extension of the Delone and McLean model of IS success. *Information Systems Research*, *240*(3), 240–253. doi:10.1287/isre.8.3.240

Senge, P. M. (1990). *The Fifth Discipline: The Art and Practice of Learning Organization*. Currency Doubleday.

Slack, N., Chambers, S., & Johnston, R. (2007). *Operations Management*. Pearson Education Limited.

Soteriou, A. C., & Chase, R. B. (2000). A robust optimisation approach for improving service quality. *Manufacturing & Service Operations Management*, *2*(3), 264–286. doi:10.1287/msom.2.3.264.12344

Torn, A. A. (1990). Models of software accumulation. *Journal of Systems and Software*, *12,* 39–42. Transport, D. O.

Wright, C. (1994). A fallible safety system: Institutionalised irrationality in the offshore oil and gas industry. *The Sociological Review*, *38*(1), 79–103. doi:10.1111/j.1467-954X.1994.tb02993.x

APPENDIX A

Interview Questions:

1. What is your organization's approximate sales growth rate (%) in the current financial year?
2. What is your organization's return on investment (%) in the current financial year?
3. How efficient is your organization from an operational standpoint?
4. How often does your organization assess its strengths, weaknesses, opportunities, and threats to understand the current business climate?
5. Does your product offering encourage innovation for the customer through versatility, usability, and efficiency?
6. How well do the organization's products solve the customers' problems and meet their expectations?
7. Approximately how many employees does your organization have?
8. How difficult or easy was it for you to talk about errors?
9. What kind of errors did you think about when you talked about human errors?
10. Did your organization management have a clear vision or mission statement regarding errors, and was there a general rationale and conscious approach toward these errors?
11. How do you select candidates for your organization? Do you choose people with several experienced and well-educated people?
12. Once you select the people, do you organize a training session, put them into teams, and give projects straight away?
13. If you organize a training session for new employees, how long do you train them?
14. Do you have a separate team for UI/UX design? If so, do you allow them to contact those people with your clients, or do only project managers and team leads get them?
15. How long does one team contact clients and get feedback?
16. Do employees get the feedback they need when they need it?
17. Do you have a separate team for Quality Testing? If not, who is doing those testing?
18. Do you experience any incidents where at some point, clients' requirements are quite different from what you did, and you changed the project? If so, how long does it take you all to recover? Is it easy to finish the project within the deadline?
19. Who is handling the maintenance of the projects? Does your organization allow people who don't have enough experience to handle that maintenance?

APPENDIX B

Figures 5-10 show the Survey questions.

Figure 5. Survey questions – Basic details

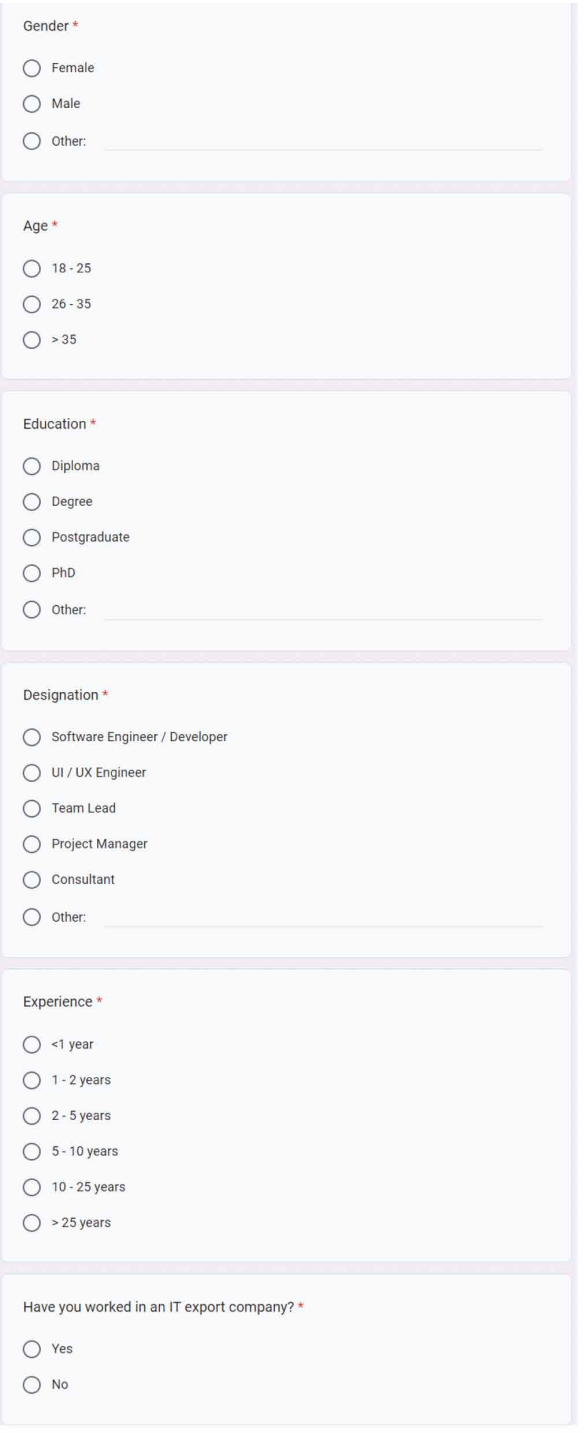


Figure 6. Survey questions – Interpersonal Skills

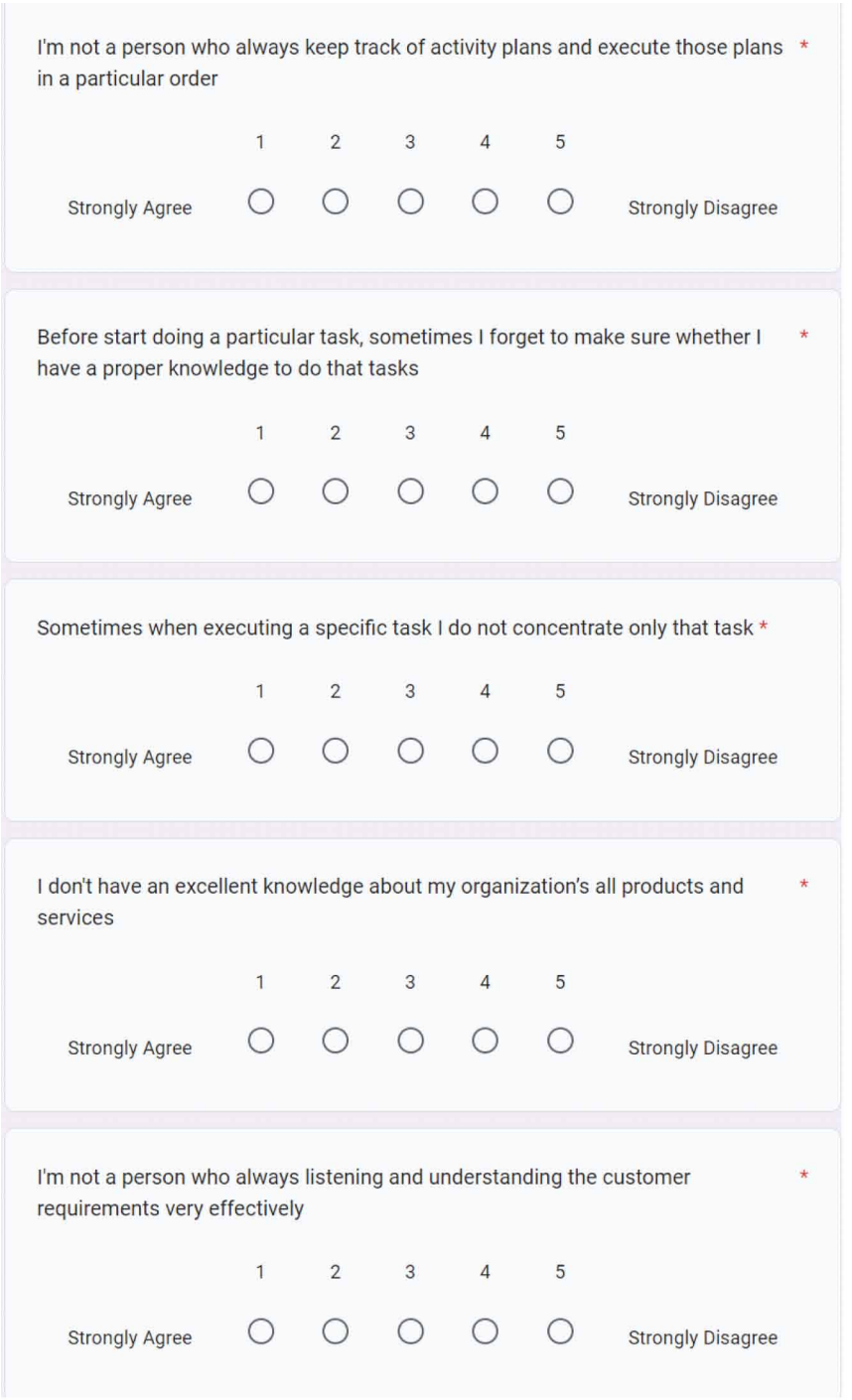


Figure 7. Survey questions – Designing Skills

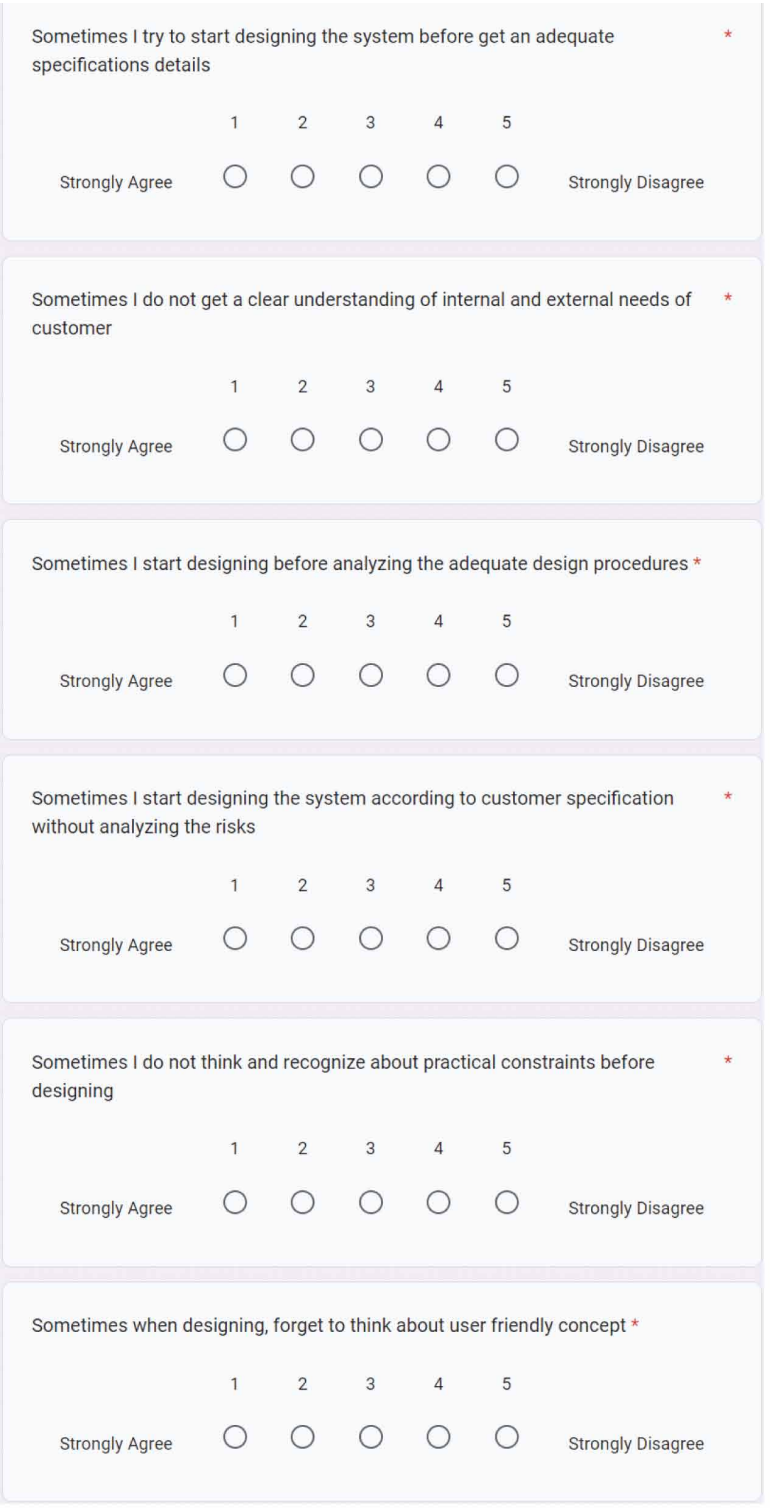


Figure 8. Survey questions – Quality Testing Skills

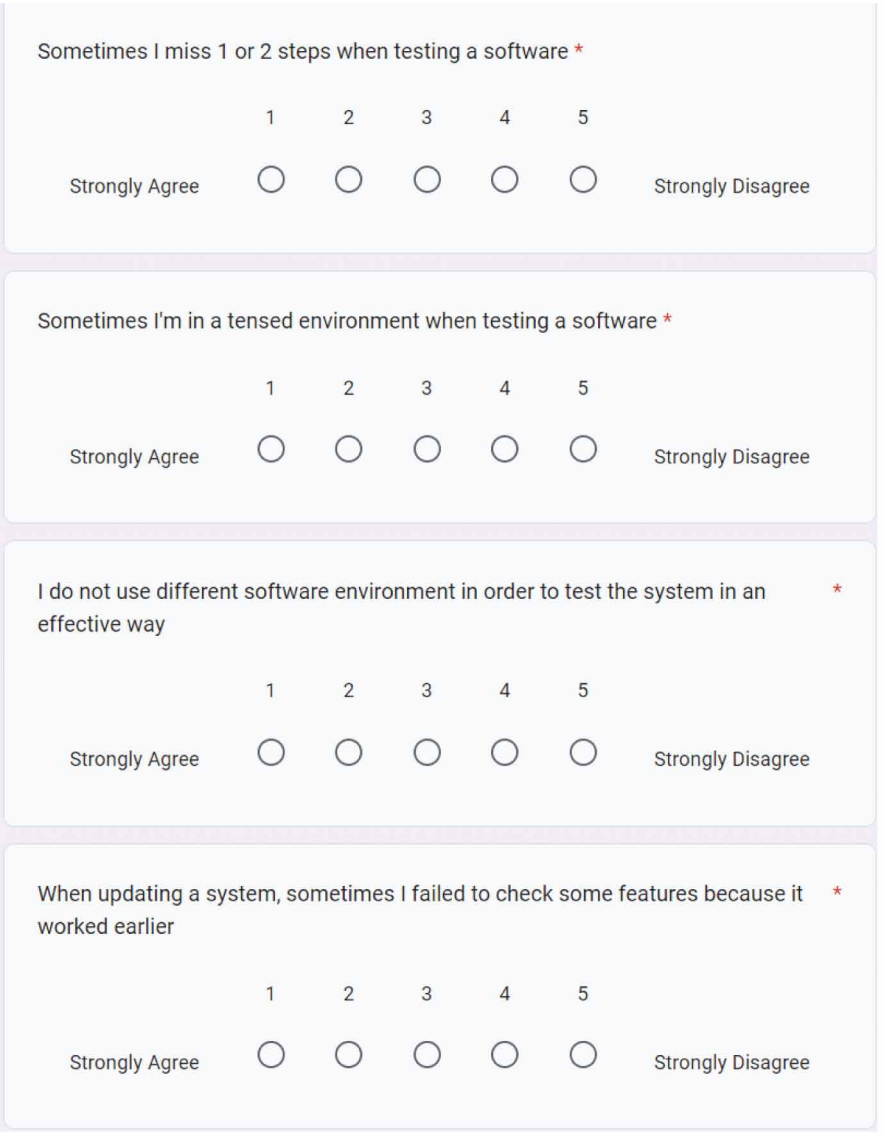
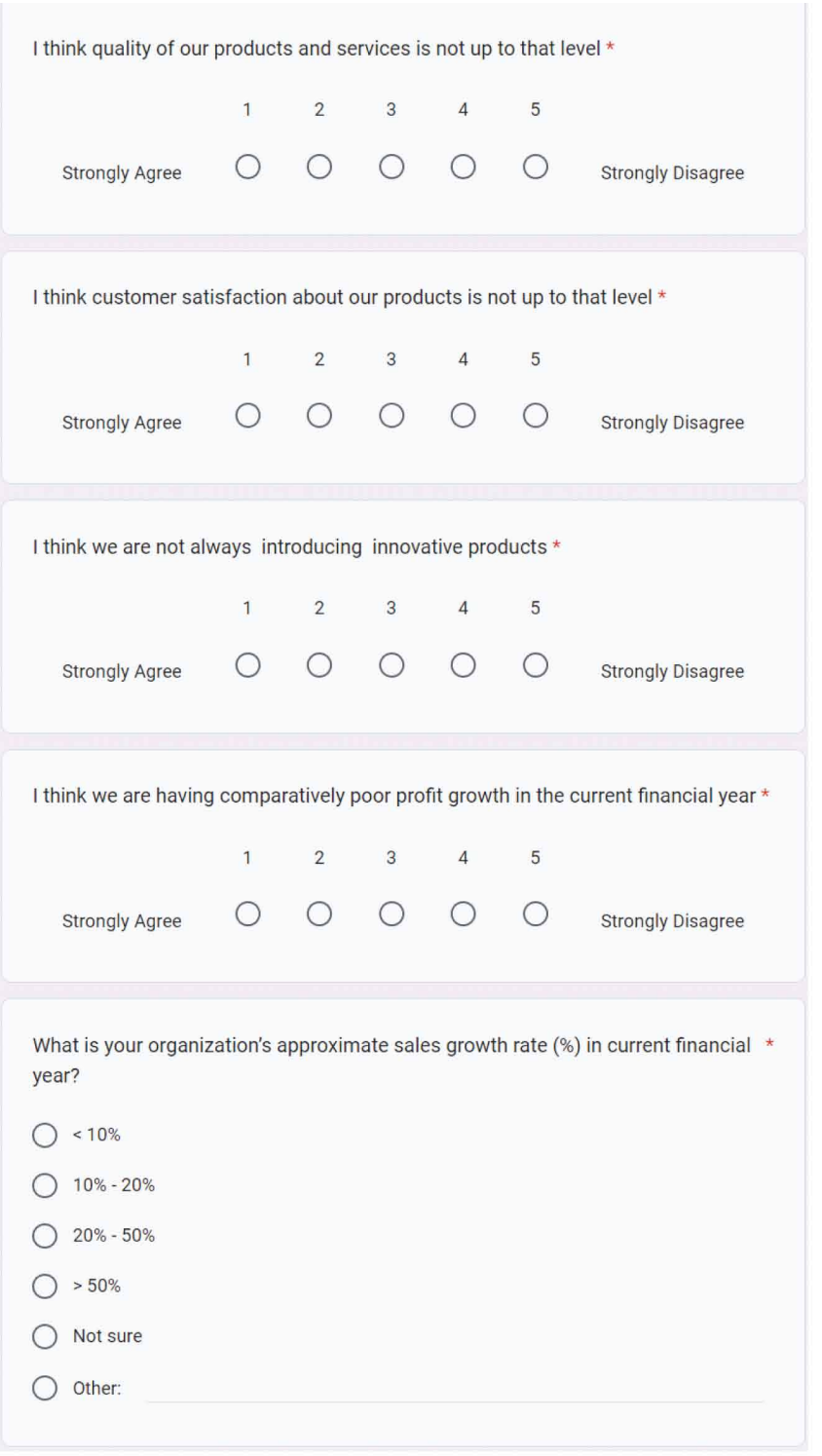


Figure 9. Survey questions – Maintenance Skills

Figure 10. Survey questions – Organization performance


I think quality of our products and services is not up to that level *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

I think customer satisfaction about our products is not up to that level *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

I think we are not always introducing innovative products *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

I think we are having comparatively poor profit growth in the current financial year *

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

What is your organization's approximate sales growth rate (%) in current financial year? *

- ○ < 10%
- ○ 10% - 20%
- ○ 20% - 50%
- ○ > 50%
- ○ Not sure
- ○ Other: _____

APPENDIX C

Table 21 shows the Interview Answers.

Table 21. Interview answers

Issue 1: Organization Performance Theme 1: Organization efficiency from an operational standpoint	
Interviewee 1	They are quite efficient because all clients are satisfied with the products.
Interviewees 2. 4	They are very efficient because recognition for the company has been received for the 4th time in a row.
Interviewee 3	*"We serve the telco industry like syntax solution, e-cash, etc. How we rate our company is the client rate card. In 2018, the Q1 core card rating given by the client was 4.7/5."*
Interviewee 5	*"First point is customizing the system. Another point is supported. The support team resolves the issues as soon as possible. Depending on the severity issues, we will decide if it is a production issue and resolve it within 2-4 hours. If that is more than that, we will give an estimate. So, I will tell you we are quite efficient because all current employees know the product well like data models, technologies. So, they can find the issues quickly."*
Issue 2: Human errors Theme 1: Vision or mission statement regarding errors	
Interviewees 1, 4	Their organization does not have a vision or mission statement regarding errors.
Interviewee 2	*"Yes, we have. We always try to give our best for clients."*
Interviewee 3	*"Of cause they do. As a startup, we try to give the best product to the client by minimizing the errors."*
Interviewee 5	*"There is no written-out vision or mission statement, but we have the attitude always to reduce the errors."*
Issue 3: Impact of skill-based errors on organization performance Theme 1: Selection of candidates	
Interviewee 1,2,4	They are recruiting. They check for well-educated, freshers, and willing to learn.
Interviewee 3	*"It's all about how willing, passionate, quick learners and knowledge."*
Interviewee 5	*"We don't select people with a large amount of experience because sometimes it's difficult to get them. Rather, we spend time getting freshers."*
Issue 4: Impact of design errors on organization performance Theme 1: UI/UX design team	
Interviewee 1	They do not have UI/UX team in their organization.
Interviewees 2, 4	They have UI/UX design team within their organization.
Interviewee 3	*"Yes, we do have. Of course. UI/UX is something we believe they should know the requirements. So, they should talk to clients and research with the head of a group of people. So, we always mingle with the client."*
Interviewee 5	*"We have two people in charge of UI/UX and a consultant who comes for three days weekly. We allow them to contact clients and project managers."*
Issue 5: Impact of quality testing errors on organization performance Theme 1: QA team	
Interviewees 1, 2, 3, 4	They have a QA team.
Interviewee 5	*"Yes, we have. So, whenever a requirement comes revenue team will be there on board. So that they can understand the requirements."*
Issue 6: Impact of maintenance errors on organization performance Theme 1: Maintenance of the projects	
Interviewees 1, 2, 4	*"Only project managers maintain the projects."*
Interviewee 3	Anyone could maintain the projects.
Interviewee 5	*"No. We won't give maintenance to new people, but we give them a chance to work under one of the seniors."*

Shampave Paramanatham is currently a Senior Software Engineer at DMS Software Technologies (Pvt) Ltd. She graduated from the Institute of Information Technology (IIT) affiliated with the University of Westminster with BEng Honours in Software Engineering in 2016. She received her MBA from the Institute of Information Technology (IIT) affiliated with Canterbury Christ Church University in 2019 and she completed her MSc in Cybersecurity and Forensic from the Institute of Information Technology (IIT) affiliated with the University of Westminster in 2021. Her research interests are in Software Engineering, Forensics, Cybersecurity, and Business Management.

Sidath R Liyanage graduated from the University of Kelaniya with BSc Honours in Statistics and Computer Science in 2005, he completed a Master of Philosophy in Computer Engineering from the University of Peradeniya in 2009 and received PhD from the National University of Singapore in 2013. His research interests are in Brain Computer Interfaces, Data Science, and applications of Machine Learning and pattern recognition. He has published over 40 publications. He is the Head of the Department and a Senior Lecturer attached to the Department of Software Engineering, Faculty of Computing and Technology, University of Kelaniya. He is a member of IEEE and a Council member of the Sri Lanka Association for Artificial Intelligence.