

**PUBLIC PROCUREMENT PROCEDURES AND
PROJECT IMPLEMENTATION FOR THE DIGITAL
AGE: A SRI LANKAN PERSPECTIVE**

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Degree of Master of Business Administration in Information Technology

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University of Moratuwa

Sri Lanka

August 2021

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Thesis submitted in partial fulfillment of the requirements for the degree
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Declaration

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Dr. C. R. De Silva

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Abstract

Procurement of information systems is a complex process as information systems include different systems ranging from off-the-shelf products to highly specialized systems for niche sectors. The inherent challenges of the procurement of information systems combined with the complex nature of public procurement make public procurement of information systems an area that should be further researched. This study is focused on identifying recommendations to overcome challenges faced in the public procurement of information systems. A literature survey was conducted to identify stakeholders' problems in the public procurement of information systems. The remainder of this research was done using the Modified Delphi method. The first round of Delphi was done using face-to-face interviews with a selected portion of an expert panel. Questions used in face-to-face interviews were formulated using the information gathered in the literature survey. Expert opinions on the solutions to the listed problems and problems they encountered in their careers were then formulated into a close-ended questionnaire. It was distributed in the second Delphi round to the full panel of experts. The outcome of the second Delphi round is a set of recommendations that can be used to overcome challenges faced in the public procurement of information systems. The recommendations are categorized under the main categories tender specifications, bid-evaluation criteria, government regulations, project management, collaboration among procurers and bidders, and competence of procurers. Further, the recommendations were ranked according to their level of importance. Furthermore, it was identified that there is no significant difference of opinion between the two stakeholder groups, procurers and bidders. The findings of this research can be adopted to improve the existing public procurement procedure and project implementation of information systems. There is a high efficacy to the generated recommendations as they were generated by the consensus of an expert panel of procurers and bidders.

Keywords: Public procurement, Information systems, Delphi method

Dedication

To

My Husband, Parents & Brothers

for their unwavering support

Acknowledgement

I express my sincere gratitude to everyone who helped me complete this study on "Public procurement procedures and project implementation for the digital age: a Sri Lankan perspective".

Firstly, my special gratitude to my supervisor Dr C. R. De Silva, for his constant guidance, encouragement and support until the end of my study.

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List of Abbreviations

CIO	Chief Information Officer
EMAT	Economically Most Advantageous Tender
ERP	Enterprise Resource Planning
ICT	Information & Communication Technology
IT	Information Technology
IS	Information Systems

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1. Introduction

1.1. Background

With the rapid development of information and communication technologies and digital connectivity, government organizations rethink how they interact and work with internal departments and external organizations (Al-Sobhi et al., 2010). Therefore, to be successful in the future, governments transfer their administrative processes to electronic systems. This process of using information and communication technologies (ICT) to improve the conveyance of government services to people, businesses, and other government agencies is known as electronic governance (e-governance) (Mittal & Kaur, 2013). Governments across the globe are focusing on implementing e-governance to facilitate and provide multiple services to people anywhere at any time and to replace traditional procedures (Alteyah et al., 2013).

Many countries, including developing countries, have achieved progress in implementing e-governance initiatives and ICT applications, which has allowed them to increase the public sector's efficiency, leading to sustainable development (United Nations, 2012). However, it has been found that developing countries have fallen short of achieving positive effects of e-governance implementation compared to developed countries. Between 60% and 85% of e-governance implementation efforts in developing countries end up as failures (Mates et al., 2013). Development in ICT infrastructure is identified as one of the most pivotal factors that will help successfully overcome challenges faced in the implementation of e-governance and avoid failure. (Choi et al., 2016)

In order to achieve successful implementation of e-governance, the public sector of a country requires to increase its capacity and readiness in technological and telecommunication infrastructure (United Nations, 2010). However, very few public entities have the capability to develop their own software (Moe, 2014). Therefore, public procurement is the most frequently used method of acquiring information systems (IS) for the public sector (Moe, 2014). However, procurement of information systems is a complex process as information systems include different systems ranging from off-the-shelf products to highly specialized systems for niche sectors. Public

procurement of specialized systems has proven to be more demanding due to challenges such as publishing tender specifications (Moe, 2014). Therefore, due to the inborn challenges that come with IS procurement combined with the complex nature of public procurement makes public procurement of information systems an area that should be further researched (Moe, 2014).

1.2. Motivation

An increasing number of e-governance projects are implemented in developing countries that promise greater efficiency in public sector activities. However, 35% of these projects are total failures, 50% are partial failures, and only 15% are successful (Heeks, 2003). These failures result in high direct and indirect costs to the world's poorer countries. Research by Choi et al. (2016), Alteyah et al. (2013) and Mohamed and Xavier (2016) have found that improvements in ICT infrastructure can help avoid failure in e-governance implementation. However, as very few public entities have the capability to develop their own solutions, public procurement is the primary method of acquiring ICT infrastructure for the public sector. Acquisition of information systems has proved to be more challenging due to its complex nature. Therefore, using a complex process like public procurement to purchase such systems has made public procurement of information systems an area that requires further research (Moe, 2014).

Studies conducted in several countries have helped identify the challenges stakeholders face in the public procurement of information systems. For example, Moe and Paivarinta (2013) and Ziemba and Oblak (2013) have identified that procuring entities face the challenge of developing clear, uncomplicated, and precise requirements. Meanwhile, Edquist et al. (2012) and Moe (2014) have identified that receiving detailed specifications limits the supplier's opportunity to show quality. Uyarra et al. (2014) and several other researchers have found that government regulations make the procurement process complex and costly. Poor change management, poor risk management, lack of top management support, lack of a project management methodology, and low competence of procurers are identified as challenges by Uyarra et al. (2014), Allane et al. (2015), and Ziemba and Oblak (2013).

However, there is a lack of research in identifying solutions to overcome the challenges stakeholders face in the public procurement of information systems. Furthermore, existing research in this area is from studies conducted in other countries. Therefore, it is essential to identify whether developing countries such as Sri Lanka also face similar challenges. Therefore, it is imperative to identify whether public procurement of information systems in Sri Lanka is also affected by similar challenges as in other countries, and recommendations should be made to overcome such challenges.

1.3. Problem Statement

Public procurement is the most frequently used method of acquiring information systems for the public sector. Improvement in ICT infrastructure is identified as one of the most critical factors that will help overcome challenges and avoid failure in the implementation of e-governance. Failure, between 60% and 85% of e-governance implementation efforts in developing countries is due to the inability to access the required infrastructure (Mates et al., 2013). The inborn challenges that come with the procurement of information systems combined with the complex nature of public procurement make public procurement of information systems an area that should be further researched. Although research from other countries has identified challenges that stakeholders face in the public procurement of information systems, there is a lack of research in identifying solutions to overcome such challenges. This research aims to identify whether public procurement of information systems in Sri Lanka is also affected by similar challenges as other countries do and to develop recommendations to overcome such challenges. Therefore, the following research problem will be addressed in this research.

What are the recommendations to overcome the challenges in the existing public procurement procedure of information systems?

1.4. Research Objectives

The following objectives will be achieved in this research to address the above research problem.

- To find similarities between the challenges faced globally and locally in public procurement of information systems
- To identify the recommendations to overcome the challenges in existing public procurement of information systems.
- To weigh and prioritize the identified recommendations to improve their practical value.

1.5. Research Significance

This study's outcome is a set of recommendations to overcome challenges faced in the public procurement of information systems. These recommendations will be ranked according to their importance level. The research will be conducted with the participation of an expert panel of procurers and bidders. Therefore, there is a high efficacy to the recommendations generated through this research.

1.6. Research Outline

The organization of the rest of the thesis can be outlined as follows. Chapter 2 is the literature review, including how the failure of e-governance implementation can be avoided by addressing challenges faced in the public procurement of information systems. It further includes challenges identified under the main categories of the public procurement procedure and testing and analysis approaches to be used. Chapter 3 is the research methodology illustrated using adopted research tools, conceptual diagram, and data collection process. Chapter 4 presents the data analysis, while chapter 5 presents research findings, recommendations, limitations, and future work.

2. Literature Review

2.1. Factors/ Type affecting the research problem

2.1.1. Failure of e-governance implementation

Heeks (2003) mentions that implementation of e-government in developing countries fail, with 35% as total failures (the initiative was not implemented or promptly abandoned after implementation), 50% as partial failures (main objectives of the initiative were not achieved, and there were unsavoury results) and 15% as success. The paper further emphasizes the critical factor that these failures come at a high price for the world's poorer countries. A study by Mates et al. (2013) also supports this view by mentioning that between 60% and 85% of e-governance implementation initiatives in developing countries end up as failures.

2.1.2. Improvement of ICT infrastructure to avoid failure of e-governance implementation

Choi et al. (2016) has proposed a method using Indonesia as a case study to appraise the e-governance implementation attempts in developing countries, which will help them identify the problems and solutions to those problems. This study has identified that improving ICT infrastructure is crucial for overcoming challenges and avoiding failures in implementing e-governance. Alteyah et al. (2013) has conducted another research using Saudi Arabia as a case study to identify influential factors for adopting e-government services in a country. This paper also supports the previous study's findings that technical infrastructure is one of the pivotal factors influencing citizens to adopt e-government services.

A recent study that adds to this mix was done by Mohamed and Xavier (2016), highlighting the implementation of e-governance in Malaysia. The findings of this study are essential for other developing countries that are initiating e-governance. Paper indicates that local authorities need to be more equipped with adequate funding, skilled human capital, adequate ICT infrastructure, transformational leadership at the central and local levels, and a strategic roadmap for implementation. It also highlights

the vital fact that governments must collaborate closely with the private sector to implement the latest infrastructure to speed up access to e-governance services. The study also indicates that the successful implementation of e-governance in South Korea is due to continued investment in high-quality ICT infrastructure. All the above studies proclaim that having solid ICT infrastructure in place is imperative for successfully implementing e-governance.

2.1.3. Influence of public procurement on the improvement of ICT infrastructure

Having identified that ICT infrastructure is a fundamental factor in securing the successful implementation of e-governance, it is now essential to identify the factors that affect implementing solid ICT infrastructure facilities in a country. Moe (2014) states that procurement is the usual method of obtaining ICT infrastructure for the public sector because only a few public entities can develop systems or infrastructure to match their requirements. He further states that procuring information systems is an overly complex process as they belong to a wide range from off-the-shelf products to specialized products for niche sectors. Procuring highly specialized systems imposes many challenges on public sector procuring entities as most of these systems are innovative solutions where the procuring entity might specify wrong functionalities or miss new functionalities required for innovation (Moe, 2014).

Since public procurement is an area that utilizes taxpayer's money, spending the money efficiently and getting the best value for money is particularly important. Furthermore, public procurement takes up a large part of private sector companies' market providing goods and services, making it essential to provide all the competitors with equal opportunity (Moe, 2014). Boyne (2002) also adds to this by saying that since public sector entities have more political control than economic control, they might have to deal with multiple authorities with conflicting interests.

Moe (2014) emphasizes that the public procurement of information systems is an area that needs more research. It is stated in the paper that public entities face several dilemmas when it comes to the procurement process of IS. Such dilemmas are

following rules and regulations vs preferring a specific bidder, following regulations vs communicating with bidders and having different stakeholders of the procurement process who have different viewpoints about the requirements. Therefore, Moe (2014) states that the inborn challenges that come with IS procurement combined with the complex nature of public procurement make public procurement of IS an area that should be further researched.

This gap is also addressed in the book *Public Procurement, Innovation and Policy: International Perspectives; Estonia as a case study* by Lember and Kalvet (2014). They suggest that the private sector often loses motivation to give their best outcome because the public sector is more concerned about the price and makes it a determining factor. They further suggest that the public procurement system can nurture innovation, leading to upgrades in the market. Another research that further emphasizes public procurement's ability to drive innovation is presented by Uyarra et al. (2014). Their work is focused on obtaining suppliers' opinions on why the public sector often fails to act as an intelligent and informed buyer.

This study is conducted as a survey of suppliers to public sector organizations in the UK such as government departments, local governments, and the National Health Service (NHS), which consists 90% share of public procurement spending in the UK. The study states that the public sector can impact the innovativeness of the private sector. For example, if a public sector buyer intends to purchase a product, system, or service currently non-existent, developing that product, system, or service will encourage the private sector to act innovatively.

The main barriers found in the research are lack of cooperation between suppliers and procurers, using over-specified tenders rather than outcome-based specifications, lack of competency of procurers, and poor risk management. Furthermore, not getting feedback from failed bids, disregarding spontaneous ideas, the private sector's delivery history, and obstacles caused by tiresome procedures are also recognized as a few other vital concerns. Additional constraints in the traditional procurement procedure are complicated regulations, conflicts in policy objectives, high entry costs, or complex procurement processes. Not having a consensus about the priorities, conflicting

requirements, and frequent policy changes increase unpredictability and reduce innovation potential.

Moe and Paivarinta (2013) add to this mix by conducting a Delphi survey to identify the challenges faced by procurement managers, chief information officers, and bidders who are stakeholders of the procurement process. They have revealed many challenges in the public procurement of information systems, such as complex regulations, technological cohesiveness problems, and the need to develop precise requirement specifications. Based on the above literature sources, the main aspects in which procuring entities and suppliers face difficulties while engaging in public procuring activities of information systems are identified as follows. Separating the literature survey into the following categories and identifying problems procuring entities and bidders encounter under each category provides better clarity to the researcher.

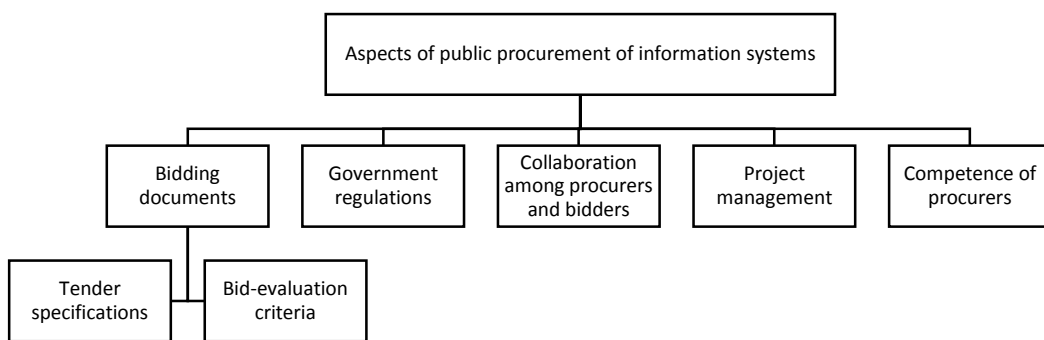


Figure 2.1: Aspects of public procurement of information systems

2.2. Existing case studies/ related work

2.2.1 Bidding Documents – Tender Specifications

When studying the literature on tender specifications of bidding documents, it becomes clear that both procuring entities and suppliers have an interest in tender specifications. Edquist et al. (2012) have identified in research the areas where public organizations and suppliers face bottlenecks in public procurement. They have identified three key phases in the tendering process: the opening of the bidding process through a tender, translating functional specifications into technical specifications, and tender assessment and contract award. According to them, opening the bidding process through a tender requires skills and demands equality and fairness of treatment. They

further state that missteps in the procedure can result in serious legal challenges, which can be costly and time-consuming.

The second phase they have identified is translating the functional specifications into technical specifications. They state that if public procurement aims to foster innovation, the public buyer should avoid translating desired functional specifications to technical specifications, and a potential supplier should do it. Furthermore, they mention that having detailed specifications in a bidding document can limit the bidder's opportunity to show quality. Moe and Paivarinta (2013) also express a similar idea on the bidder's opportunity to show quality. They state that the bidders approached in their study were not overly concerned with receiving complete and unambiguous specifications. However, they highlighted the importance of receiving feasible and realistic requirements from their customers. Researchers state that the lack of interest of bidders in detailed requirements may be because exceedingly detailed specifications would restrict the opportunity to show their qualities.

In research done to identify the challenges of public procurement of information systems by Moe and Paivarinta (2013), procurement officers and CIOs rated high the challenge of "developing clear requirements". Nevertheless, they gave a slightly lower rank to "complete requirements". Another research that gives a similar idea is done by Ziembra and Oblak (2013) on 'Critical Success Factors for ERP systems Implementation in Public Administration'. They say that existing public procurement procedures affect the prolongation of order and implementation time. They further state that the tender specifications should be straightforward and precise to speed up the public procurement process. Johansson and Lahtinen (2012) also claim that the vagueness of specifications can become an opportunity for the suppliers.

Another study done by Moe and Sein (2014) establishes this idea by stating that there is a dilemma between creating requirement specifications before the procurement process or developing system specifications as a part of the procurement process. In another study conducted by Uyarra et al. (2014), to understand suppliers' perspectives in this matter, one of the main barriers identified is over-specified tenders rather than outcome-specific specifications.

2.2.2 Bidding Documents – Bid Evaluation Criteria

Johansson and Lahtinen (2012) mention that the benefits of using more precise evaluation criteria are two folded. Firstly, it will give bidders a better chance to evaluate their products against the criteria and give more accurate pricing. Secondly, it will make the evaluation of specific tenders easier for procurers. Furthermore, they mention that the suppliers' qualities should be given more consideration to have a helpful framework for IT procurement. Bergman and Lundberg (2013) say that the quality of the product can vary between multiple suppliers and that the buyer's bid-evaluation criteria often influence the quality of the purchased product. Moe and Paivantara (2013) support this idea by saying that internal stakeholders such as project managers and CIOs have rated high using a good assessment criterion. Furthermore, they mention that it could be used to avoid bidder complaints.

Bergman and Lundberg (2013) say that while the lowest-price tender evaluation is straightforward, defining appropriate minimum quality requirements can be challenging in this method. In this paper, they have considered the bid evaluation criteria of the European Union. They mention that while procurement contracts are usually awarded to the qualified bidder with the lowest price in countries like the US, European Union prefers selecting suppliers by using a combination of quality and price. Therefore, there are two methods to select the supplier: the lowest price and the economically most advantageous tender (EMAT). The lowest price method does not need a scoring rule. However, if EMAT is used as the selection method, three categories of scoring rules can be used. Those are quality-only, price-to-quality, and quality-to-price.

These scoring rules are usually based on numerical or monetary values. This study's final recommendation is to use quality-to-price scoring (assigning monetary values to quality characteristics) if bid evaluation is done as a combination of quality and price. The lowest price method can be used when the cost of producing certain quality levels is known, and multiple suppliers could provide optimal quality. Moe and Paivantara (2014) support the need for an EMAT model by saying that internal stakeholders

should focus on balancing the cost with quality and give bidders room to show their qualities if they want to see the benefits of investing in new systems.

2.2.3 Government Regulations

Moe and Paivarinta (2013) say that having contract agreements and regulations to protect the public buyers through payment models and standard government contracts can hurt the bidder's interest to participate in the tender. They state that as a result, public buyers may have fewer suppliers to select from and, therefore, might not get enough bargaining power. Furthermore, they say that complex, constraining regulations also make the procuring process unnecessarily complex and costly. Moe and Sein (2014) also have brought into light a different set of problems caused by strict regulations. They say that public procurement is heavily regulated similarly to any other aspect in the public sector.

Furthermore, they say that these regulations are from both local authorities and international bodies, such as the European Union. The main idea they present as a contradiction in public procurement is following regulations vs satisfying system needs. Furthermore, they say that this might lead to conflict in goals such as conducting a formally correct procedure vs selecting the system that meets the actual needs.

Moe (2014) also supports the previous research by saying that legal regulations usually result in a more complex public procurement process. However, he presents an idea that previous researchers had not presented, saying that these regulations are backed by solid motivators such as preventing corruption. Furthermore, since public procurement uses taxpayers' money, achieving the best value for money is a crucial challenge.

Uyarra et al. (2014) also mention that suppliers are sensitive to hefty pre-qualification procedures and conditions of the public sector procurements. They emphasize that this is particularly disadvantageous to smaller firms as complex regulations prevent them from getting into contracts that will help them innovate. Ziemba and Oblak (2013) also add to this mix by saying that legal regulations prolong purchase and implementation time. They emphasize that such prolongation can result in functional changes due to inflation of requirements and government regulations changes.

2.2.4 Collaboration among Procurers and Bidders

In their survey focused on suppliers to public sector organizations of the UK, Uyaraa et al. (2014) strongly comment on the barriers to innovation caused by lack of collaboration among procurers and bidders. They mention that the public sector could influence the innovation activities of private firms. However, they have identified that one of the main barriers to innovation in the private sector is a lack of interaction with procuring organizations. Furthermore, they have found that poor buyer-supplier interaction leads to a lack of skills of the buyer. One of the suppliers has emphasized that this dialogue is crucial if a bidder wants to innovate effectively. A second supplier has addressed the problem in-depth and says there should be communication between bidder and user rather than between bidder and procurer. He has identified procurer as a restrictive interface between supplier and user. Uyarra et al. (2014) identify this situation as a "Structural Disconnect" between suppliers, users, and buyers.

Mohamed and Xavier (2016) have done an empirical study through semi-structured interviews with 50 respondents on transforming public service delivery in Malaysia by implementing e-governance. This research is focused mainly on challenges faced in practical implementation. They present a similar idea to Uyarra et al. (2014) by saying that the government and private sector should work closely to implement the modern infrastructure. Many researchers share the above idea by Uyarra et al. (2014). Ziemba and Oblak (2013) highlight that knowledge acquired from external experts who are specialized in the area can impact the project's success in a significant way. They also agree that end-user involvement is significant and that they should be involved in the project at the earliest possible time, giving them time to adapt to changes.

The existing procurement regulations expect procurement entities to develop requirement specifications without communicating with bidders. However, this could be problematic because procuring entities' knowledge might be limited while dealing with expert bidders who have specialized knowledge. (Moe and Paivarinta, 2013). However, it is unclear whether the requirement specifications mentioned in this study are functional specifications or technical specifications. Edquist and Zabala-Iturriagagoitia (2012) have also addressed this issue and recommend translating

functional specifications to technical specifications by a potential supplier. Uyarra et al. (2014) discuss collaboration among procurers and bidders differently by saying that feedback from failed bids is also essential.

2.2.5 Project Management

In a study done by taking an IS acquisition project as a case study, Allane et al. (2015) mention that the procurement process should be ready for the influence of external events. In other words, change management and risk management procedures should be in place. Furthermore, they mention that change management can be problematic in public procurement because it is governed by legislation. Uyarra et al. (2014) identify poor management of risk during the procurement process as one of the main barriers to innovation. However, the paper does not discuss poor public sector risk management in detail but mentions that the public sector tends to be risk-averse.

Ziemba and Oblak (2013) have discussed project management of public sector IS procurement projects. They say that insufficient top management support and failing to assign responsibilities and roles will negatively affect project implementation. Furthermore, they emphasize that implementing large projects without a proven project management methodology will be more prone to failure. Furthermore, they mention that implementing an ERP system brings in many changes in an organization. Therefore, they emphasize the necessity of proper change management as poor change management will increase the risk of failure.

2.2.6 Competence of Procurers

Uyarra et al. (2014) has identified the low competence of procurers as one of the main barriers to innovation. They mention that in-house competence is vital in the procurement of innovation compared to off-the-shelf purchases for the lowest possible price. Furthermore, they mention that rigid specifications are a result of the low competence of procurers. One of the suppliers who participated in the survey has mentioned that procurers are either afraid or cannot understand the benefits of innovation. Edquist and Zabala-Iturriagagoitia (2012) have also identified that insufficient competence on the procurer's side prolongs project completion time. Furthermore, they mention that procurers should have highly developed competence

to translate needs/ challenges/ problems into functional specifications and sophisticated competence to translate functional specifications to technical specifications.

Ziembra and Oblak (2013) mention that project team competence is a critical success factor in ERP projects. They mention that this refers to both employees of the government institute and the supplier. It elaborates that suppliers should have previous experience and competence in implementing ERP systems and previous experience working with the public sector. It also mentions that public sector employees should have good knowledge about the project's functional scope.

2.3 Evaluation of related works/ approaches

Table 2.1: Evaluation of related works/ approaches

Related Work	Factors Considered	Research Methodology	Relevance for Future Work
Edquist et al. (2012)	• Translating functional specifications to technical specifications should be done by a potential supplier • Excessively detailed specification limits the ability and creativity of supplier • The translation of needs/problems/ challenges into functional specifications needs high competence from procurers	6 case studies from Sweden, Norway, and the USA	Focuses on how public procurement can trigger innovation
Ziembra and Oblak (2013)	• Tender specifications should be straightforward and precise • Knowledge of external experts have a significant impact on the success of the project • Legal regulations affect prolongation of purchase • Short and unrealistic deadlines	☐ Case study of a government agency in Poland ☐ Critically analyzed literature ☐ Action research ☐ Logical deduction	Emphasizes the need to thoroughly studying BPM and GRP projects of the public sector.
Alanne et al. (2015)	• Change management and risk management procedures should be in place • Change management can be problematic because the legislation governs it • The expertise of stakeholders is narrowed to a limited field	Single case study on IS acquisition	Explores how multiple stakeholders work together

Related Work	Factors Considered	Research Methodology	Relevance for Future Work
Moe and Paivarinta (2013)	Procurement officers and CIO, - Rated high – developing clear requirements - Rated low – developing complete requirements Bidders, - Rated high – receiving feasible and realistic requirements - Rated low – receiving complete and unambiguous specifications - Detailed specifications limit bidders' opportunity to show their qualities - Use, weigh and prioritize good assessment criteria - Having a good assessment criterion could avoid bidder complaints - Procurers should balance cost with quality - Procurers should give bidders room to show their qualities - Having contract agreements and regulations can hurt bidders' interest to participate in the tender - Might lead to less competition, less choice, and less bargaining power for the procurer - It makes the procurement process complex and costly - There are issues of technological integration and compatibility	Delphi Method Composition of an expert panel consisting of procurement managers, CIOs and bidders	Has used a research method that can be used to identify, select and rank observed challenges Has identified challenges faced by Procurement managers, CIOs and Bidders separately
Moe and Sein (2014)	- A dilemma exists between creating requirements specifications before procurement or developing system specifications as a part of the procurement process - As a result of strict regulations,	Case study of procurement of Electronic Health Records system for a Norwegian municipality.	Provides better understanding by combining two analytical methods Has identified and classified contradictions in public procurement

Related Work	Factors Considered	Research Methodology	Relevance for Future Work
	- The contradiction of following regulations vs satisfying system needs - Conflict in goals such as conducting a formally correct procedure vs meeting actual system needs.	Dialectics and Stakeholder Theory	
Bergman and Lundberg (2013)	- The buyer's bid-evaluation criteria influence the quality of the product - Use quality-to-price scoring if evaluation is done as a combination of quality and price - Use the lowest price method when the cost of producing certain quality levels is known, and multiple suppliers can provide optimal quality.	Builds a theoretical framework based on microeconomic theories	Discusses advantages and disadvantages of different supplier selection methods
Uyarra et al. (2014)	- From the supplier's perspective, one of the main barriers is over specified tenders rather than outcome specific specifications - Public sector requirements can encourage the private sector to innovate. - Barriers to innovation - Lack of interaction with procuring organizations - Low competence of procurers - Poor management of risk - Lack of feedback from unsuccessful bids - Difficulties posed by procedures and conditions - Potential conflicts between policy objectives - High entry cost - Complex procurement processes	Survey with the participation of suppliers who supply to the public sector of the UK.	Future research should also consider why suppliers try to access the public sector market but fail.
Mohamed and Xavier (2016)	Government and private sector should work closely to establish modern infrastructure	Empirical study through semi-structured interviews with 50 respondents	Focuses on challenges faced in practical implementation

Related Work	Factors Considered	Research Methodology	Relevance for Future Work
Johansson and Lahtinen (2012)	• The vagueness of specifications become an opportunity for suppliers • Specify and separate functional and non-functional requirements • Benefits of using a more precise evaluation criterion • It gives bidders a better chance to evaluate their products against criteria • It gives a better chance to give more accurate pricing • It makes evaluation easier for procurers	Analysis of eleven "call for bids" from Swedish National Procurement Database	Research focuses on specifying requirements, which is the central contractual element between procurer and supplier
Lember and Kalvet (2014)	• Most public tenders are carried out by officials whose primary duties lie outside public procurement • Existing procurement training is biased towards legal matters rather than strategy and management. • The private sector lacks the motivation to offer the best solutions because determining factor in public procurement is price	Analysis of cases from eleven countries	Addresses theoretical and practical gaps
Moe (2014)	• Regulations result in a more complex public procurement process • Regulations are backed by motivators such as prevention of corruption • Developing clear and precise requirements • Specifying requirements upfront, or do it as a part of the procurement process • Communication is prohibited between procurers and bidders.	Systemic literature review	Provides a gap analysis and research questions to conduct future research in procurement.

Bidding Documents – Tender Specifications

Related Work	Translating functional specifications to technical specifications	Developing clear, straightforward, and precise requirements	Separating functional and non-functional requirements	Create specifications before procurement or as a part of the procurement process	Detailed specifications limit the bidder's opportunity to show quality	The vagueness of specifications becomes an opportunity for suppliers	Receiving over specified tenders rather than outcome-based specifications	Need of feasible and realistic requirements
	Procuring entity				Suppliers			
Edquist et al.(2012)	X				X			
Moe and Paivarinta (2013)		X			X			X
Ziemba and Oblak (2013)		X						
Moe and Sein (2014)				X				
Uyarra et al. (2014)							X	
Johansson and Lahtinen (2012)			X			X		
Moe (2014)		X		X	X			

Bidding Documents- Bid Evaluation Criteria

Related Work	Benefits of a precise evaluation criterion			Qualities of the suppliers should be given more consideration	Quality of product is influenced by choice of award criteria	Determining factor in public procurement is the price – leads to a lack of motivation from the private sector	Use quality-to-price scoring if evaluation is done as a combination of quality and price
	Bidders get a chance to evaluate products against criteria	Better chance to give more accurate pricing	Makes evaluation easier for procurers				
Bergman and Lundberg (2013)					X		X
Moe and Paivarinta (2013)							X
Johansson and Lahtinen (2012)	X	X	X	X			
Lember and Kalvet (2014)						X	

Government Regulations

Related Work	Has an adverse effect on bidders' interest to participate	Leads to less competition, less choice, and less bargaining power	Makes the procurement process complex and costly	Legal regulations result in prolongation of purchase	Leads to the contradiction of following regulations vs satisfying system needs	Regulations are backed by motivators such as prevention of corruption
Moe and Paivarinta (2013)	X	X	X			
Moe and Sein (2014)					X	
Moe (2014)			X			X
Uyarra et al. (2014)			X			
Ziemba and Oblak (2013)				X	X	

Collaboration among Procurers and Bidders

Related Work	Translating functional specifications should be done by a potential supplier	Knowledge of external experts have a significant impact	Government should work closely with the private sector	Communication being prohibited between procurers and bidders	Lack of feedback from unsuccessful bids is an issue
Uyarra et al. (2014)			X		X
Mohamed and Xavier (2016)			X		
Edquist et al. (2012)	X				
Ziemba and Oblak (2013)		X			
Moe (2014)				X	

Project Management

Related Work	Poor change management	Poor Risk Management	Lack of top management support	Use proven project management methodology
Uyarra et al. (2014)		X		
Allane et al. (2013)	X	X		
Ziemba and Oblak (2013)	X	X	X	X

Competence of Procurers

Related Work	Low competence of procurers	The expertise of stakeholders is in a narrow field
Uyarra et al.(2014)	X	
Lember and Kalvet (2014)	X	
Edquist et al.(2014)	X	
Alanne et al.(2015)		X

2.4 Testing and analysis approaches

2.4.1 Delphi method

The Delphi method is used to develop and identify consensus by a panel of experts on a given topic (Holey et al., 2007). Several other researchers have also given definitions, such as the Delphi method is a survey with multiple stages that attempts to achieve a final consensus on an issue (McKenna, 1994). Furthermore, it is used to achieve the consensus of an expert panel using a succession of questionnaires together with controlled feedback (Dalkey and Helmer, 1963). According to Keeney et al. (2014), the Delphi method's key characteristics are anonymity, the use of an expert panel, and controlled feedback. Furthermore, they mention that the Delphi method is built on the basis that there is more validity to a group opinion than to an individual opinion. They have also successfully aggregated several definitions given by other researchers over the years by saying that the Delphi technique intends to achieve consensus among a set of experts on an issue where no agreement has previously existed.

Classical Delphi method

Keeney et al. (2014) provide a comprehensive insight into the classical Delphi method as follows. Round 01 of the classical Delphi method uses open-ended questions and is typically a qualitative round. It is distributed among the expert panel through the post, and panel members can respond to the questionnaire freely. Round 01 is traditionally used to get the expert panel to brainstorm and generate ideas about the issue focused on the study. The statements generated in round 01 are content analyzed and are grouped into different areas. The set of statements finalized using content analysis is circulated back among the expert panel as a structured questionnaire in round 02 along with controlled feedback. The Likert scale is the most used in gathering responses in round 02 as it is associated with agreement and consensus.

Summary statistics such as frequencies and descriptive statistics are run on round 02 to identify whether any statements have achieved consensus. In subsequent rounds, the expert panel is provided feedback on the statements and the level of consensus they have achieved so far, along with an opportunity to change their responses from the previous round. Likewise, iterative rounds are run until the consensus set at the study's

outset is finally met. The practical scenario is to accept that all statements will not reach consensus and to stop the rounds based on time constraints, and to prevent reduced response rates caused by participant fatigue (Keeny et al., 2014)

Modified Delphi method

Keeny et al. (2014) has pointed out several variations developed from the classical Delphi method over the years. One such method is the Modified Delphi method. In the Modified Delphi method, the first round is not open-ended as in the classical Delphi method. Instead, it is replaced by one of the following (Keeny et al., 2014).

1. Statements developed from existing literature in the field
2. Focus groups
3. One-to-one interviews

Hsu (2007) also mentions that it is a common modification of Delphi to use a structured questionnaire as the first round after an extensive study of literature. The rest of the rounds are conducted similarly to the Classical Delphi method. Another variation is the e-Delphi method, which uses electronic methods such as email for survey distribution instead of the postal method used in the Classical Delphi method. E-Delphi is suitable for studies that engage experts who can conveniently use email for correspondence (Keeny et al., 2014).

2.4.2 Attitude scales

In a review done using 88 Delphi studies, Ameyaw et al. (2016) have identified that 41 out of 88 Delphi studies used the Likert scale to quantify the expert opinion on a particular subject. They have also identified that the five-point Likert scale is the most used with a frequency of 22. Keeny et al. (2014) support this finding by saying that the Likert scale is the most suitable for Delphi questionnaires associated with consensus and agreement.

2.4.3 Expert panel

Expert opinion

Chan et al. (2001) mention that selecting the expert panel with care can ensure a Delphi study's success. Keeny et al. (2014) mention that it should be noted that Delphi studies do not always use a random sample that is representative of the target population but instead uses experts. McKenna (1994) interprets the term 'experts' as a group of informed individuals, while Goodman (1987) interprets 'experts' as specialists in a particular area. An inclusion criterion can be developed to select the expert panel using factors such as qualifications, number of publications in the study area, geographical location, and years of experience in the study area (Keeny et al., 2014).

Panel size

Keeny et al. (2014) mention that there is no direction in the existing literature to decide the number of experts required to represent a sample in the Delphi method. Authors such as Delbecq et al., 1975; Fink et al., 1984; Brooks, 1979 and Clayton, 1997 agree that having a panel size greater than 30 does not seem to improve results. Gustafson (1975) mentions that ten to fifteen experts are sufficient if the expert panel is homogeneous. Thangaratinam & Redman (2005) add to this mix by saying that a Delphi study's sample size is empirical and pragmatic and depends on the available resources, study aim, and design.

Akins et al. (2005) found that responses gathered from a small expert panel (n=23) are stable after augmenting the sample via bootstrapping. Ameyaw et al. (2016) say that out of 67 Delphi studies they reviewed, 41 studies used expert panels with 8 – 20 experts. The literature also mentioned that since the Delphi method does not rely on a statistical sample, representative sampling techniques are inappropriate (Powell, 2003; Beretta, 1996). Therefore, representativeness is based on the expert panel's quality rather than on the panel size (Keeny et al., 2014).

2.4.4 Consensus measurement

Diamond et al. (2014) have published a paper after investigating how the concept of consensus is operated in Delphi studies by doing a systematic review of 100 Delphi studies published between 2000 and 2009. They have concluded that even though the

consensus is the concept of primary concern in Delphi studies, the definition of consensus varies widely across papers. It was found that the most common definition for consensus was per cent agreement. Keeny et al. (2014) have also done a comprehensive analysis of existing Delphi studies and found that the level of agreement is regarded as a measure of consensus. A study incorporated in their paper has chosen a consensus level as 70%, quoting that McKenna et al. (2002) and Sumison (1998) suggested it as a solid cut-off point. However, different researchers have used various agreement levels in their studies, varying from 100% (Williams and Webb, 1994) to 51% (Loughlin & Moore, 1979; McKenna, 1994).

2.4.5 Importance Rank

Keeny et al. (2014) mention that statements can be ranked from most important to least important using their mean value.

2.4.6 Mann-Whitney U test

Hon et al. (2012) mention in their study that an inter-group comparison should be conducted to test whether a significant agreement exists between different expert subgroups before combining the data. Furthermore, they mention that non-parametric tests can test inter-group comparison as Likert data is usually treated as ordinal data. According to Mann & Whitney (1947) and Wilcoxon (1945) Mann-Whitney U test, also known as the Wilcoxon rank-sum test, can test the difference between two groups on a single, ordinal variable without a specific distribution.

2.5 Limitations in existing work and new challenges

The literature survey helped identify that public procurement of ICT infrastructure, especially procurement of complex information systems, is crucial in avoiding e-governance implementation failures. The main aspects where challenges occur in public procurement of information systems were identified through the literature as tender specifications, bid-evaluation criteria, government regulations, collaboration among procurers and bidders, project management, and competence of procurers. Furthermore, a set of challenges under each main aspect were also identified.

However, there is a lack of research when it comes to recommendations to overcome those challenges. Furthermore, it is essential to identify whether similar challenges exist in the public procurement of information systems in Sri Lanka. Suppose the research findings establish that similar challenges exist in the Sri Lankan context. Then the recommendations generated from this study can also be applied to overcome challenges faced while procuring information systems for other countries' e-governance initiatives.

3. Methodology

This chapter focuses on the methodology that is adapted in this research. The chapter consists of the conceptual framework and the process of formulating the Delphi technique for data collection. Section 3.1 presents an overall picture of the research methodology, and the conceptual framework is illustrated in Section 3.2. Data collection methods used to collect primary and secondary data will be explained in Section 3.3, while Section 3.4 illustrates the sampling design, including the target population and sample size. Pre-survey/ first Delphi round design and second Delphi round design are addressed in Section 3.5. Finally, the chapter summary is presented in Section 3.6.

3.1. Research Methodology

The Delphi technique is used as the primary research method in this study. Research work starting from the literature survey helps build up the Delphi technique, and the adopted approach can be elaborated as follows. A comprehensive literature survey on the existing studies identifies the problems procurers and bidders face in the procurement of information systems for the public sector. Due to the reason that all these literature sources are from foreign studies, a pre-survey for the research was formulated to identify whether the same problems and factors also affect public procurement of IS in Sri Lanka. This pre-survey is also used as the first Delphi round. Therefore, this pre-survey was conducted through interviews with standardized open-ended questions using only a selected portion of the expert Delphi panel.

The expert Delphi panel is selected from procurers, bidders, and auditors involved in the public procurement of information systems. The selection criteria for the expert panel is elaborated in the target population section. In the pre-survey/ first Delphi round, selected experts were asked to brainstorm and develop recommendations to overcome the problems listed in the interview questionnaire. After a qualitative analysis, the recommendations generated in round 01 are used to formulate the questionnaire for Delphi round 02. Delphi round 02 questionnaire is a close-ended questionnaire that is distributed among the entire Delphi panel electronically. Data collected from round 02 is statistically analyzed to see whether each recommendation

has reached the pre-defined consensus level of 70%. If the desired consensus level is not met, controlled feedback will be provided to the expert panel about the results of round 02. Panellists will be provided with an opportunity to reconsider their previous answers based on how others have responded to the same questions. Afterwards, further Delphi rounds will be conducted until the expert panel reaches a 70% consensus on the recommendations. When consensus is met, a comprehensive data analysis will be done to derive the research findings.

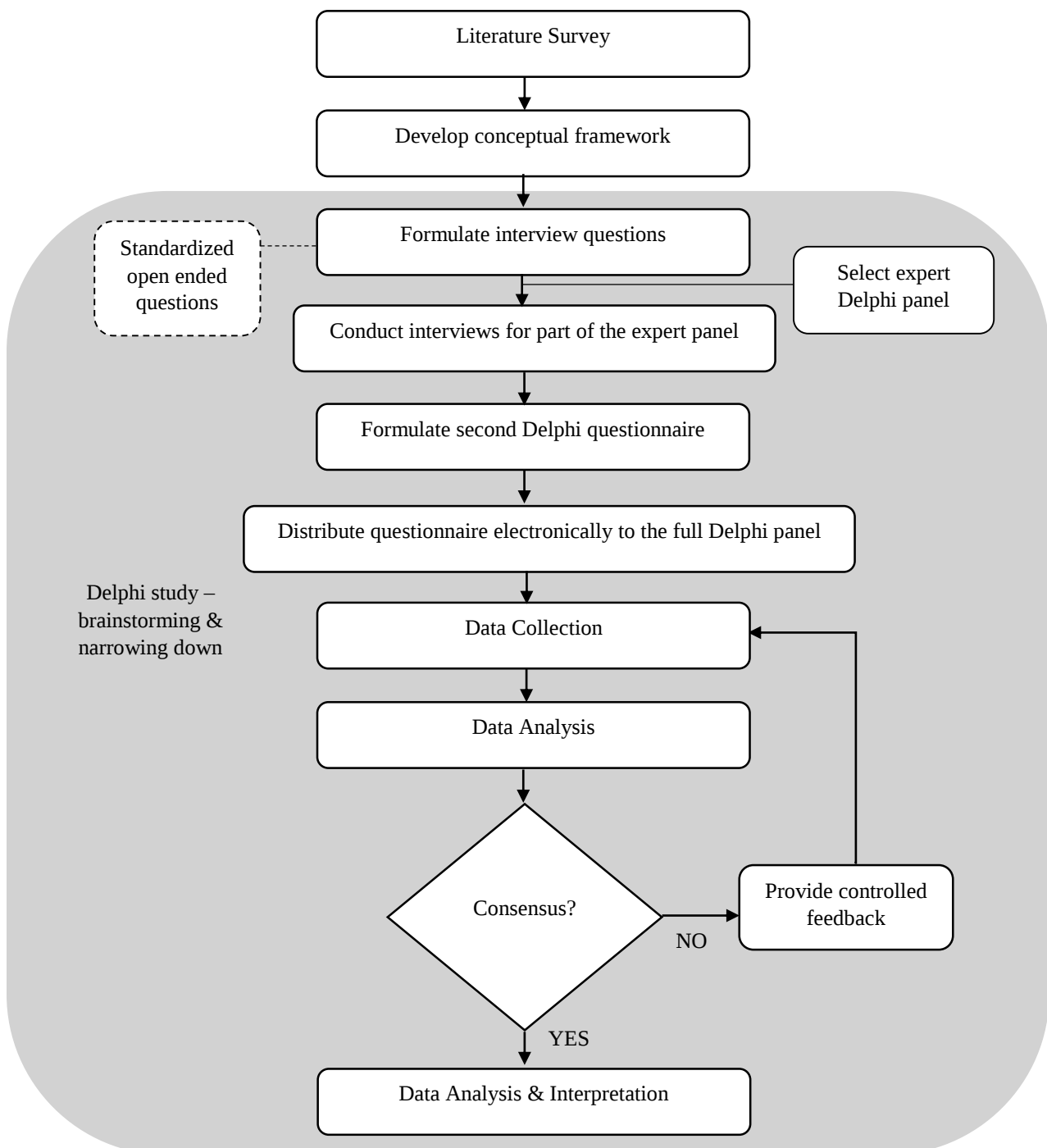
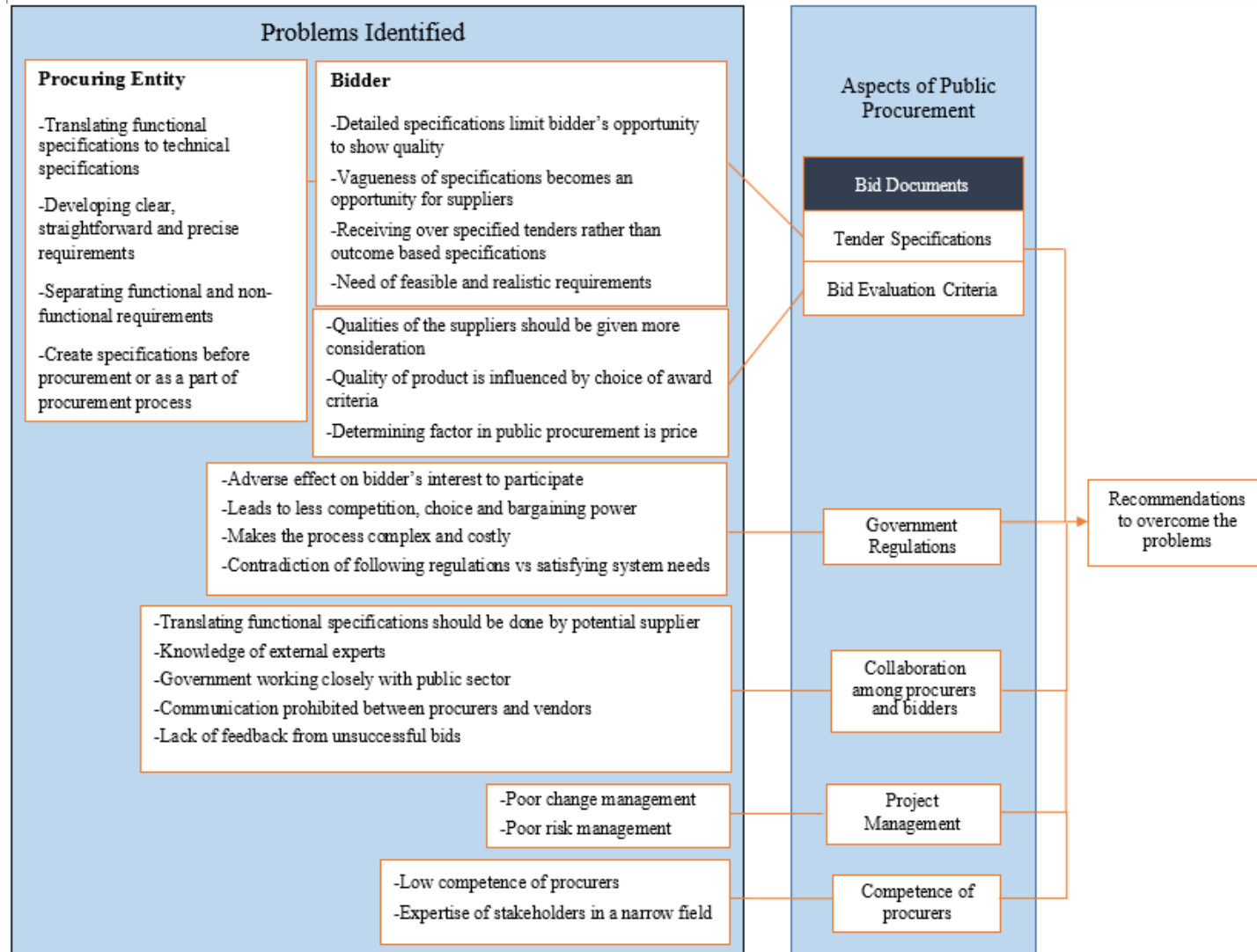


Figure 3.1: Research methodology

3.2 Conceptual Framework



3.3 Data Collection Methods

3.3.1 Primary Data

The primary data collection method that is used in this research is Delphi Technique. The nature of the research topic called for a research method that can evaluate experts' opinions in public procurement. A specific group of people is involved in procuring IS for the public sector, which calls for research methods similar to focus groups. According to Dalkey (1969), using focus groups has disadvantages such as group pressure, noise, and dominant persons' influence. However, the Delphi technique holds the main attributes of anonymity, using experts, and controlled feedback. McKenna (1994) identified the Delphi technique as a survey with multiple stages which focus on achieving consensus on a significant problem.

The experts involved in the public procurement of information systems can be categorized into three main groups. Those are procurers, bidders, and auditors. These three groups can have contradicting views on the problems faced in the public procurement of information systems. Furthermore, they are geographically scattered. Procurers belong to different departments or ministries, and bidders belong to different companies. The Delphi technique's nature will allow them to bring different perspectives together and work towards solutions until meeting consensus. Therefore, the Delphi technique is chosen as the most suitable technique to conduct the research.

There are few variations of the Delphi technique. Two of the main variations are Classical Delphi and Modified Delphi. In Classical Delphi's first round, the expert panel is asked their opinion on a specific matter using an open-ended questionnaire. This process can be identified as brainstorming or an idea generation session. The first round responses are analyzed, and outcomes are sent back to the panel as a close-ended questionnaire, known as providing controlled feedback. The expert panel answers the second questionnaire and sends back the answers. These successive rounds pursue till the panel reaches consensus on all or selected issues discussed.

The second variation of the Delphi method is the Modified Delphi technique. The modification used here is that the first round of idea generation in Classical Delphi is replaced with face-to-face interviews or focus groups. Ideas generated in the

interviews or focus groups are then sent out in a close-ended questionnaire like Classical Delphi. The only difference between Classical and Modified versions is replacing the first round of open-ended questionnaires with interviews or focus groups.

This research is done using the Modified Delphi method. Therefore, Delphi's first round is done using face-to-face interviews with a selected portion of the expert panel. Focus groups were ruled out due to the conflicting schedules of the expert panel. Questions used in face-to-face interviews were formulated using the information gathered in the literature survey. A selected portion of the expert panel was asked to identify whether the problems and factors identified using foreign literature sources were relevant to the Sri Lankan context.

Furthermore, they were asked to comment on the possible solutions to the listed problems in an open-ended manner. Their expert opinion on the solutions to the listed problems and problems they have encountered in their careers were then formulated into a close-ended questionnaire. It was distributed among the full expert panel in the second Delphi round. Delphi rounds in this survey were terminated after the second round.

3.3.2 Secondary Data

Secondary data used in this research was gathered from existing research articles, journal articles, and books. There were studies which were conducted in Europe, the USA, Africa, and Southeast Asia. Therefore, during the first Delphi round, the expert panel was explicitly asked to identify and filter factors affecting public procurement and project implementation of information systems in Sri Lanka.

3.4 Sampling Design

3.4.1 Target Population

This research's target population was procurers from the public sector, bidders from the private sector, and auditors from the public sector involved in auditing IS procurement activities. Individuals from all three groups must be experts in their subject areas. Therefore, it is essential to understand the term 'expert' better. Any person with relevant input can be known as an expert (Kaplan, 1971). An expert can

also be known as an 'informed individual' (McKenna, 1994). Following four factors can be used to understand the expertise of a person participating in a Delphi study (Adler and Ziglio, 1996)

1. Having knowledge and experience on the problems under investigation
2. Having the capacity and the willingness to participate
3. Having sufficient time to participate
4. Having effective communication skills

Furthermore, the literature reveals that an expert can be decided by the number of years of experience gained in a particular area (Hardy et al., 2004). Therefore, individuals who have worked in public sector IS procurement projects for at least five years and have experience of working in at least five IS procurement projects were considered as the target population.

Procurers belonged to different government departments, and some procurers have worked in different departments over a period. Furthermore, some procurers worked in the ministries and were overlooking several IS procurement projects for different departments.

The target population also includes bidders who bid for IS procurement projects of the public sector. These bidders are individuals from different companies who have engaged in public sector IS procurement activities at some point. They should be engaged in the procurement process from the bidding stage up to project completion.

The third group in the target population is auditors. The researcher intended to select auditors who have engaged in auditing IS procurement processes. However, auditors were removed from the second Delphi round based on the first Delphi round's feedback. This scenario is explained further in the data analysis chapter.

3.4.2 Sampling Size

The Delphi technique uses a panel of experts, which is not a random sample representing the target population (Keeney et al., 2014). In the first Delphi round, face-to-face interviews were conducted with five procurers, five bidders, and four auditors. Therefore, fourteen interviews were conducted in total. In the second Delphi round, a

questionnaire was electronically distributed among 24 procurers and 24 bidders, resulting in a panel of 48 experts.

3.5 Research Instruments

3.5.1 Distribution Methods

The first Delphi round was conducted through face-to-face interviews, and the second Delphi round was distributed electronically using Google Forms.

3.5.2 Pre survey/ Delphi Round 01

Pre survey of this research also acted as the first round of Delphi. Firstly, the pre-survey confirmed the problems and factors identified using existing studies in the area. It was essential to identify whether those engaged in the public procurement of IS in Sri Lanka also faced the same issues found in foreign literature.

Therefore, fourteen interviews in total were done with five procurers, five bidders, and four auditors. The interview questions consisted of both open-ended and closed-ended questions, and they were created using the factors identified through the literature survey (Appendix A). Questions were designed in such a manner that,

- i. Experts had to talk about their level of experience.
- ii. Experts had to brainstorm and identify limitations in existing public procurement procedures and mention preferred changes.
- iii. Experts were guided to identify problems faced under different aspects of public procurement of ICT infrastructure as identified through the literature survey, namely, tender specifications, bid-evaluation criteria, government regulations, collaboration among procurers and bidders, project management and competence of procurers. Afterwards, they had to come up with recommendations to overcome problems faced in each category.
- iv. Experts had to identify the reasons behind the partial or complete failure of projects they have participated in if there were such failures.

Pre survey and the first Delphi round were combined due to two reasons. The first reason being highlighting the problems and simultaneously asking for solutions proved

to be effective. It was understood that it was an excellent platform to motivate the experts to brainstorm and produce solutions to the problems listed in the interview questions. Experts tended to express their ideas about possible solutions to the listed problems without asking them to provide solutions. The second reason is to avoid panellists become frustrated and distracted due to being asked to comment on a similar topic multiple times. Doing so might make them lose interest in participating and view research-related activities as a waste of time.

3.5.3 Questionnaire Design/ Delphi Round 2

The questionnaire was designed under the main categories identified through the literature survey: tender specifications, bid-evaluation criteria, government regulations, collaboration among procurers and bidders, project management, and competence of procurers. There were another five questions under the "general" category to understand the general perspective of the experts. Recommendations given by experts in Delphi round 01 to overcome challenges were listed under each main category. There were 37 recommendations in total in the final questionnaire (Appendix B). Responses to these recommendations were gathered using a five-point Likert scale from strongly disagree to strongly agree. Q11 and Q15 were introduced as redundant questions to check the accuracy level of the responses. Table 3.1 presents survey questions under each main category.

Table 3.1: Questionnaire mapping table

Aspects of public procurement of ICT infrastructure	Number of questions	Related questions in the questionnaire
General	5	6, 7, 8, 9, 10
Tender specifications	6	11, 12, 13, 14, 15, 16
Bid-evaluation criteria	7	17, 18, 19, 20, 21, 22, 23
Government regulations	4	24, 25, 26, 27
Collaboration among procurers and bidders	5	28, 29, 30, 31, 32
Project management	4	33, 34, 35, 36
Competence of procurers	5	37, 38, 39, 40, 41, 42

Furthermore, there were five demographic-related questions to capture the age group, gender, occupation, years of experience, and the number of projects handled. The

questionnaire was distributed among twenty-four procurers and twenty-four bidders in electronic format using Google Forms. Altogether, the questionnaire was distributed among 48 experts, out of which 40 experts responded successfully.

3.6 Summary

A literature survey was conducted to identify stakeholders' problems in the public procurement of ICT infrastructure. The remainder of this research was done using the Modified Delphi method. The first round of Delphi was done using face-to-face interviews with a selected portion of the expert panel. Questions used in face-to-face interviews were formulated using the information gathered in the literature survey. Expert opinions on the solutions to the listed problems and problems encountered in their careers were then formulated into a close-ended questionnaire distributed in the second Delphi round to the full panel of experts. The next chapter presents the data analysis of the collected data in the first and second Delphi rounds.

4. Data Analysis

Section 4.1 presents the data collection method and participant profiles of the first Delphi round, while section 4.2 presents the qualitative analysis of data gathered in the first Delphi round using interviews. Section 4.3 illustrates the data collection of the second Delphi round using an online questionnaire, and Section 4.4 illustrates the descriptive analysis of responses gathered for the questionnaire. Section 4.5 presents the statistical analysis used to clarify the expertise of the Delphi panel. Finally, Section 4.6 presents the second Delphi round's statistical analysis, including consensus, importance ranking, and inter-group comparison.

4.1. Data collection of first Delphi round

Data collection of the first Delphi round was done in fourteen interviews with five procurers, five bidders, and four auditors. These interviews were considered as both the pre-survey and the first Delphi round. The list of interview questions is given in Appendix A. The set of questions was emailed to the participants a few days before the interviews. As there were twenty questions in total, sharing the interview questions beforehand allowed the participants to prepare for the interview. Table 4.1 presents the profiles of the interview participants. Each participant was assigned a master code to maintain their anonymity and for ease of content analysis.

Table 4.1: Participant profiles

	Master code	Designation	Years of experience
Procurer 1	IP1	Superintendent of Customs/ Head of ICT	20 years
Procurer 2	IP2	Director (Sri Lanka Administrative Service)	18 years
Procurer 3	IP3	Procurement and infrastructure specialist	10 years
Procurer 4	IP4	Project manager of a large national-level IS project	15 years
Procurer 5	IP5	Head of IT	15 years
Bidder 1	IB1	Head of public & government segment	15 years
Bidder 2	IB2	Lead consultant	15 years
Bidder 3	IB3	Business development manager	14 years

	Master code	Designation	Years of experience
Bidder 4	IB4	Chief executive officer	15 years
Bidder 5	IB5	General Manager	20 years
Auditor 1	IA1	Audit superintendent	-
Auditor 2	IA2	Audit superintendent	-
Auditor 3	IA3	Audit superintendent	-
Auditor 4	IA4	Audit superintendent	-

4.2. Presentation of qualitative analysis

During the interviews, auditors who participated seemed not very thorough with the research subject of IS procurement. Instead, they were only able to give an insight into the general nature of a government audit. Unlike the diverse opinions given by procurers and bidders, all four auditors bore similar opinions. They skipped the rest of the questions except “government regulations”, mentioning that they lacked the expertise to answer them. Therefore, the researcher decided to eliminate the group of auditors from the research sample in future work.

Data analysis of the first Delphi round was done as a qualitative analysis of interview data. First, the responses were analyzed to see whether the experts found similarities between the global challenges identified through the literature survey and the challenges they have faced in Sri Lanka. At the end of the interviews, two challenges were not accepted by any of the participants. The remaining challenges were identified to be present in the local context by at least one of the participants. The two challenges that were not accepted by any of the participants are,

1. The dilemma of creating specifications before procurement or as a part of the procurement process
2. Lack of feedback from unsuccessful bids

Therefore, these two challenges were removed from further analysis. It was also observed that the listed challenges and other factors helped the participants to recall their own experiences, which helped them to focus on the discussed topic with ease.

Afterwards, the interview participants came up with recommendations to overcome the remaining problems mentioned in the interview questions. There were many instances where multiple participants gave the same recommendation to overcome a specific problem. In such instances, a single recommendation was coded, representing the ideas of all the participants who mentioned that recommendation. Furthermore, there were unique recommendations given by single participants. These recommendations were also listed so that none of the ideas generated through the interviews was lost. Table 4.2. presents the list of recommendations generated under each main category, the frequency each recommendation was mentioned, and evidence in participants' own words.

Table 4.2: Presentation of qualitative analysis

	Theme	Recommendation	Frequency	Evidence
General	Lack of guidance provided by existing public procurement guidelines	The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS.	10	“The IT sector is very vast. Lack of guidelines is a big problem. Other procurement areas do not change, but the IT sector is very volatile. Existing procurement guidelines do not match IT procurement” (IP3) “Guidelines are outdated. Cannot be used for digitalization.” (IB5)
		The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.	10	“There should be a specialized procedure for ICT infrastructure procurement.” (IB3) “We cannot procure from a well-known brand. We cannot buy directly/ online. Those are not addressed in guidelines. Guidelines are not specialized for ICT infrastructure.” (IP4)

	Theme	Recommendation	Frequency	Evidence
	Implementing an e-procurement system	Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods.	4	“Online system should be there. Sealed quotations are old school. Payment systems should change. Should have the ability to pay online. E gov procurement should be there.” (IP3)
		Implementing an e-procurement system will facilitate international bidders to participate in a tender.	4	“Even international bidders can easily participate when there is an e-procurement system. They are already used to online systems.” (IP5)
	Consider IS procurement projects as national level projects	Information systems procurement should be considered projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.	6	“Elections delay procurement process and implementation process. Frequent changes of regulations are a problem.” (IP1) “Some projects are scrapped once a new government comes into power. These are projects with national interest. Lots of resources are wasted. Regulations should be put in place not to scrap national level IS projects” (IB5)

	Theme	Recommendation	Frequency	Evidence
Tender Specifications	The knowledge gap between procuring entity (PE) and bidder	PE to publish only functional requirements and let bidders architect solutions to match the requirement in complex IS procurement	8	“Bidders know the subject better than us. We should give them the chance to prepare tender specifications. We should only give high-level functional requirements” (IP2)
		If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies	4	“We as procurers have precise requirements. But it is difficult to understand what is available in the market to fulfil that requirement.” (IP1) “Yes. Detailed specifications are good if they are realistic. If you put out a detailed specification, then you should communicate with bidders beforehand to get an idea about existing technologies” (IB2) “Interaction with industry is very good. It is important to get to know about available solutions and latest technology” (IP4)
		In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.	1	“I think procuring a consultant upfront will help greatly to achieve the overall success of the project.” (IP3)

	Theme	Recommendation	Frequency	Evidence
	Select procurement method according to the complexity of the project	In a straightforward IS procurement, publishing clear cut functional and technical specifications ensures transparency and fair evaluation	5	“When buying off the shelf, vagueness might be disadvantageous to the supplier. It is better if specifications are detailed. Otherwise, you cannot go for a fair evaluation.” (IB1)
		In a complex IS procurement, publishing clear cut specifications will limit the bidder’s opportunity to present the best solution available in the market	6	“ When buying complex systems, explain the requirement without putting the exact specification. But that could be disadvantageous too. Not good for the day to day products.” (IB4)
Bid evaluation criteria	Selecting evaluation method	The two-stage bidding method is more suitable for complex information systems procurement as the price bid is considered only upon completion of the technical evaluation.	10	“Opening the technical bid first and pricing bid secondly is good.” (IP5) “Open the price bid only after selecting the best solution from the technical bids. Do not let the price be the deciding factor” (IB4)
		If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.	10	“We have to consider both quality and cost. Not just the price. Weights should be assigned.” (IP2) “This is what is addressed by the weighted system. Important in IS procurement. It is beneficial.” (IB2) “Least price leads them to supply a product that does not meet our requirement.” (IP4)

	Theme	Recommendation	Frequency	Evidence
	International standards	Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.	6	“We usually use international standards such as Gartner quadrants. But we should not seem biased. We should use first-class qualifications with worldwide recognition.” (IP1)
		International standards requested in bid-evaluation criteria should be pre-approved for public sector IS procurements to prevent bias to a particular bidder.	4	“Use only international standards that are previously approved. Sometimes these standards are used to grant undue advantage to a particular supplier.” (IB1)
		Procuring entities should justify the requirement of asking for each international standard.	3	“Procuring entities should be able to justify the reasons for asking for each certification. Otherwise, it can lead to unnecessary bias” (IB3)
	Bidder’s quality	The sustainability of the bidder should be addressed in the bid evaluation criteria.	5	“Quality/sustainability of the supplier should be given more consideration” (IP4)
		Bidder’s quality is not a significant factor if the procured item is a “product”, as manufacturers thoroughly test those “products” before releasing them to market.	1	“Products these days are thoroughly tested. So, no need of supplier’s quality.” (IP2)

	Theme	Recommendation	Frequency	Evidence
Complex government regulations	Strict regulations are mandatory	Strict regulations are mandatory in public sector procurements to ensure transparency.	9	“It is necessary to maintain transparency in government procurement. Therefore, regulations are necessary” (IP5) “Regulations are not a barrier. They should be there for public sector procurement” (IB1)
	Implementing an e-procurement system	Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process.	3	“Following the procurement procedure will be much easier if an e-procurement system was there” (IB3)
		Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.	3	“Things such as sealed quotations are not feasible now. Cloud solution providers communicate through email. But emails can arrive at different times, and people can manipulate them. That is why we need e-procurement systems.” (IP4)
	Use public procurement guidelines as a guide only	Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions.	2	“People from procurement entities are afraid to take decisions and try to pass the responsibility. They are worried that they will be unnecessarily penalized if they deviate from procurement guidelines. I think they should be able to freely make their decisions as long as they can justify those decisions”. (IB4)

	Theme	Recommendation	Frequency	Evidence
Collaboration among procurers and bidders	Communication between TEC and bidders	It will be useful and time-saving if a tender committee member can have a telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas.	3	“Sometimes, as TEC members, we need to clarify small things. We have to go through a whole process to get clarification. However, we should have the ability to communicate over the phone at least with a nominated person.” (IB2)
		The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received.	3	“Of course, the records should be kept of the whole conversation. Otherwise, people will manipulate such opportunities” (IP1)
		It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas.	4	“We cannot clarify things then and there. No one gives meetings. There are questions we cannot ask publicly due to their intellectual nature. We will lose our competitive edge. If we ask a question, the reply is forwarded to everyone.” (IB5)
		Appointed tender committee member should maintain written records of any such calls/emails received and points discussed.	4	“Appointed TEC member can keep records” (IB5)
	The Right to Information Act	The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.	6	“Bidders can ask for reasons according to the guidelines. Bidders have a right to ask. You can ask for anything under the RTI act.” (IP1)

	Theme	Recommendation	Frequency	Evidence
Project Management	Top management support	Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.	10	“Yes. Very important. Problem is not clear to them. They do not understand the weight. Less knowledge. Do not take the responsibility.” (IB1) “Top management should drive the project.” (IP1)
	Project champion	Apart from strong leadership, assigning an employee from the public sector entity as the project champion for IS procurement projects will ensure the successful implementation of such projects.	1	“Project champion is also a critical concept. Project champions can motivate the rest and drive projects to success.” (IP5)
	Follow project management methodology	Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.	10	“You must have a project management methodology for large projects.” (IB3) “Planning is essential for IT. We lose millions due to lack of planning.” (IP3)
	Complete feasibility study	Procuring entities should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.	10	“I have experiences of projects that failed due to lack of a feasibility study. Even though the procurement was done properly, other requirements such as land, support of stakeholders, and other infrastructure have been neglected.” (IP2) “Even though we plan everything else, projects have failed

	Theme	Recommendation	Frequency	Evidence
				due to lack of feasibility. It should be a must for the procuring entity to complete a feasibility study before starting the tender process”. (IB2)
Competence of procurers	Dedicated IT teams	Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.	8	“If you have a dedicated IT team, your projects are most successful. You know what you want. But most of the time people do not give proper requirements. At the end, the project becomes unsuccessful.” (IP4)
		Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.	9	“One of the main limitations is not identifying the requirements correctly. It will be useful if the requirement comes from actual users. They should be guided to present their requirements clearly.” (IB5)
	A single entity to handle IS procurement	It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest.	3	“Procurement officers are not properly trained. IT procurement needs skilled people. Procurement people need vast knowledge. Not having the proper people is the main issue. Procurements of more than 100 million should be handled by one entity. So there is no need to have large procurement teams everywhere.” (IP4)

	Theme	Recommendation	Frequency	Evidence
	Use of an IS procurement specialist	An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.	7	“Procurement is not their main job. Expertise is in different areas. Their main focus is something else. So, an IS procurement specialist with both IS and procurement knowledge should be assigned to work with them.” (IB4)
		These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in.	3	“Proper people with good skill level should be appointed to proper places. They should be held accountable for the success of the project. Project should be driven from the top level.” (IP1)
	TEC composition	There should be at least two people with technical knowledge in a tender committee for the procurement of information systems.	1	“Especially true for large projects. You should have comprehensive knowledge. In TEC, there should be at least two people with technical knowledge. (for complex projects)”. (IP4)

Finally, thirty-seven recommendations in total were generated through qualitative analysis. These recommendations were used to prepare the questionnaire for the second Delphi round.

4.3. Data collection of second Delphi round

Once thirty-seven recommendations were finalized using the first Delphi round, data collection of the second Delphi round was done through an online survey. Similar to the first Delphi round, experts from procuring entities and bidders participated in the online survey. However, auditors were removed from the research sample due to a lack of expertise in the research area. Delphi survey has an iterative process where multiple survey rounds are conducted until consensus among panellists is met.

Due to this iterative nature and required participants' expertise, an invitation letter to participate in the Delphi survey was distributed via email to potential panellists (Appendix B). Potential panellists were identified mainly through peer recommendations. The researcher contacted all potential panellists by telephone and explained the survey process to build a stronger relationship and increase the response rate. The experts who positively responded to the telephone conversation and the invitation letter and expressed interest in participating in the Delphi survey were selected as the second Delphi round participants.

The survey was distributed through email using Google Forms. Five demographic questions and the thirty-seven recommendations identified through round one were included in the online survey. Each recommendation's responses were measured using a 5-point Likert scale from strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. Values 1, 2, 3, 4, and 5 were assigned to these responses for coding purposes.

The questionnaire was distributed among 48 participants, consisting of 24 experts from procuring entities and 24 experts from private sector bidding companies. The researcher received 43 responses after two email reminder rounds and several reminders through telephone to some participants. There were 21 responses from public sector employees and 22 responses from private sector employees. Data cleansing was performed to verify the accuracy of the data. The data cleansing process was done manually, and three responses had to be removed after detecting random answers given to the two redundant questions. After the data cleansing process, the

data set was reduced to 40 responses, where 19 responses were from experts from procuring entities, and 21 were from experts from private sector bidding companies.

4.4. Descriptive analysis

A descriptive analysis is performed before the comprehensive analysis of the data. The following section illustrates the demographic analysis of the data.

4.4.1. Age

Figure 4.1 presents the age group distribution of the Delphi panel. The majority of the participants belonged to the 41-50 years group, which is 40% out of the total. It is closely followed by the 31-40 years group, which is at 37.5%. The age group of 51-60 years was 17.5%, while the minor percentage of 5% was 20-30 years. According to Table 4.3, only two participants out of 40 were from the 20-30 years group. This reduced participation of the 20-30 years group may be because only the experts in the subject area participated in the survey. It may require several years to gather a level of expertise in the subject area.

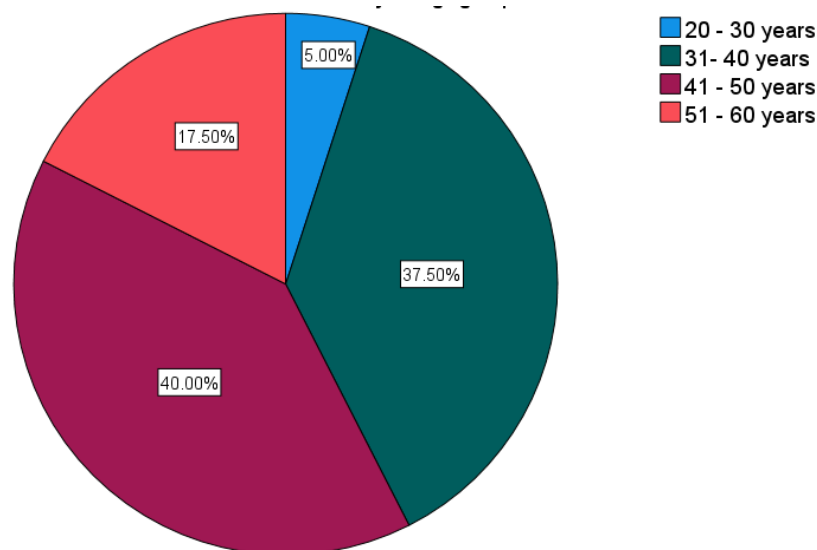


Figure 4.1: Age groups of Delphi panellists

Table 4.3: Age groups of Delphi panellists

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 - 30 years	2	5.0	5.0	5.0
	31- 40 years	15	37.5	37.5	42.5
	41 - 50 years	16	40.0	40.0	82.5
	51 - 60 years	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

4.4.2. Gender

Figure 4.2 and Table 4.4 illustrate the gender distribution among the Delphi panellists. According to the figure, 75% of the respondents were male, while only 25% were female. According to the table, 30 out of 40 participants were male, while only 10 out of 40 participants were female.

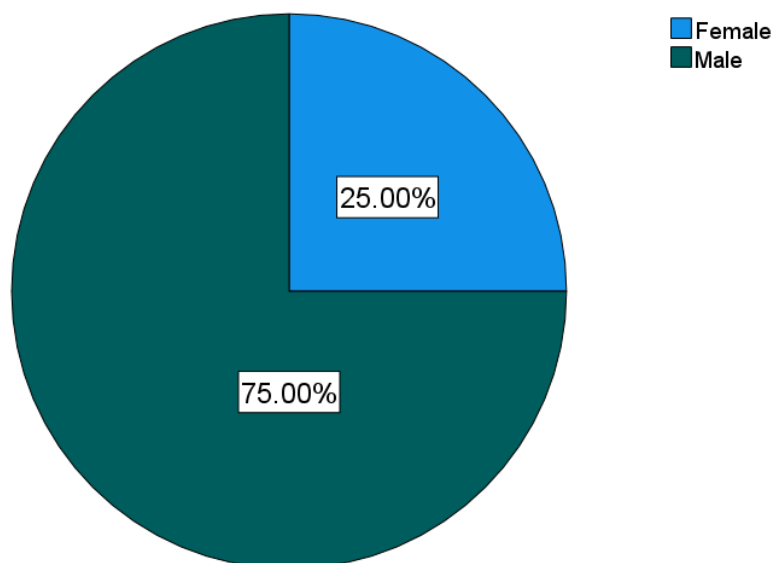


Figure 4.2: Gender of Delphi panellists

Table 4.4: Gender of Delphi panellists

		Frequency	Percent	Valid Percent	Percent
Valid	Female	10	25.0	25.0	25.0
	Male	30	75.0	75.0	100.0
	Total	40	100.0	100.0	

4.4.3. Occupation

The survey was distributed among experts from both the public sector and the private sector. After data cleansing, 40 responses were considered for data analysis. Figure 4.3 and Table 4.5 illustrate the distribution of public and private sector employees within the dataset. The majority of the employees were from private sector companies who bid for IS tenders of the public sector, 52.5%, and 21 out of 40 participants. It is closely followed by employees who are/ were employees of public sector procuring entities which is 47.5% out of the total and 19 participants out of 40. Two responses from public sector employees and one from a private sector employee had to be removed during the data cleansing process due to random answers given to the two redundant questions.

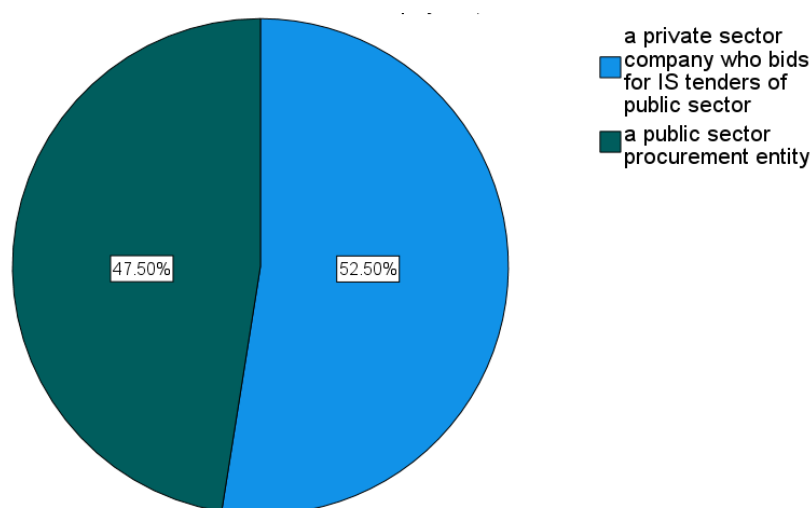


Figure 4.3: Occupation of Delphi panellists

Table 4 5: Occupation of Delphi panellists

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a private sector company who bids for IS tenders of public sector	21	52.5	52.5	52.5
	a public sector procurement entity	19	47.5	47.5	100.0
	Total	40	100.0	100.0	

4.4.4. Years of experience in public procurement

A Delphi survey is used to gather expert opinions on a particular matter. Therefore, the expertise of the Delphi panel was an essential factor in this survey. According to the literature, one of the main factors that decide a Delphi survey's success is selecting the correct expertise. Therefore, the literature advises predefining the level of expertise required to ensure the successful execution of the Delphi survey. Initially, it was decided to recruit panellists with more than 05 years of experience in public procurement of IS and has handled more than 05 projects during their careers.

Figure 4.4 and Table 4.6 illustrate the number of years of experience panellists had in the public procurement of IS. It is observed that 27.5% of the panellists had 6 to 10 years of experience, 20% of the panellists had 11 to 15 years of experience, and 25% had more than 15 years of experience. The cumulative percentage of panellists who had more than five years of experience is 72.5%. However, it should be noted that 27.5% of the panellists only had 0-5 years of experience, which created the dilemma of whether to consider them as experts or not.

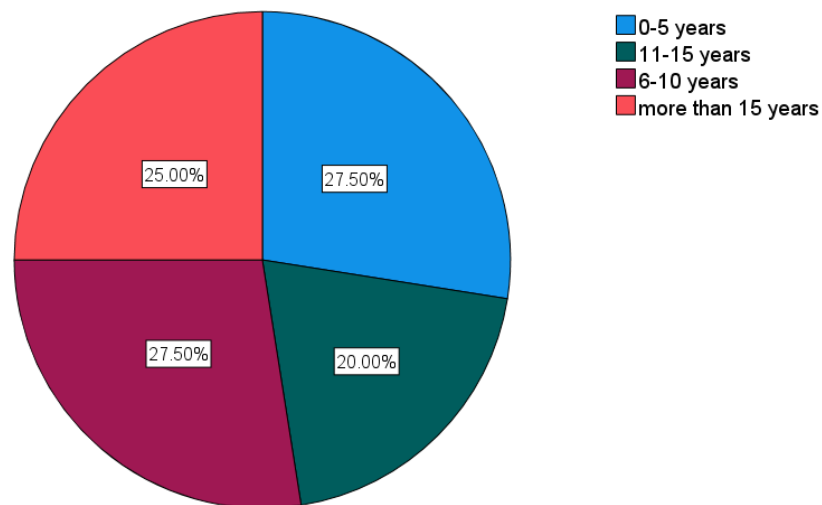


Figure 4.4: Years of experience in public procurement

Table 4.6: Years of experience in public procurement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 years	11	27.5	27.5	27.5
	11-15 years	8	20.0	20.0	47.5
	6-10 years	11	27.5	27.5	75.0
	more than 15 years	10	25.0	25.0	100.0
	Total	40	100.0	100.0	

4.4.5. Number of projects

The number of projects each expert has handled is another variable used to measure the Delphi panel's level of expertise. Figure 4.5 and Table 4.7 illustrate the number of IS procurement projects the Delphi panellists have engaged in during their careers. It is observed that a majority of 60% out of the total have handled more than ten projects. 17.5% of the panel has handled 6 to 10 projects. Therefore, a cumulative of 77.5% has handled more than six projects that satisfy one of the conditions considered an expert in this survey. However, it should be noted that 22.5% of the panellists, which is 9 out of 40 panellists, have experience in handling only 0-5 projects. Again the dilemma of whether to consider them as experts arise at this point.

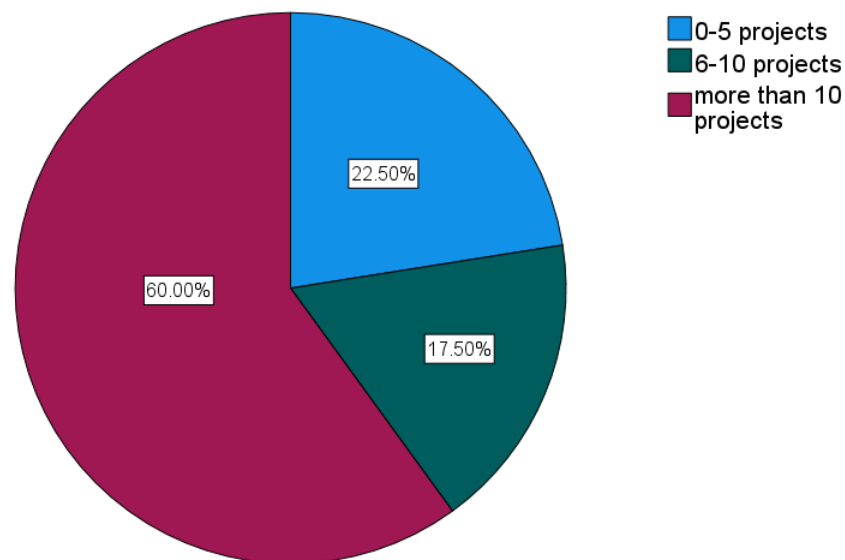


Figure 4.5: Number of projects handled by Delphi panellists

Table 4.7: Number of projects handled by Delphi panellists

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 projects	9	22.5	22.5	22.5
	6-10 projects	7	17.5	17.5	40.0
	more than 10 projects	24	60.0	60.0	100.0
	Total	40	100.0	100.0	

4.5. Statistical analysis to clarify expertise of 0-5 years of experience/ 0-5 projects group.

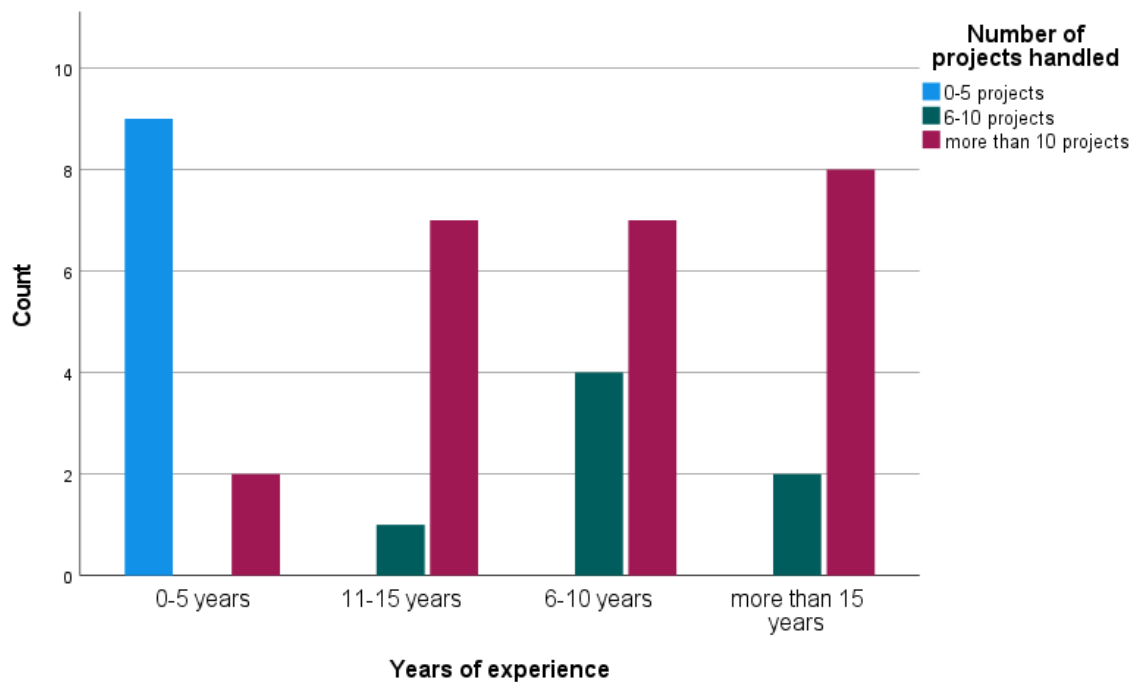


Figure 4.6: Number of projects vs years of experience

According to Figure 4.6, there were two responses where the panellist had only 0-5 years of experience yet has handled more than ten projects. It was decided to recognize these two responses as expert opinions owing to the high number of projects handled. A decision had to be made whether to include the nine responses from Delphi panellists who had only 0-5 years of experience and have handled only 0-5 projects. Therefore, the Mann-Whitney U test was used to test whether a significant difference existed between the responses of these nine panellists and the rest.

Mann-Whitney U test

Mann-Whitney U test, also known as the Wilcoxon rank-sum test, is used to determine differences between two groups when the variables are ordinal, and the distribution is not normal. Therefore, this method was used to determine whether the 0-5 projects group's responses differed significantly from the rest of the Delphi panel. The data set was first divided into two groups as 0-5 projects and more than six projects. After that,

the two groups were compared using the Mann-Whitney U test function of SPSS software. The significance level was 0.05, and if the significance level for each variable was greater than 0.05, it could be decided that there is no significant difference between responses given by the two groups. Table 4.8 illustrates the 37 recommendations and whether the two groups have answered similarly or differently to each recommendation.

Table 4.8: Hypothesis test summary of Mann-Whitney U test

	Null Hypothesis	Sig.^{a,b}	Decision
1	The distribution of 6. The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS. is the same across categories of projects.	.321 ^c	Retain the null hypothesis.
2	The distribution of 7. The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka. is the same across categories of projects.	.824 ^c	Retain the null hypothesis.
3	The distribution of 8. Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods. is the same across categories of projects.	.874 ^c	Retain the null hypothesis.
4	The distribution of 9. Implementing an e-procurement system will facilitate international bidders to participate in a tender. is the same across categories of projects.	.223 ^c	Retain the null hypothesis.
5	The distribution of 10. Information systems procurement should be considered as projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party. is the same across categories of projects.	.406 ^c	Retain the null hypothesis.
6	The distribution of 11. In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements. is the same across categories of projects.	.775 ^c	Retain the null hypothesis.

	Null Hypothesis	Sig.^{a,b}	Decision
7	The distribution of 12. In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all. is the same across categories of projects.	.444 ^c	Retain the null hypothesis.
8	The distribution of 13. In a complex IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market. is the same across categories of projects.	.975 ^c	Retain the null hypothesis.
9	The distribution of 14. If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies is the same across categories of projects.	.524 ^c	Retain the null hypothesis.
10	The distribution of 15. Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement. is the same across categories of projects.	.021 ^c	Reject the null hypothesis.
11	The distribution of 16. In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project. is the same across categories of projects.	.075 ^c	Retain the null hypothesis.
12	The distribution of 17. The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation. is the same across categories of projects.	.043 ^c	Reject the null hypothesis.
13	The distribution of 18. If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price. is the same across categories of projects.	.702 ^c	Retain the null hypothesis.
14	The distribution of 19. Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful. is the same across categories of projects.	.750 ^c	Retain the null hypothesis.

	Null Hypothesis	Sig.^{a,b}	Decision
15	The distribution of 20. International standards requested in bid-evaluation criteria should be pre-approved to be used in public sector IS procurements to prevent bias to a particular bidder. is the same across categories of projects.	.726 ^c	Retain the null hypothesis.
16	The distribution of 21. Procuring entity should justify the requirement of asking for each international standard. is the same across categories of projects.	.463 ^c	Retain the null hypothesis.
17	The distribution of 22. The sustainability of the bidder should be addressed in the bid evaluation criteria. is the same across categories of projects.	.503 ^c	Retain the null hypothesis.
18	The distribution of 23. Bidder's quality is not a very significant factor if the procured item is a "product", as manufacturers thoroughly test those "products" before releasing them to market. is the same across categories of projects.	.975 ^c	Retain the null hypothesis.
19	The distribution of 24. Strict regulations are mandatory in public sector procurements to ensure transparency. is the same across categories of projects.	.799 ^c	Retain the null hypothesis.
20	The distribution of 25. Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process. is the same across categories of projects.	.503 ^c	Retain the null hypothesis.
21	The distribution of 26. Implementing an e-procurement system will facilitate both parties to use technology such as using email instead of sealed envelopes and e-payments instead of traditional payments. is the same across categories of projects.	.799 ^c	Retain the null hypothesis.
22	The distribution of 27. Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions. is the same across categories of projects.	.223 ^c	Retain the null hypothesis.
23	The distribution of 28. It will be useful and time-saving if a tender committee member can have a telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas of a submitted bid. is the same across categories of projects.	.075 ^c	Retain the null hypothesis.

	Null Hypothesis	Sig.^{a,b}	Decision
24	The distribution of 29. The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received. is the same across categories of projects.	.874 ^c	Retain the null hypothesis.
25	The distribution of 30. It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas of a published tender. is the same across categories of projects.	.702 ^c	Retain the null hypothesis.
26	The distribution of 31. Appointed member of the procuring entity should maintain written records of any such calls/emails received and points discussed. is the same across categories of projects.	.949 ^c	Retain the null hypothesis.
27	The distribution of 32. The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement. is the same across categories of projects.	.824 ^c	Retain the null hypothesis.
28	The distribution of 33. Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects. is the same across categories of projects.	.003 ^c	Reject the null hypothesis.
29	The distribution of 34. Apart from strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects. is the same across categories of projects.	.031 ^c	Reject the null hypothesis.
30	The distribution of 35. Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end. is the same across categories of projects.	.610 ^c	Retain the null hypothesis.
31	The distribution of 36. Procuring entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process. is the same across categories of projects.	.545 ^c	Retain the null hypothesis.
32	The distribution of 37. Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects. is the same across categories of projects.	.633 ^c	Retain the null hypothesis.

	Null Hypothesis	Sig.^{a,b}	Decision
33	The distribution of 38. Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively. is the same across categories of projects.	.899 ^c	Retain the null hypothesis.
34	The distribution of 39. It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest. is the same across categories of projects.	.463 ^c	Retain the null hypothesis.
35	The distribution of 40. An IS procurement specialist with both IS and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes. is the same across categories of projects.	.503 ^c	Retain the null hypothesis.
36	The distribution of 41. These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in. is the same across categories of projects.	.975 ^c	Retain the null hypothesis.
37	The distribution of 42. There should be at least two people with technical knowledge in a tender committee for the procurement of information systems. is the same across categories of projects.	.726 ^c	Retain the null hypothesis.

It was observed that both groups responded similarly to 33 out of 37 recommendations. There were only four recommendations where the 0-5 project groups responded significantly different from the rest. According to table 4.8, only four recommendations have significance levels less than 0.05, resulting in the rejected null hypothesis. Therefore, it was decided to consider the opinion of the 0-5 projects group as an expert opinion, and all 40 responses will be used in future data analysis.

4.6. Statistical analysis of Delphi round 02

Level of consensus - According to the literature, pre-defining the expected level of consensus is a characteristic of a good Delphi study. The iterative Delphi process is stopped once the desired consensus level is met. The level of consensus expected in this study was pre-defined as a percentage agreement of 70%.

Level of agreement- The level of the agreement will be determined by the cumulative percentage values of Agree and Strongly Agree.

Response rate - The second Delphi round questionnaire was distributed among 48 panellists from the public and private sectors. Out of 48 panellists, 43 members successfully responded to the questionnaire after two reminder rounds. Therefore, a response rate of 89.6% was achieved.

After receiving the responses, the data cleansing process removed three more responses from the data set. The remaining 40 responses were used to set up an SPSS database to analyse data collected in round 2. Each recommendation was considered a variable in SPSS. Responses for all the variables were inserted into the SPSS database against a unique master code assigned for each expert.

After inserting all the data into SPSS, frequencies were run on the data set to determine the percentage of responses received under the Likert scale for every recommendation. This was done to identify the recommendations that have reached the 70% level of consensus after the second Delphi round. Bar graphs were also generated using SPSS to understand how the expert panel responded to each recommendation

4.6.1. Consensus Measurement

The following tables illustrate frequency output for each recommendation sent out in Delphi round 2. Bar graphs illustrate the count of responses received for each level from strongly disagree to strongly agree.

1. Recommendation 01 - The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS.

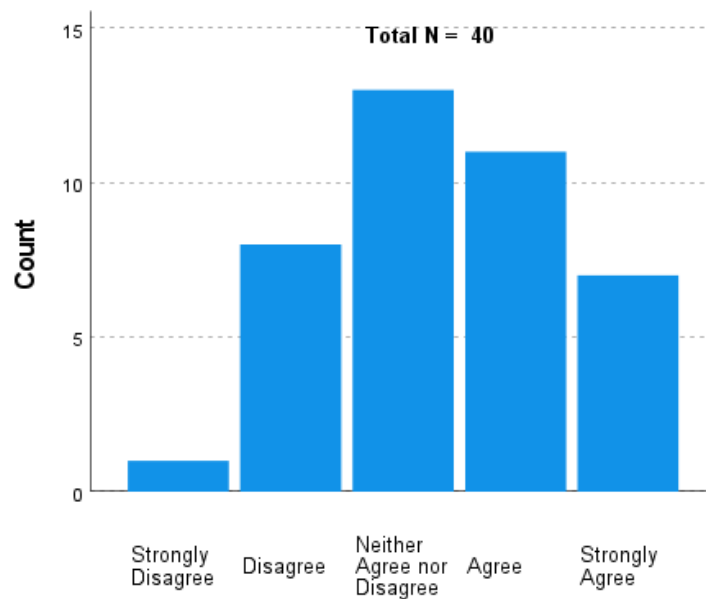


Figure 4.7: Responses for recommendation 01

Table 4.9: Frequency response for recommendation 01

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	8	20.0	20.0	22.5
	Neither Agree nor Disagree	13	32.5	32.5	55.0
	Agree	11	27.5	27.5	82.5
	Strongly Agree	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

Table 4.9 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 27.5% of the experts responded “agree”, and

17.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 45%.

2. Recommendation 02 -

The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.

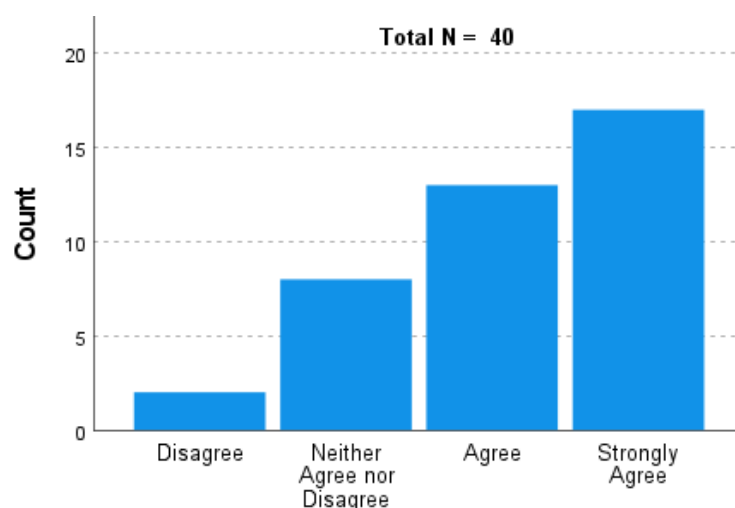


Figure 4.8: Responses for recommendation 2

Table 4.10: Frequency response for recommendation 02

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	8	20.0	20.0	25.0
	Agree	13	32.5	32.5	57.5
	Strongly Agree	17	42.5	42.5	100.0
	Total	40	100.0	100.0	

Table 4.10 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 32.5% of the experts responded “agree”, and 42.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 75%.

3. Recommendation 03 -

Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods.

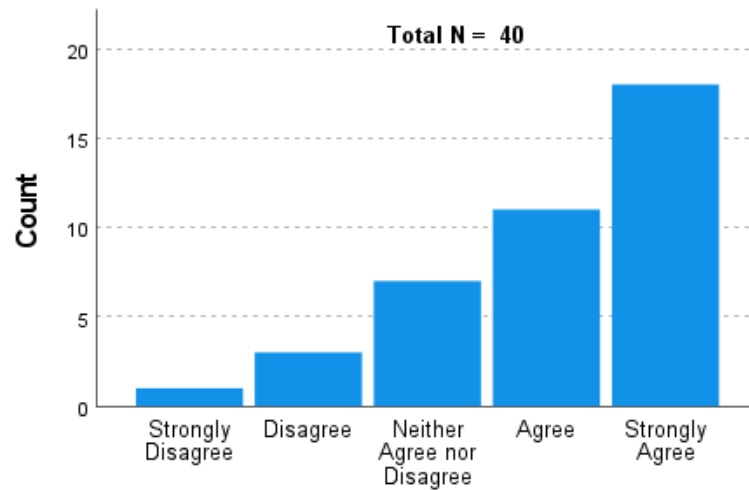


Figure 4.9: Responses for recommendation 3

Table 4.11: Frequency response for recommendation 03

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	3	7.5	7.5	10.0
	Neither Agree nor Disagree	7	17.5	17.5	27.5
	Agree	11	27.5	27.5	55.0
	Strongly Agree	18	45.0	45.0	100.0
	Total	40	100.0	100.0	

Table 4.11 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 27.5% of the experts responded as “agree”, and 45% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 72.5%.

4. Recommendation 04 -

Implementing an e-procurement system will facilitate international bidders to participate in a tender.

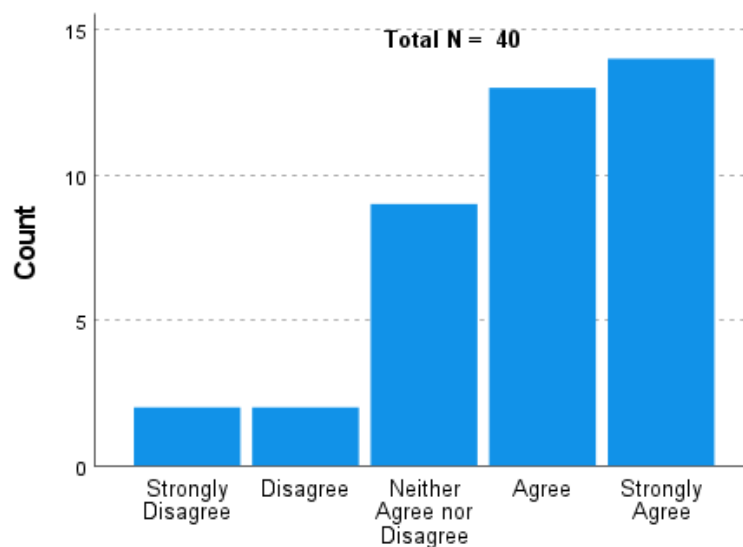


Figure 4.10: Responses for recommendation 4

Table 4.12: Frequency response for recommendation 04

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.0	5.0	5.0
	Disagree	2	5.0	5.0	10.0
	Neither Agree nor Disagree	9	22.5	22.5	32.5
	Agree	13	32.5	32.5	65.0
	Strongly Agree	14	35.0	35.0	100.0
	Total	40	100.0	100.0	

Table 4.12 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 32.5% of the experts responded “agree”, and 35% responded, “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 67.5%.

5. Recommendation 05 -

Information systems procurement should be considered as projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.

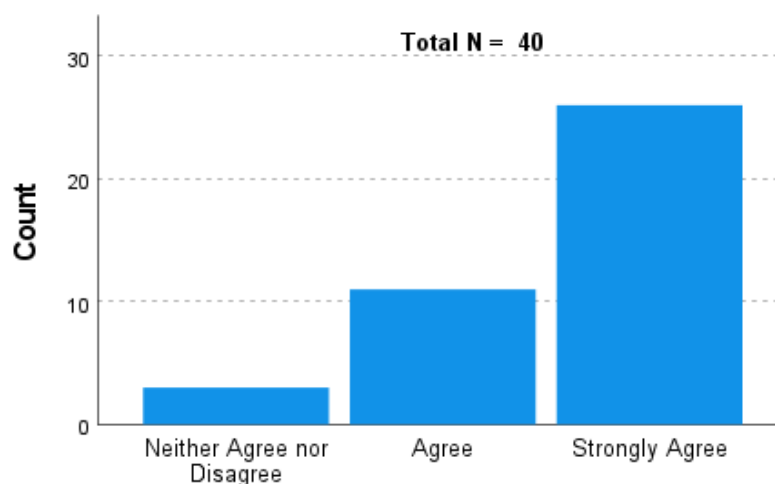


Figure 4.11: Responses for recommendation 5

Table 4.13: Frequency response for recommendation 05

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	3	7.5	7.5	7.5
	Agree	11	27.5	27.5	35.0
	Strongly Agree	26	65.0	65.0	100.0
	Total	40	100.0	100.0	

Table 4.13 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 27.5% of the experts responded “agree”, and 65% responded, “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 92.5%.

6. Recommendation 06 -

In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements.

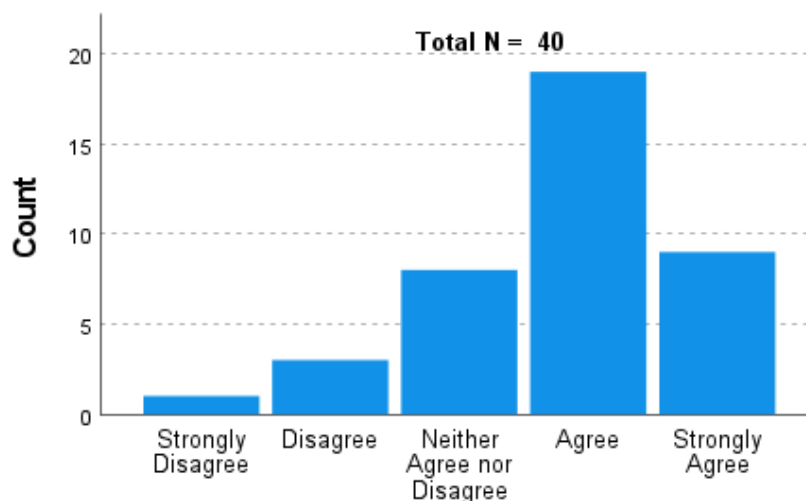


Figure 4.12: Responses for recommendation 6

Table 4.14: Frequency response for recommendation 06

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	3	7.5	7.5	10.0
	Neither Agree nor Disagree	8	20.0	20.0	30.0
	Agree	19	47.5	47.5	77.5
	Strongly Agree	9	22.5	22.5	100.0
	Total	40	100.0	100.0	

Table 4.14 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 47.5% of the experts responded “agree”, and 22.5% responded, “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 70%.

7. Recommendation 07 -

In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all.

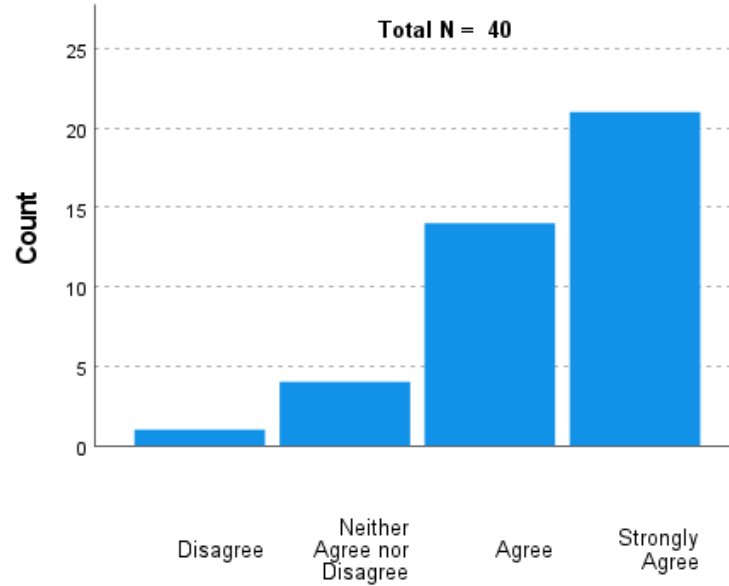


Figure 4.13: Responses for recommendation 07

Table 4.15: Frequency response for recommendation 07

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	4	10.0	10.0	12.5
	Agree	14	35.0	35.0	47.5
	Strongly Agree	21	52.5	52.5	100.0
	Total	40	100.0	100.0	

Table 4.15 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 35% of the experts responded “agree”, and 52.5% responded, “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 87.5%.

8. Recommendation 08 -

In a complex IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market.

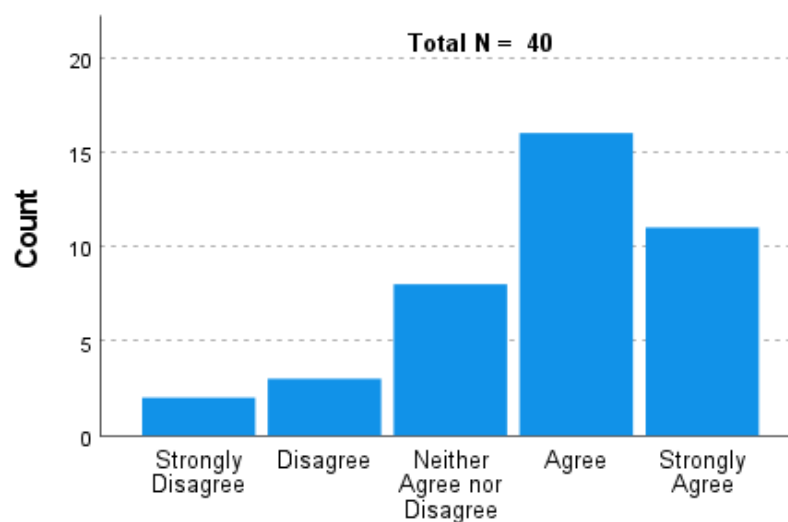


Figure 4.14: Responses for recommendation 08

Table 4.16: Frequency response for recommendation 08

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.0	5.0	5.0
	Disagree	3	7.5	7.5	12.5
	Neither Agree nor Disagree	8	20.0	20.0	32.5
	Agree	16	40.0	40.0	72.5
	Strongly Agree	11	27.5	27.5	100.0
	Total	40	100.0	100.0	

Table 4.16 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 40% of the experts responded “agree”, and 27.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 67.5%.

9. Recommendation 09 -

If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies.

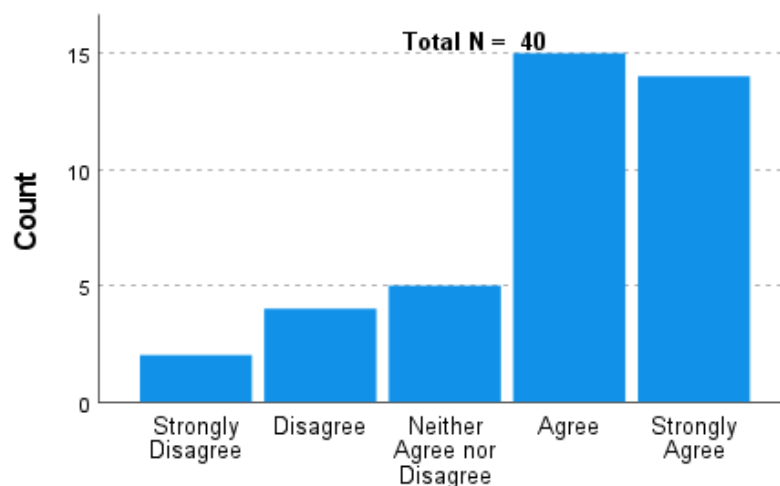


Figure 4.15: Responses for recommendation 09

Table 4.17: Frequency response for recommendation 09

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.0	5.0	5.0
	Disagree	4	10.0	10.0	15.0
	Neither Agree nor Disagree	5	12.5	12.5	27.5
	Agree	15	37.5	37.5	65.0
	Strongly Agree	14	35.0	35.0	100.0
	Total	40	100.0	100.0	

Table 4.17 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 37.5% of the experts responded “agree”, and 35% responded, “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 72.5%.

10. Recommendation 10 -

Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement.

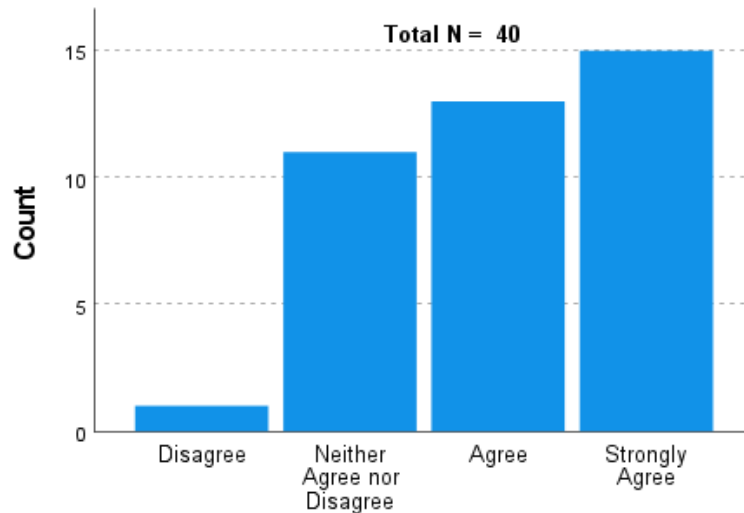


Figure 4.16: Responses for recommendation 10

Table 4.18: Frequency response for recommendation 10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	11	27.5	27.5	30.0
	Agree	13	32.5	32.5	62.5
	Strongly Agree	15	37.5	37.5	100.0
	Total	40	100.0	100.0	

Table 4.18 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 32.5% of the experts responded “agree”, and 37.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 70%.

11. Recommendation 11 -

In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.

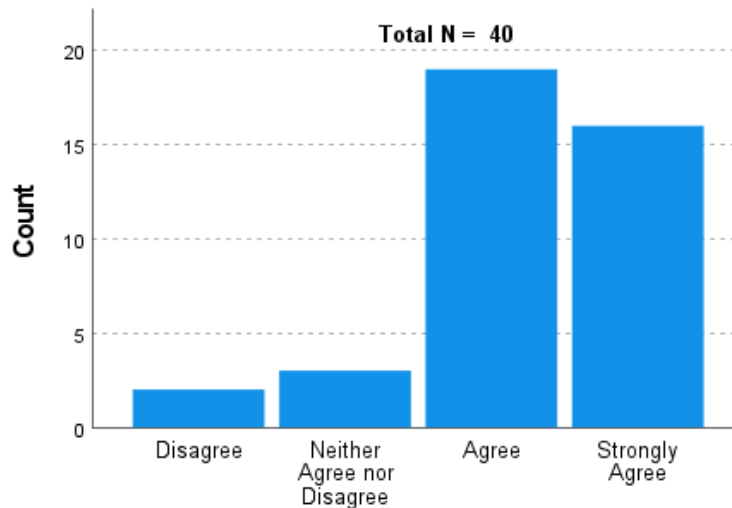


Figure 4.17: Responses for recommendation 11

Table 4.19: Frequency response for recommendation 11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	3	7.5	7.5	12.5
	Agree	19	47.5	47.5	60.0
	Strongly Agree	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Table 4.19 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 47.5% of the experts responded “agree”, and 40% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 87.5%.

12. Recommendation 12 -

The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation.

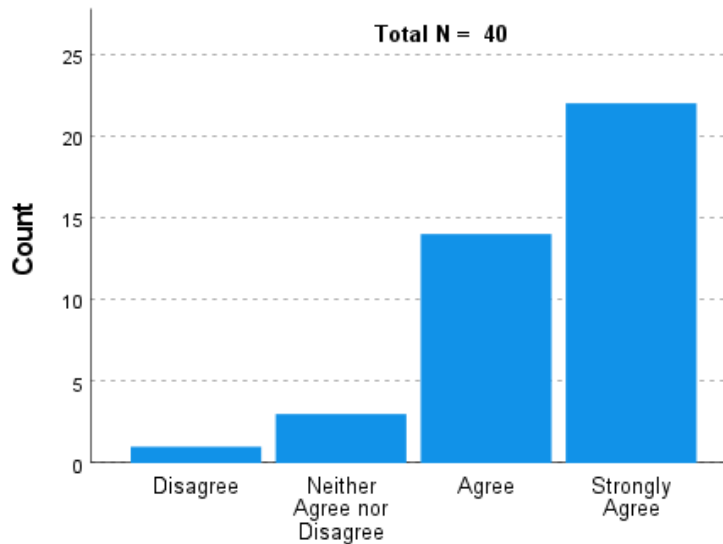


Figure 4.18: Responses for recommendation 12

Table 4.20: Frequency response for recommendation 12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	3	7.5	7.5	10.0
	Agree	14	35.0	35.0	45.0
	Strongly Agree	22	55.0	55.0	100.0
	Total	40	100.0	100.0	

Table 4.20 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 35% of the experts responded “agree”, and 55% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 90%.

13. Recommendation 13 -

If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.

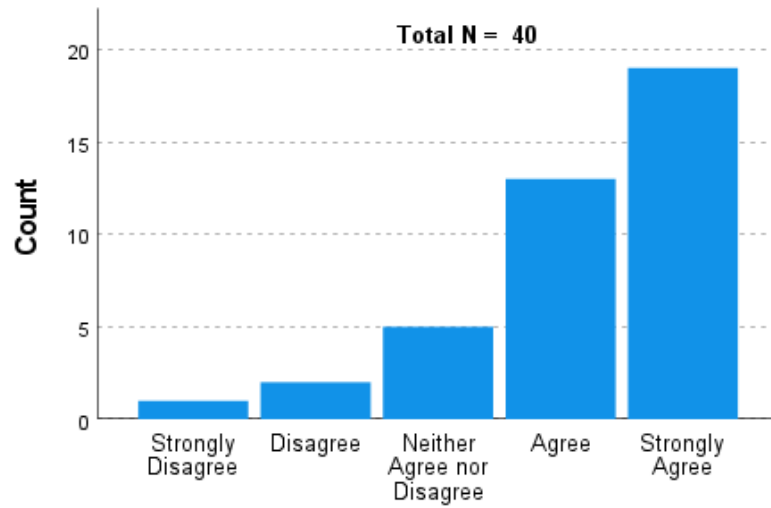


Figure 4.19: Responses for recommendation 13

Table 4.21: Frequency response for recommendation 13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	2	5.0	5.0	7.5
	Neither Agree nor Disagree	5	12.5	12.5	20.0
	Agree	13	32.5	32.5	52.5
	Strongly Agree	19	47.5	47.5	100.0
	Total	40	100.0	100.0	

Table 4.21 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 32.5% of the experts responded “agree”, and 47.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 80%.

14. Recommendation 14 -

Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.

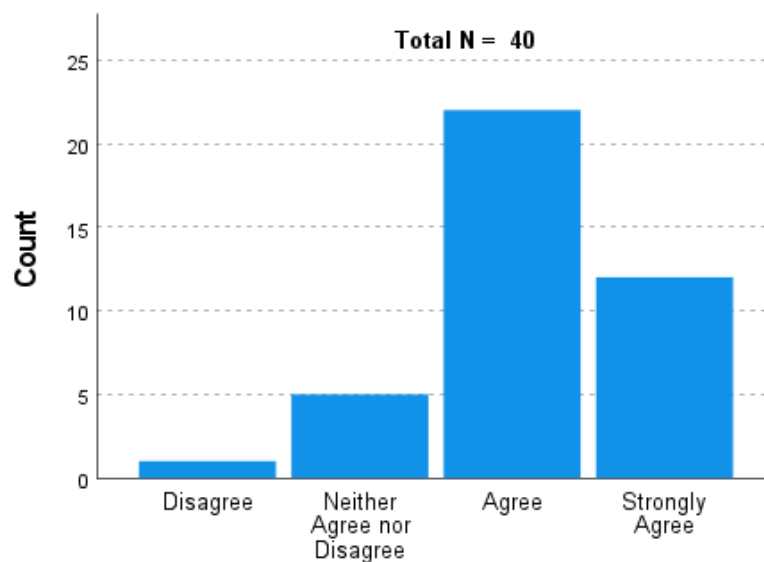


Figure 4.20: Responses for recommendation 14

Table 4.22: Frequency response for recommendation 14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	5	12.5	12.5	15.0
	Agree	22	55.0	55.0	70.0
	Strongly Agree	12	30.0	30.0	100.0
	Total	40	100.0	100.0	

Table 4.22 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 55% of the experts responded “agree”, and 30% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 85%.

15. Recommendation 15 -

International standards requested in bid-evaluation criteria should be pre-approved to be used in public sector IS procurements to prevent bias to a particular bidder.

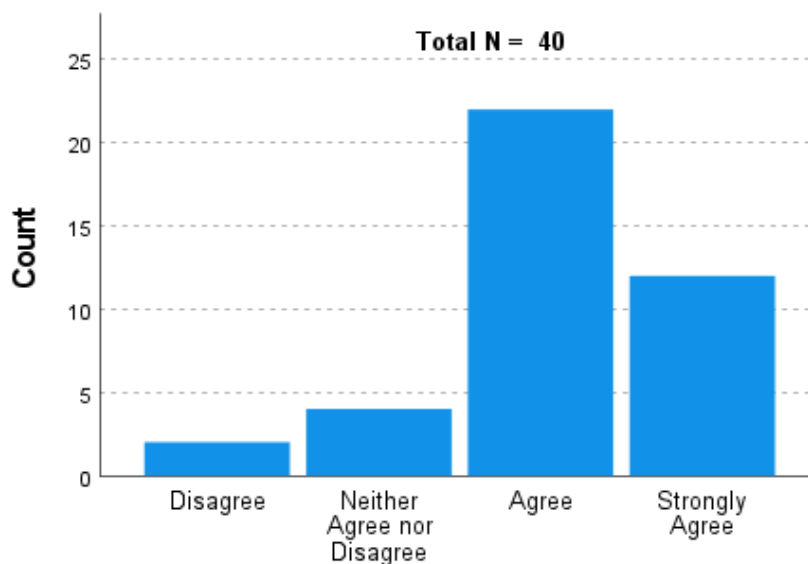


Figure 4.21: Responses for recommendation 15

Table 4.23: Frequency response for recommendation 15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	4	10.0	10.0	15.0
	Agree	22	55.0	55.0	70.0
	Strongly Agree	12	30.0	30.0	100.0
	Total	40	100.0	100.0	

Table 4.23 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 55% of the experts responded “agree”, and 30% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 85%.

16. Recommendation 16 -

Procuring entities should justify the requirement of asking for each international standard.

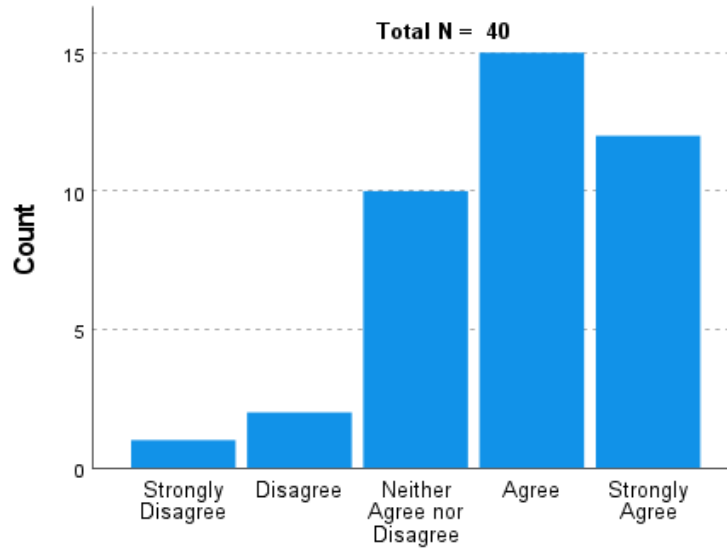


Figure 4.22: Responses for recommendation 16

Table 4.24: Frequency response for recommendation 16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	2	5.0	5.0	7.5
	Neither Agree nor Disagree	10	25.0	25.0	32.5
	Agree	15	37.5	37.5	70.0
	Strongly Agree	12	30.0	30.0	100.0
	Total	40	100.0	100.0	

Table 4.24 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 37.5% of the experts responded “agree”, and 30% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 67.5%.

17. Recommendation 17 -

The sustainability of the bidder should be addressed in the bid evaluation criteria.

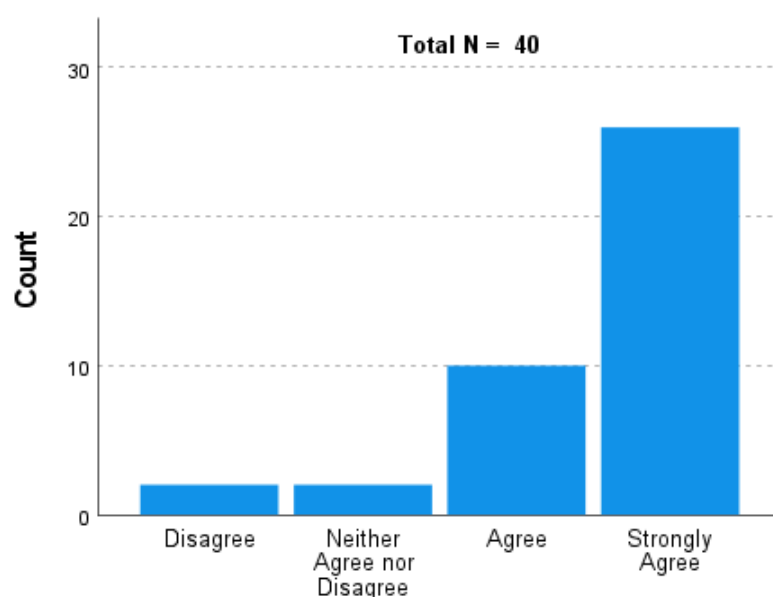


Figure 4.23: Responses for recommendation 17

Table 4.25: Frequency response for recommendation 17

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	2	5.0	5.0	10.0
	Agree	10	25.0	25.0	35.0
	Strongly Agree	26	65.0	65.0	100.0
	Total	40	100.0	100.0	

Table 4.25 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 25% of the experts responded “agree”, and 65% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 90%.

18. Recommendation 18 -

Bidder's quality is not a very significant factor if the procured item is a "product", as manufacturers thoroughly test those "products" before releasing them to market.

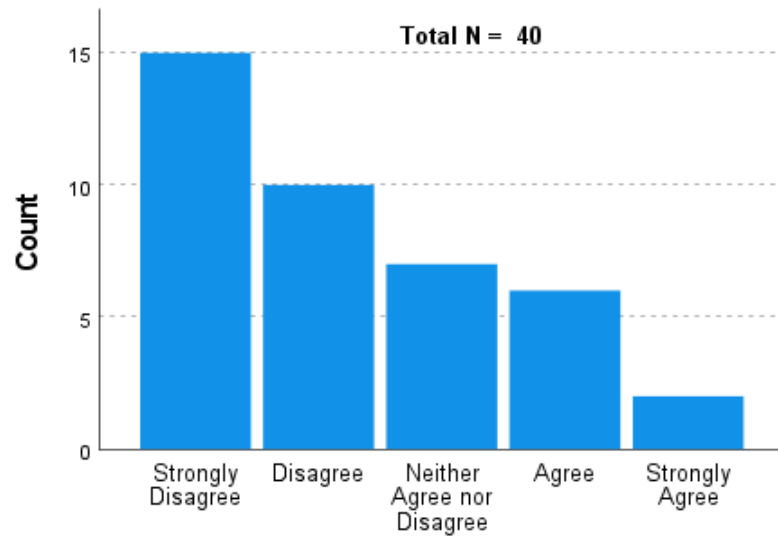


Figure 4.24: Responses for recommendation 18

Table 4.26: Frequency response for recommendation 18

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	37.5	37.5	37.5
	Disagree	10	25.0	25.0	62.5
	Neither Agree nor Disagree	7	17.5	17.5	80.0
	Agree	6	15.0	15.0	95.0
	Strongly Agree	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

Table 4.26 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 15% of the experts responded "agree", and 5% responded "strongly agree". Therefore, the cumulative level of agreement for this recommendation is 20%.

19. Recommendation 19 -

Strict regulations are mandatory in public sector procurements to ensure transparency.

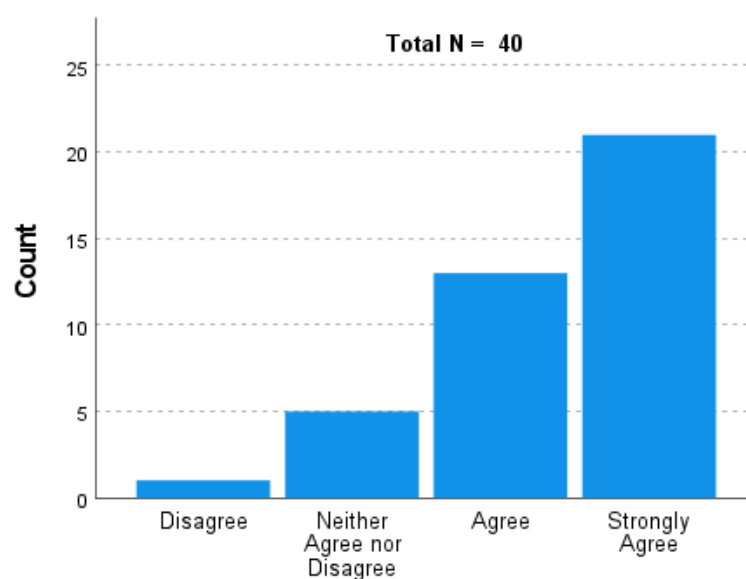


Figure 4.25: Responses for recommendation 19

Table 4.27: Frequency response for recommendation 19

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	5	12.5	12.5	15.0
	Agree	13	32.5	32.5	47.5
	Strongly Agree	21	52.5	52.5	100.0
	Total	40	100.0	100.0	

Table 4.27 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 32.5% of the experts responded “agree”, and 52.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 85%.

20. Recommendation 20 -

Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process.

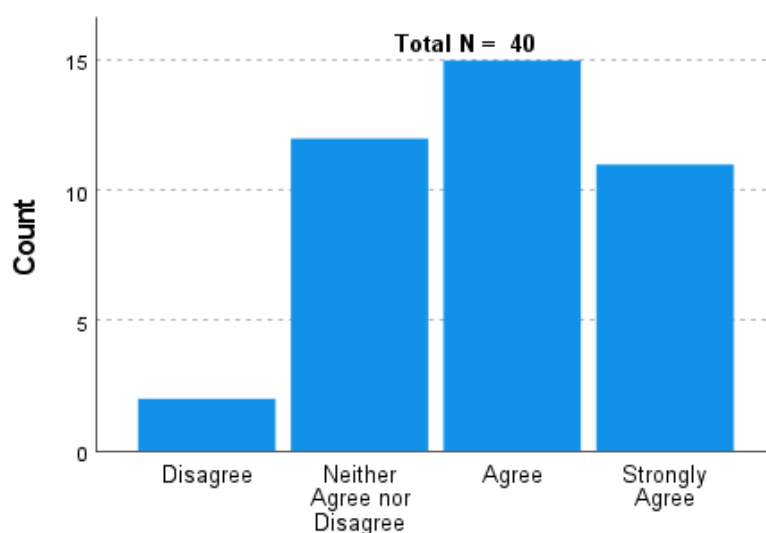


Figure 4.26: Responses for recommendation 20

Table 4.28: Frequency response for recommendation 20

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	12	30.0	30.0	35.0
	Agree	15	37.5	37.5	72.5
	Strongly Agree	11	27.5	27.5	100.0
	Total	40	100.0	100.0	

Table 4.28 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 37.5% of the experts responded “agree”, and 27.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 65%.

21. Recommendation 21 -

Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.

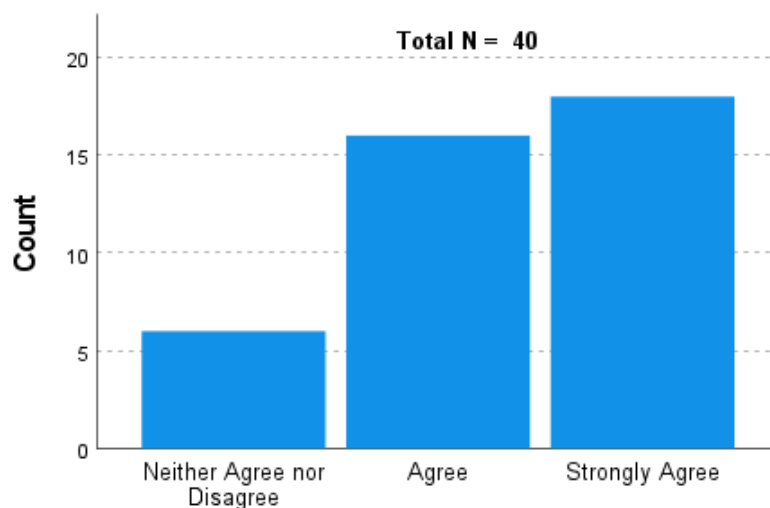


Figure 4.27: Responses for recommendation 21

Table 4.29: Frequency response for recommendation 21

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	6	15.0	15.0	15.0
	Agree	16	40.0	40.0	55.0
	Strongly Agree	18	45.0	45.0	100.0
	Total	40	100.0	100.0	

Table 4.29 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 40% of the experts responded “agree”, and 45% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 85%.

22. Recommendation 22 -

Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions.

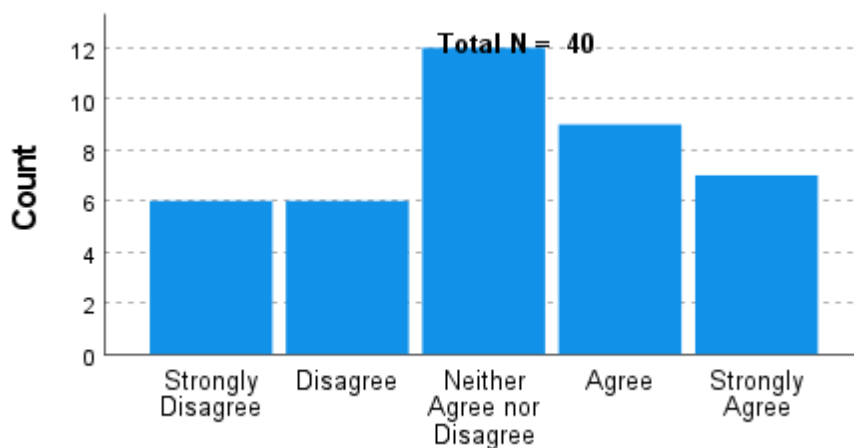


Figure 4.28: Responses for recommendation 22

Table 4.30: Frequency response for recommendation 22

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	15.0	15.0	15.0
	Disagree	6	15.0	15.0	30.0
	Neither Agree nor Disagree	12	30.0	30.0	60.0
	Agree	9	22.5	22.5	82.5
	Strongly Agree	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

Table 4.30 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 22.5% of the experts responded “agree”, and 17.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 40%.

23. Recommendation 23 -

It will be useful and time-saving if a tender committee member can have a telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas of a submitted bid.

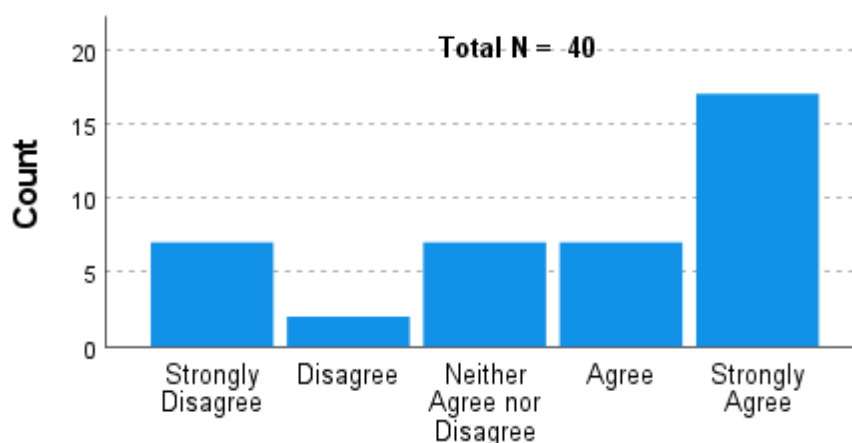


Figure 4.29: Responses for recommendation 23

Table 4.31: Frequency response for recommendation 23

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	17.5	17.5	17.5
	Disagree	2	5.0	5.0	22.5
	Neither Agree nor Disagree	7	17.5	17.5	40.0
	Agree	7	17.5	17.5	57.5
	Strongly Agree	17	42.5	42.5	100.0
	Total	40	100.0	100.0	

Table 4.31 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 17.5% of the experts responded “agree”, and 42.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 60%.

24. Recommendation 24 -

The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received.

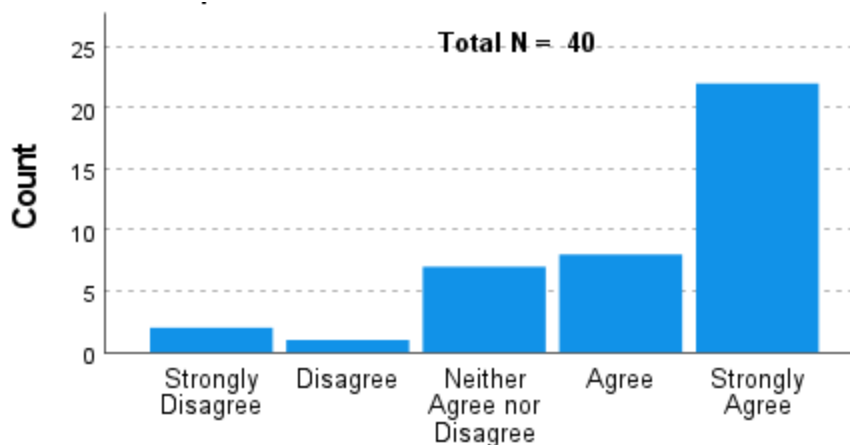


Figure 4.30: Responses for recommendation 24

Table 4.32: Frequency response for recommendation 24

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.0	5.0	5.0
	Disagree	1	2.5	2.5	7.5
	Neither Agree nor Disagree	7	17.5	17.5	25.0
	Agree	8	20.0	20.0	45.0
	Strongly Agree	22	55.0	55.0	100.0
	Total	40	100.0	100.0	

Table 4.32 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 20% of the experts responded “agree”, and 55% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 75%.

25. Recommendation 25 -

It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas of a published tender.

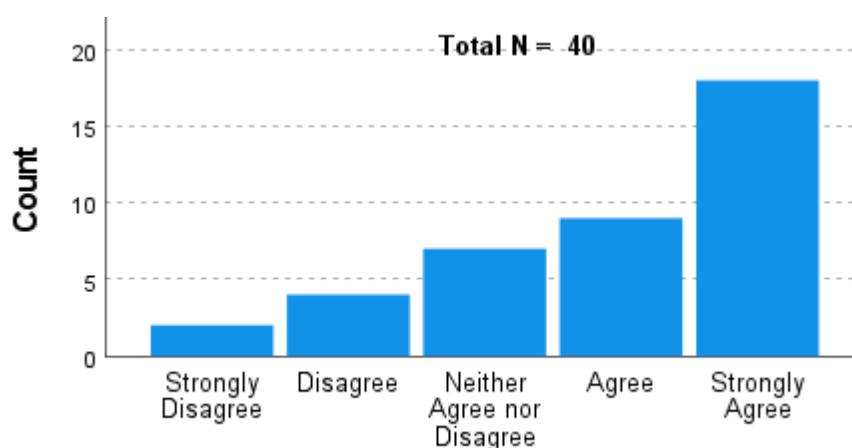


Figure 4.31: Responses for recommendation 25

Table 4.33: Frequency response for recommendation 25

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.0	5.0	5.0
	Disagree	4	10.0	10.0	15.0
	Neither Agree nor Disagree	7	17.5	17.5	32.5
	Agree	9	22.5	22.5	55.0
	Strongly Agree	18	45.0	45.0	100.0
	Total	40	100.0	100.0	

Table 4.33 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 22.5% of the experts responded “agree”, and 45% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 67.5%.

26. Recommendation 26 -

Appointed member of the procuring entity should maintain written records of any such calls/emails received and points discussed.

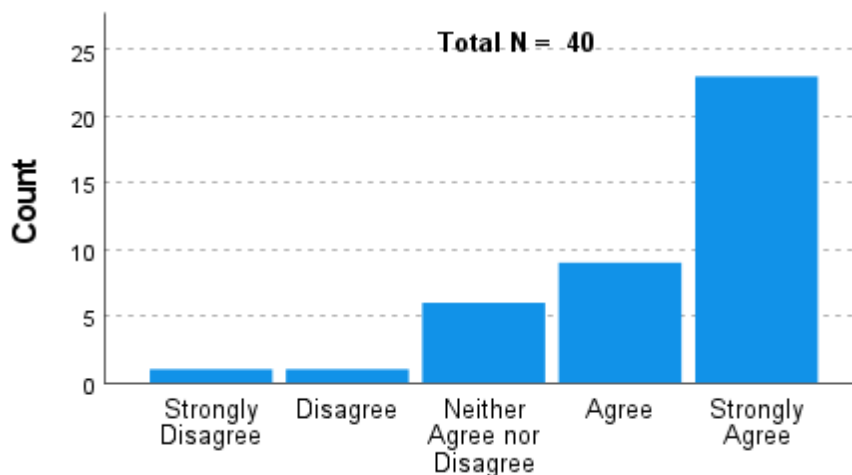


Figure 4.32: Responses for recommendation 26

Table 4.34: Frequency response for recommendation 26

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	1	2.5	2.5	5.0
	Neither Agree nor Disagree	6	15.0	15.0	20.0
	Agree	9	22.5	22.5	42.5
	Strongly Agree	23	57.5	57.5	100.0
	Total	40	100.0	100.0	

Table 4.34 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 22.5% of the experts responded “agree”, and 57.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 80%.

27. Recommendation 27-

The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.

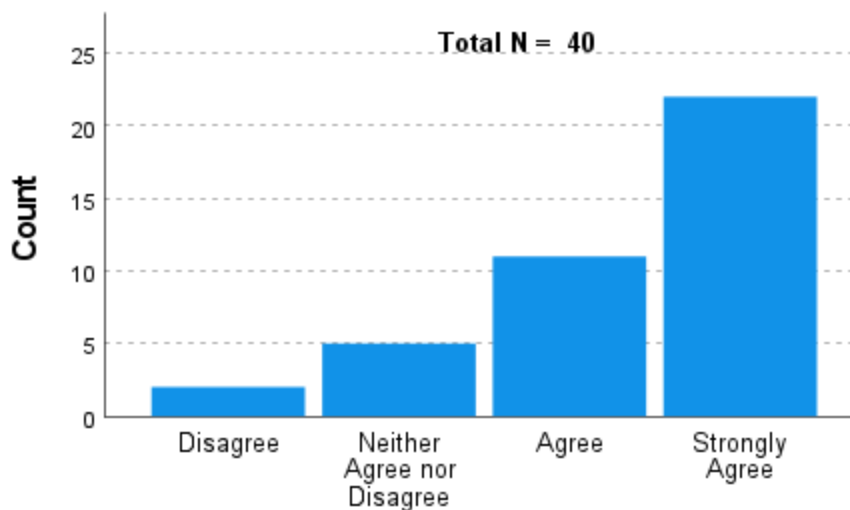


Figure 4.33: Responses for recommendation 27

Table 4.35: Frequency response for recommendation 27

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	5	12.5	12.5	17.5
	Agree	11	27.5	27.5	45.0
	Strongly Agree	22	55.0	55.0	100.0
	Total	40	100.0	100.0	

Table 4.35 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 27.5% of the experts responded “agree”, and 55% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 82.5%.

28. Recommendation 28-

Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.

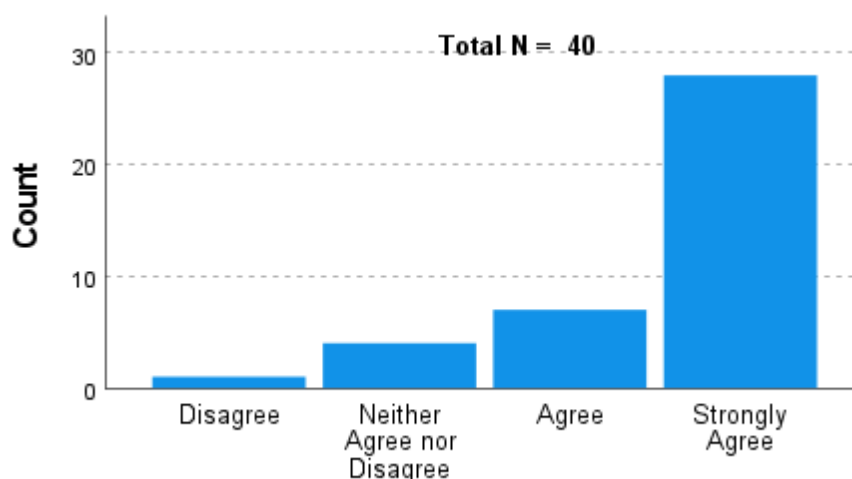


Figure 4.34: Responses for recommendation 28

Table 4.36: Frequency response for recommendation 28

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.5	2.5	2.5
	Neither Agree nor Disagree	4	10.0	10.0	12.5
	Agree	7	17.5	17.5	30.0
	Strongly Agree	28	70.0	70.0	100.0
	Total	40	100.0	100.0	

Table 4.36 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 17.5% of the experts responded “agree”, and 70% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 87.5%.

29. Recommendation 29-

Apart from strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects.

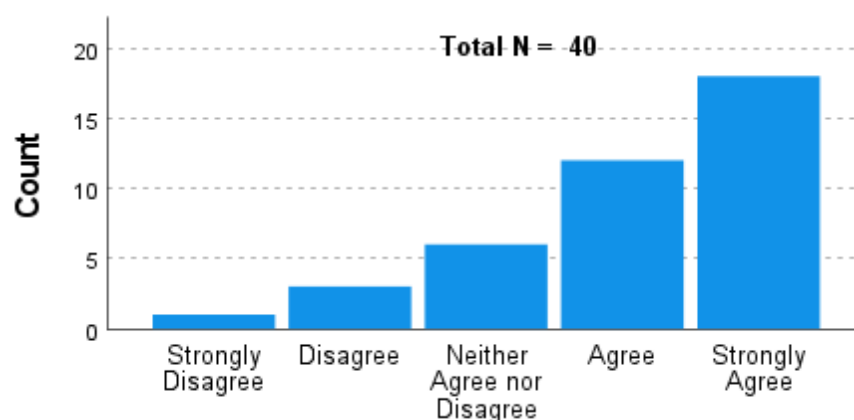


Figure 4.35: Responses for recommendation 29

Table 4.37: Frequency response for recommendation 29

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	3	7.5	7.5	10.0
	Neither Agree nor Disagree	6	15.0	15.0	25.0
	Agree	12	30.0	30.0	55.0
	Strongly Agree	18	45.0	45.0	100.0
	Total	40	100.0	100.0	

Table 4.37 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 30% of the experts responded “agree”, and 45% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 75%.

30. Recommendation 30 -

Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.

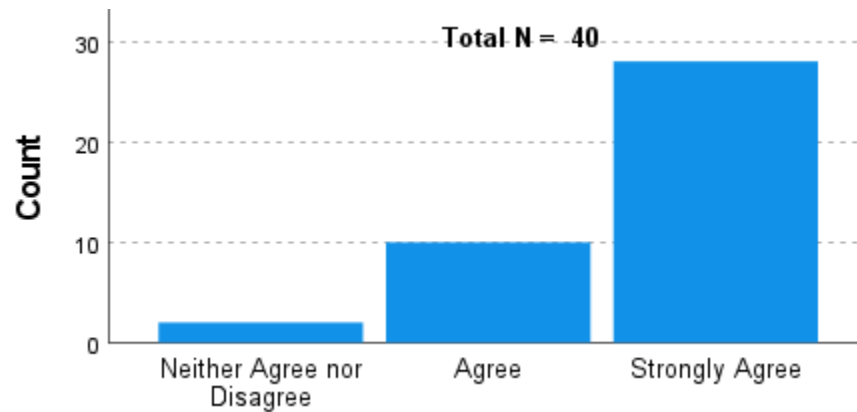


Figure 4.36: Responses for recommendation 30

Table 4.38: Frequency response for recommendation 30

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	2	5.0	5.0	5.0
	Agree	10	25.0	25.0	30.0
	Strongly Agree	28	70.0	70.0	100.0
	Total	40	100.0	100.0	

Table 4.38 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 25% of the experts responded “agree”, and 70% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 95%.

31. Recommendation 31 -

Procuring entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.

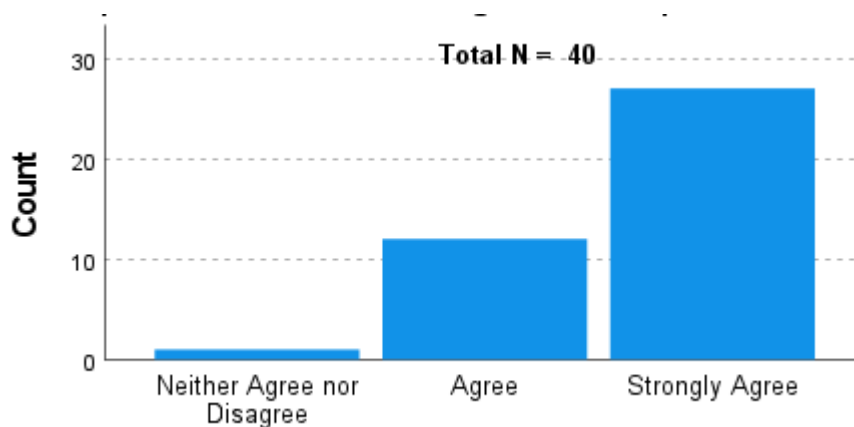


Figure 4.37: Responses for recommendation 31

Table 4.39: Frequency response for recommendation 31

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	1	2.5	2.5	2.5
	Agree	12	30.0	30.0	32.5
	Strongly Agree	27	67.5	67.5	100.0
	Total	40	100.0	100.0	

Table 4.39 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 30% of the experts responded “agree”, and 67.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 97.5%.

32. Recommendation 32 -

Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.

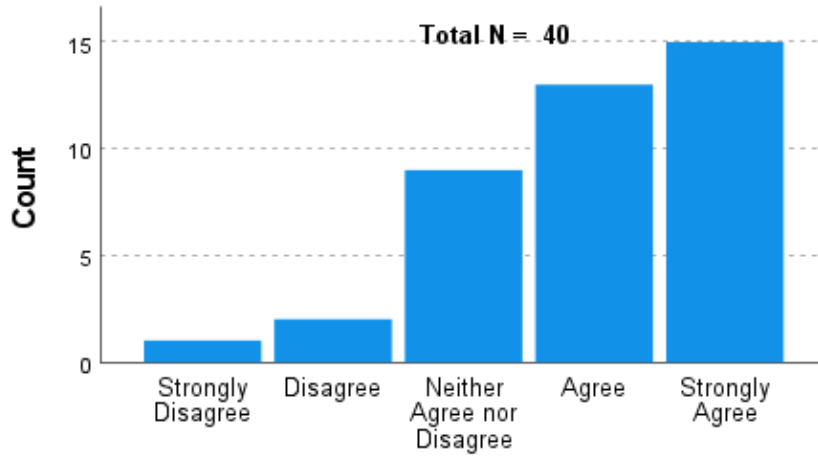


Figure 4.38: Responses for recommendation 32

Table 4.40: Frequency response for recommendation 32

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	2	5.0	5.0	7.5
	Neither Agree nor Disagree	9	22.5	22.5	30.0
	Agree	13	32.5	32.5	62.5
	Strongly Agree	15	37.5	37.5	100.0
	Total	40	100.0	100.0	

Table 4.40 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 32.5% of the experts responded “agree”, and 37.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 70%.

33. Recommendation 33 -

Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.

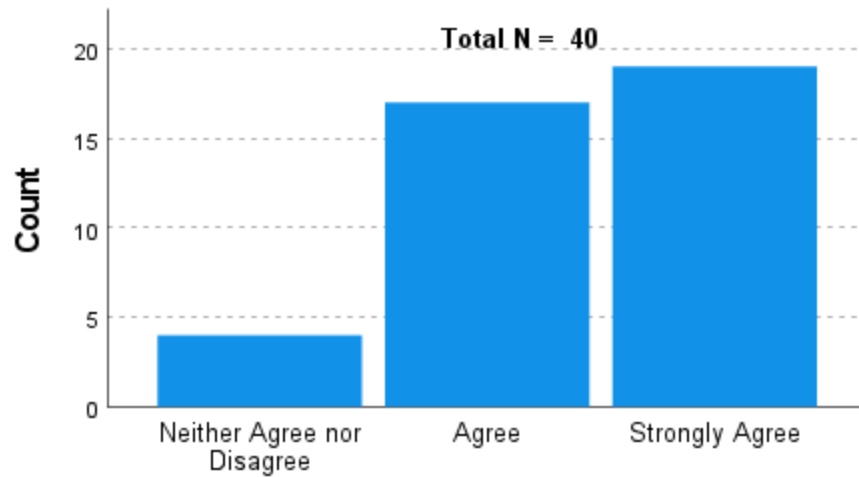


Figure 4.39: Responses for recommendation 33

Table 4.41: Frequency response for recommendation 33

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	4	10.0	10.0	10.0
	Agree	17	42.5	42.5	52.5
	Strongly Agree	19	47.5	47.5	100.0
	Total	40	100.0	100.0	

Table 4.41 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 42.5% of the experts responded “agree”, and 47.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 90%.

34. Recommendation 34 -

It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest.

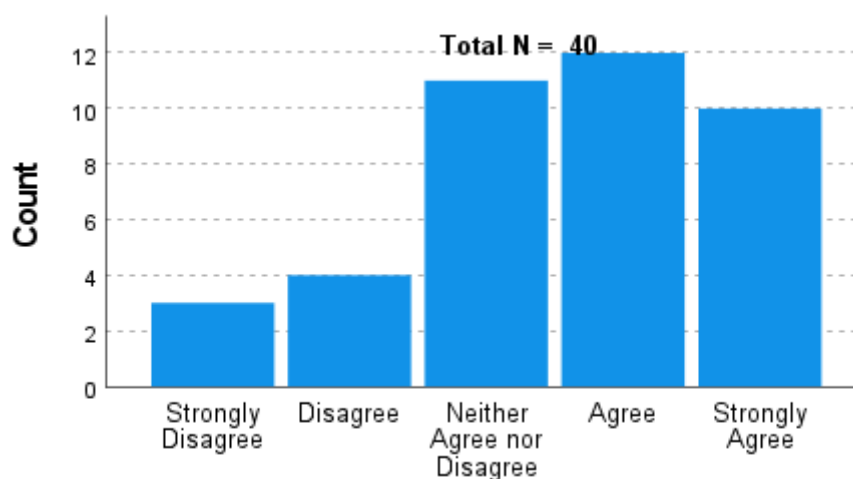


Figure 4.40: Responses for recommendation 34

Table 4.42: Frequency response for recommendation 34

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	7.5	7.5	7.5
	Disagree	4	10.0	10.0	17.5
	Neither Agree nor Disagree	11	27.5	27.5	45.0
	Agree	12	30.0	30.0	75.0
	Strongly Agree	10	25.0	25.0	100.0
	Total	40	100.0	100.0	

Table 4.42 illustrates that recommendation has not reached the desired consensus level of 70% after the second round. However, 30% of the experts responded “agree”, and 25% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 55%.

35. Recommendation 35 -

An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.

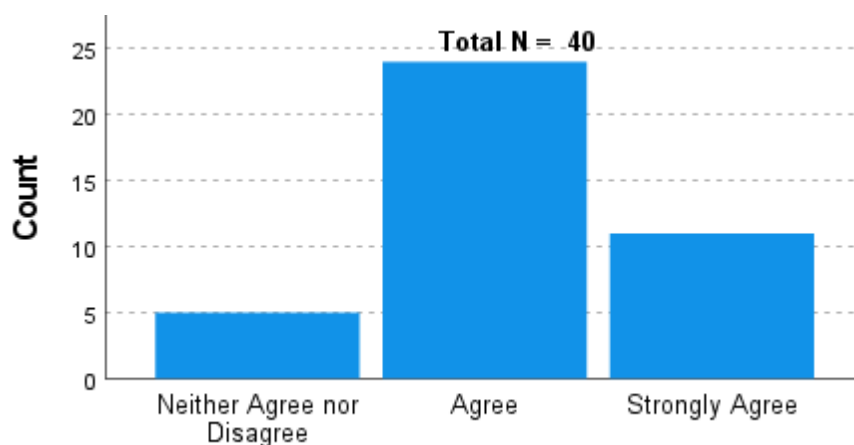


Figure 4.41: Responses for recommendation 35

Table 4.43: Frequency response for recommendation 35

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Agree nor Disagree	5	12.5	12.5	12.5
	Agree	24	60.0	60.0	72.5
	Strongly Agree	11	27.5	27.5	100.0
	Total	40	100.0	100.0	

Table 4.43 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 60% of the experts responded “agree”, and 27.5% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 87.5%.

36. Recommendation 36 -

These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in.

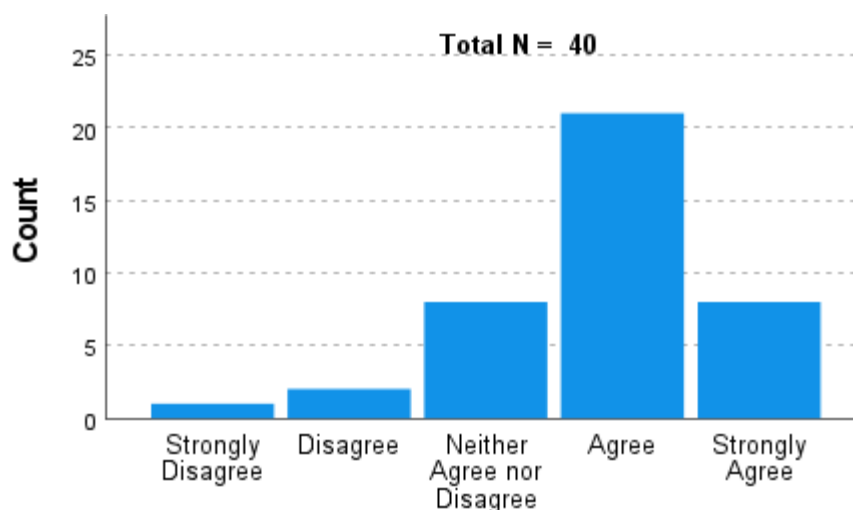


Figure 4.43: Responses for recommendation 36

Table 4.44: Frequency response for recommendation 36

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.5	2.5	2.5
	Disagree	2	5.0	5.0	7.5
	Neither Agree nor Disagree	8	20.0	20.0	27.5
	Agree	21	52.5	52.5	80.0
	Strongly Agree	8	20.0	20.0	100.0
	Total	40	100.0	100.0	

Table 4.44 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 52.5% of the experts responded “agree”, and 20% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 72.5%.

37. Recommendation 37 -

There should be at least two people with technical knowledge in a tender committee for the procurement of information systems.

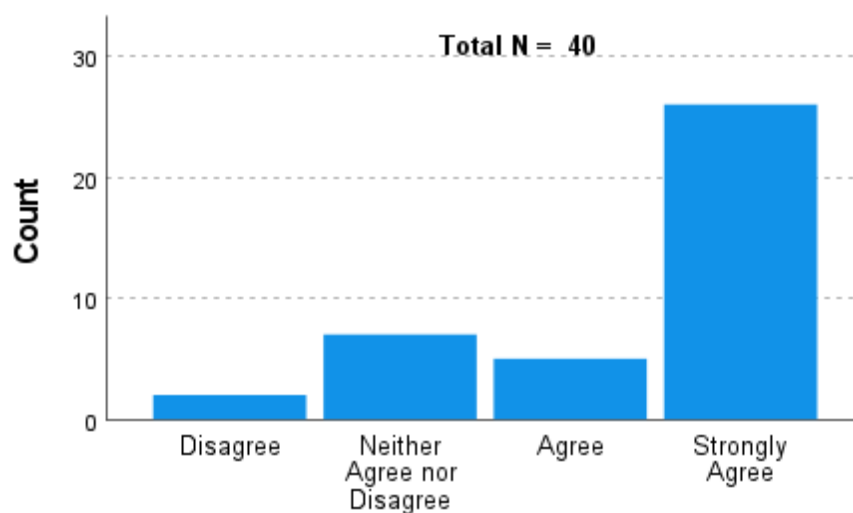


Figure 4.44: Responses for recommendation 37

Table 4.45: Frequency response for recommendation 37

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.0	5.0	5.0
	Neither Agree nor Disagree	7	17.5	17.5	22.5
	Agree	5	12.5	12.5	35.0
	Strongly Agree	26	65.0	65.0	100.0
	Total	40	100.0	100.0	

Table 4.45 illustrates that recommendation has reached the desired consensus level of 70% after the second round. 12.5% of the experts responded “agree”, and 65% responded “strongly agree”. Therefore, the cumulative level of agreement for this recommendation is 77.5%.

4.6.1.1. Summary of percentage agreement after Delphi round 2

The recommendations that achieved a level of agreement of 70% were considered as consensus achieved, and the recommendations that achieved less than 70% were considered as consensus not achieved. The summary of the above frequency response tables and charts is as below.

Table 4.46: Summary of percentage agreement

	Category	Recommendation	Percentage agreement	Status of consensus
1	General	The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS.	45%	Consensus not achieved
2		The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.	75%	Consensus achieved
3		Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods.	72.5%	Consensus achieved
4		Implementing an e-procurement system will facilitate international bidders to participate in a tender.	67.5%	Consensus not achieved
5		Information systems procurement should be considered projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.	92.5%	Consensus achieved
6	Tender specifications	In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements.	70%	Consensus achieved
7		In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all.	87.5%	Consensus achieved

	Category	Recommendation	Percentage agreement	Status of consensus
8		In a complex IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market.	67.5%	Consensus not achieved
9		If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies	72.5%	Consensus achieved
10		Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement.	70%	Consensus achieved
11		In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.	87.5%	Consensus achieved
12	Bid evaluation criteria	The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation.	90%	Consensus achieved
13		If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.	80%	Consensus achieved
14		Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.	85%	Consensus achieved
15		International standards requested in bid-evaluation criteria should be pre-approved for public sector IS procurements to prevent bias to a particular bidder.	85%	Consensus achieved
16		Procuring entities should justify the requirement of asking for each international standard.	67.5%	Consensus not achieved
17		The sustainability of the bidder should be addressed in the bid evaluation criteria.	90%	Consensus achieved

	Category	Recommendation	Percentage agreement	Status of consensus
18		Bidder's quality is not a very significant factor if the procured item is a "product", as manufacturers thoroughly test those "products" before releasing them to market.	20%	Consensus not achieved
19	Government regulations	Strict regulations are mandatory in public sector procurements to ensure transparency.	85%	Consensus achieved
20		Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process.	65%	Consensus not achieved
21		Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.	85%	Consensus achieved
22		Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions.	40%	Consensus not achieved
23	Collaboration among procurers and bidders	It will be useful and time-saving if a tender committee member can have a telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas of a submitted bid.	60%	Consensus not achieved
24		The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received.	75%	Consensus achieved
25		It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas of a published tender.	67.5%	Consensus not achieved
26		Appointed member of the procuring entity should maintain written records of any such calls/emails received and points discussed.	80%	Consensus achieved
27		The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.	82.5%	Consensus achieved
28	Project management	Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.	87.5%	Consensus achieved

	Category	Recommendation	Percentage agreement	Status of consensus
29		Apart from strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects.	75%	Consensus achieved
30		Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.	95%	Consensus achieved
31		Procurement entities should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.	97.5%	Consensus achieved
32	Competence of procurers	Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.	70%	Consensus achieved
33		Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.	90%	Consensus achieved
34		It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest.	55%	Consensus not achieved
35		An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.	87.5%	Consensus achieved
36		These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in.	72.5%	Consensus achieved
37		There should be at least two people with technical knowledge in a tender committee for the procurement of information systems	77.5%	Consensus achieved

According to the above table, 27 out of 37 recommendations achieved 70% consensus in round 2. Five more recommendations achieved a consensus of more than 65%. Only five statements out of 37 failed to reach at least 65% consensus.

4.6.1.2. Termination of Delphi rounds

General practice in a Delphi survey is to conduct iterative rounds until consensus is met. It would have been ideal for this study to have another round where the researcher could provide feedback from the second Delphi round and then ask the Delphi panel to reconsider their previous answers based on group opinions. During the second Delphi round, the researcher had to send two reminder emails followed by a reminder through telephone to gather 43 responses out of 48 participants. In a few cases, multiple telephone calls had to be made to remind and encourage the panellists to respond to the questionnaire.

Despite the efforts, the researcher was unable to gather responses from five panellists. The process of collecting responses proved to be time-consuming and tedious due to most of the panellists' busy schedules. Therefore, due to the time constraints and the difficulties the researcher faced during the second Delphi round, it was decided not to conduct any further Delphi rounds for this study. However, it should be noted that 27 out of 37 statements reached a consensus during the second Delphi round. As a percentage, 73% of recommendations have reached 70% consensus on the first effort. Even though conducting further Delphi rounds was ruled out, it was decided to analyze why the rest of the recommendations did not achieve consensus.

4.6.2. Importance ranking

The identified recommendations which achieved consensus had to be ranked according to their importance to achieve one of the research objectives. The mean of each recommendation was calculated using SPSS to rank them from most important to least important. The following table illustrates final recommendations ranked according to their mean with the level of consensus they achieved. In the instances where two recommendations had the same mean, they were ranked according to the order of standard deviation.

Table 4.47: Importance rank of recommendations according to the mean

Rank	Recommendation	Mean	Standard Deviation	Level of consensus
1	Procuring entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.	4.65	0.533	97.5%
2	Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.	4.65	0.580	95%
3	Information systems procurement should be considered as projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.	4.58	0.636	92.5%
4	Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.	4.55	0.783	87.5%
5	The sustainability of the bidder should be addressed in the bid evaluation criteria.	4.50	0.816	90%
6	The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation.	4.43	0.747	90%
7	Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.	4.38	0.667	90%
8	In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all.	4.38	0.774	87.5%
9	There should be at least two people with technical knowledge in a tender committee for the procurement of information systems	4.38	0.952	77.5%
10	Strict regulations are mandatory in public sector procurements to ensure transparency.	4.35	0.802	85%
11	The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.	4.33	0.888	82.5%
12	Implementing an e-procurement system will facilitate both parties to use technology such as using email	4.30	0.723	85%

Rank	Recommendation	Mean	Standard Deviation	Level of consensus
	instead of sealed envelopes and e-payments instead of traditional payments.			
13	Appointed member of the procuring entity should maintain written records of any such calls/emails received and points discussed.	4.30	0.992	80%
14	In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.	4.23	0.8	87.5%
15	If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.	4.18	1.010	80%
16	The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received.	4.18	1.130	75%
17	An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.	4.15	0.622	87.5%
18	Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.	4.13	0.723	85%
19	The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.	4.13	0.911	75%
20	International standards requested in bid-evaluation criteria should be pre-approved to be used in public sector IS procurements to prevent bias to a particular bidder.	4.10	0.778	85%
21	Apart from strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects.	4.08	1.071	75%
22	Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement.	4.05	0.876	70%
23	Implementing an e-procurement system will help eliminate the outdated procedures used in public	4.05	1.085	72.5%

Rank	Recommendation	Mean	Standard Deviation	Level of consensus
	procurement, such as sealed envelopes, bid securities, and traditional payment methods.			
24	Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.	3.98	1.025	70%
25	If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies	3.88	1.159	72.5%
26	These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in	3.83	0.903	72.5%
27	In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements.	3.80	0.966	70%

4.6.3. Inter-group comparison.

Experts from public sector procuring entities and experts from private sector bidding companies participated in this survey. Therefore, it is beneficial to identify any significant difference between the two groups in responding to and ranking each recommendation. Therefore, each group's responses were compared under the main categories General, Tender specifications, Bid-evaluation criteria, Government regulations, Project management, Collaboration among procurers and bidders, and Competence of procurers.

The means and standard deviations of the responses given to each recommendation are presented in below Table 4.49. The difference between the way each expert group ranked the recommendations is also presented in the table. The combination of means and standard deviations was used to obtain these ranks. Finally, the Mann-Whitney U test was used to identify any significant difference between the way procurers and bidders responded to each recommendation. The significance level used in the Mann-

Whitney U test is 0.05. If the test result is less than 0.05, it was decided that there is a significant difference between the two groups.

4.6.3.1. Inter-group comparison under General category

Table 4.48: Inter-group comparison under General category

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. Information systems procurement should be considered as projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.	1	4.37	0.684	1	4.76	0.539	No (0.074)
2. Implementing an e-procurement system will facilitate international bidders to participate in a tender.	2	3.95	1.177	4	3.81	1.078	No (0.611)
3. The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.	3	3.84	1.015	2	4.38	0.740	No (0.105)
4. Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods.	4	3.79	1.182	3	4.29	0.956	No (0.178)

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
5. The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS.	5	3.42	0.902	5	3.33	1.238	No (0.810)

According to the results obtained for the Mann-Whitney U test, there is no significant difference between the two groups under the “general” category ($p > 0.05$). However, it is observed that the two groups ranked recommendations 2,3 and 4 differently from each other. It can be concluded that there is no significant disagreement between the two groups when it comes to recommendations under the “general” category.

4.6.3.2. Inter-group comparison under Tender Specifications category

Table 4.49: Inter-group comparison under Tender specifications category

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all.	1	4.16	0.834	1	4.57	0.676	No (0.111)
2. In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.	2	4	0.882	2	4.43	0.507	No (0.138)
3. Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement.	3	3.89	0.809	4	4.19	0.928	No (0.258)
4. In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements.	4	3.74	0.872	5	3.86	1.062	No (0.573)

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
5. In a complex IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market.	5	3.74	0.991	6	3.81	1.209	No (0.688)
6. If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies	6	3.47	1.307	3	4.24	0.889	No (0.061)

According to the results obtained for the Mann-Whitney U test, there is no significant difference between the two groups under the “tender specifications” category ($p > 0.05$). Both groups identified recommendations 1 and 2 as the most important, and there is a difference between the rankings given to other recommendations. It can be concluded that there is no significant disagreement between the two groups when it comes to recommendations under the “tender specifications” category.

4.6.3.3. Inter-group comparison under Bid Evaluation Criteria category

Table 4.50: Inter-group comparison under Bid-evaluation criteria category

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. The sustainability of the bidder should be addressed in the bid evaluation criteria.	1	4.42	0.838	2	4.57	0.811	No (0.503)
2. The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation.	2	4.26	0.933	1	4.57	0.507	No (0.469)
3. International standards requested in bid-evaluation criteria should be pre-approved for public sector IS procurements to prevent bias to a particular bidder.	3	4.16	0.501	5	4.05	0.973	No (0.957)
4. If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.	4	4.16	0.834	3	4.19	1.167	No (0.537)
5. Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.	5	4.11	0.567	4	4.14	0.854	No (0.668)

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
6. Procuring entity should justify the requirement of asking for each international standard.	6	3.95	0.970	6	3.81	1.030	No (0.668)
7. Bidder's quality is not a very significant factor if the procured item is a "product", as manufacturers thoroughly test those "products" before releasing them to market.	7	2.21	1.182	7	2.29	1.347	No (1.000)

According to the results obtained for the Mann-Whitney U test, there is no significant difference between the two groups under the "bid-evaluation criteria" category ($p > 0.05$). Both groups identified recommendations 1 and 2 as the most important and recommendations 6 and 7 as the least important. There is a difference between the ranks given to the rest of the recommendations by the two groups. It can be concluded that there is no significant disagreement between the two groups when it comes to recommendations under the "bid-evaluation criteria" category.

4.6.3.4. Inter-group comparison under Government regulations category

Table 4.51: Inter-group comparison under Government regulations category

Recommendations	Procurers			Bidders			Difference of means statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. Strict regulations are mandatory in public sector procurements to ensure transparency.	1	4.11	0.875	2	4.57	0.676	No (0.093)
2. Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.	2	3.89	0.567	1	4.67	0.658	Yes (0.000)
3. Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process.	3	3.58	0.902	3	4.14	0.793	No (0.065)
4. Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions.	4	3.05	1.224	4	3.19	1.401	No (0.649)

According to the results obtained for the Mann-Whitney U test, there is a significant difference between the way the two groups responded to recommendation no 2: “Implementing an e-procurement system will facilitate both parties to use technology such as using email instead of sealed envelopes and e-payments instead of traditional

payments”. Mann-Whitney U test outcome of SPSS is as shown below. The mean rank of bidders is 26.4, while the mean rank of procurers is 13.97. Therefore, it is clear that bidders rated this recommendation more favourably than procurers. ($p = 0.000$).

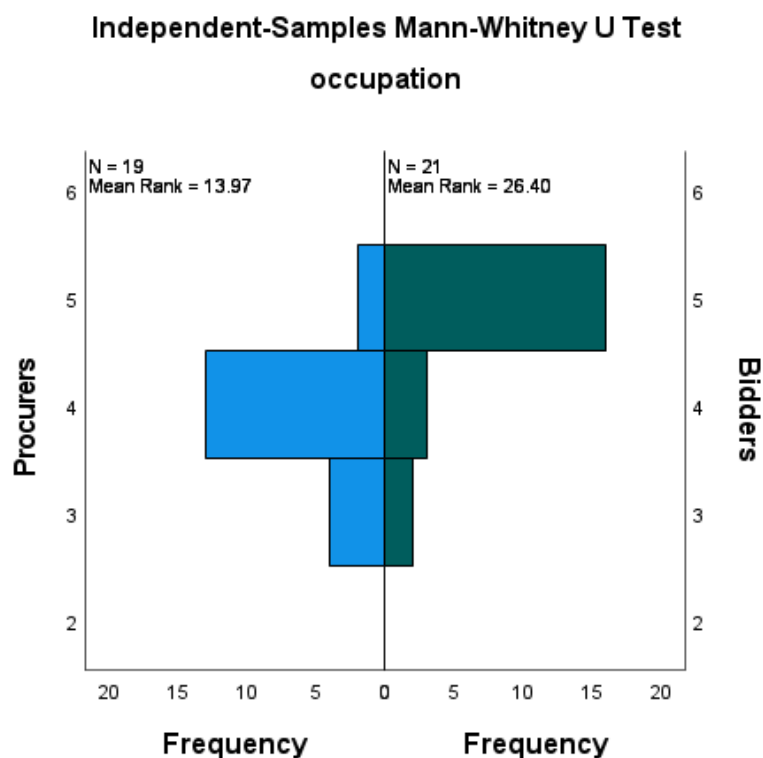


Figure 4.45: Mann-Whitney U test outcome for recommendation 2

However, there is no significant difference between the two groups when responding to other recommendations ($p > 0.05$). Both groups ranked the recommendations similarly other than recommendations 1 and 2. Procurers thought recommendation 1: “Strict regulations are mandatory in public sector procurements to ensure transparency” is the most important while bidders ranked it second. Bidders ranked recommendation 2: “Implementing an e-procurement system will facilitate both parties to use technology such as using email instead of sealed envelopes and e-payments instead of traditional payments” as the most important while procurers ranked it second.

4.6.3.5. Inter-group comparison under Collaboration among procurers and bidders category

Table 4.52: Inter-group comparison under Collaboration among procurers and bidders category

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.	1	4.05	0.848	1	4.57	0.870	Yes (0.031)
2. Appointed member of the procuring entity should maintain written records of any such calls/emails received and points discussed.	2	4.05	1.77	2	4.52	0.750	No (0.236)
3. The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received.	3	3.95	1.311	3	4.38	0.921	No (0.347)
4. It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas of a published tender.	4	3.58	1.346	4	4.24	1.044	No (0.226)
5. It will be useful and time-saving if a tender committee member can have a	5	3.32	1.6	5	3.9	1.411	No (0.226)

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas of a submitted bid.							

According to results obtained for the Mann-Whitney U test, there is a significant difference between how the two groups responded to recommendation no 1: “The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during the procurement”. Mann-Whitney U test outcome of SPSS is as shown below. The mean rank of bidders is 24.26, while the mean rank of procurers is 16.34. Therefore, it is clear that bidders rated this recommendation more favourably than procurers. ($p = 0.031$).

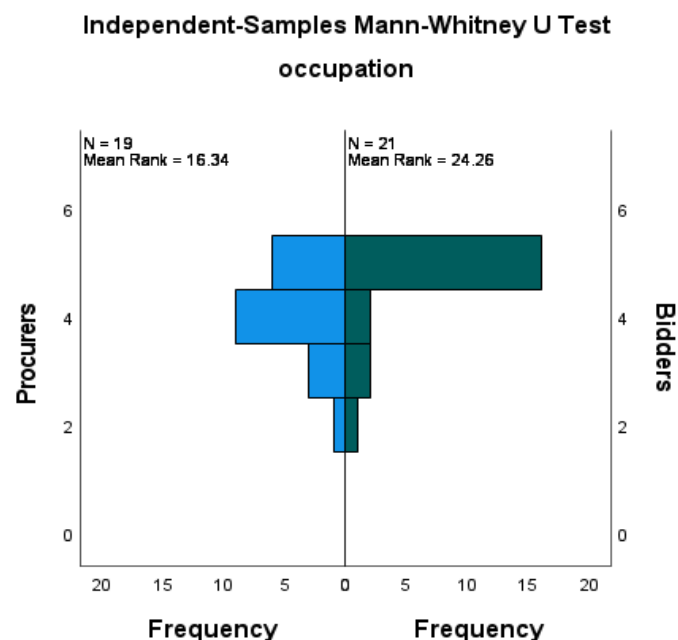


Figure 4.46: Mann-Whitney U test outcome for recommendation 1

However, there is no significant difference between the two groups when responding to other recommendations ($p > 0.05$). The importance rank given to all the recommendations according to the means is similar for both groups.

4.6.3.6. Inter-group comparison under Project Management category

Table 4.53: Inter-group comparison under Project management category

Recommendations	Procurers			Bidders			Difference of means statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.	1	4.68	0.671	3	4.43	0.870	No (0.376)
2. Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.	2	4.53	0.612	2	4.76	0.539	No (0.236)
3. Procuring entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.	3	4.47	0.513	1	4.81	0.512	No (0.054)
4. Apart from strong leadership, assigning an employee from the public sector	4	4.21	1.032	4	3.95	1.117	No (0.436)

Recommendations	Procurers			Bidders			Difference of means statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects.							

According to the Mann-Whitney U test results, there is no significant difference between the two groups under the “project management” category ($p > 0.05$). Both groups identified recommendation two as the second most important and recommendation four as the least important. Top management support of the public sector is ranked most important by the procurers while conducting a feasibility study is ranked most important by the bidders. It can be concluded that there is no significant disagreement between the two groups when it comes to recommendations under the “project management” category.

4.6.3.7. Inter-group comparison under Competence of Procurers category

Table 4.54: Inter-group comparison under Competence of procurers category

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
1. Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.	1	4.37	0.684	2	4.38	0.669	No (0.979)
2. There should be at least two people with technical knowledge in a tender committee for the procurement of information systems	2	4.26	1.046	1	4.48	0.873	No (0.520)
3. An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.	3	4.05	0.524	3	4.24	0.700	No (0.376)
4. Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.	4	3.89	1.197	4	4.05	0.865	No (0.872)
5. These IS procurement specialists should be made liable for the successful implementation of the	5	3.53	1.020	5	4.10	0.700	No (0.105)

Recommendations	Procurers			Bidders			Difference of mean ranks statistically significant? (using Mann-Whitney U test)
	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	
projects they were involved in.							
6. It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest.	6	3.53	1.219	6	3.57	1.207	No (0.979)

According to the results obtained for the Mann-Whitney U test, there is no significant difference between the two groups under the “competence of procurers” category ($p > 0.05$). Both groups ranked the recommendations similarly except for recommendations 1 and 2. Procurers ranked guiding potential users to identify their requirements clearly as the most important while bidders ranked it second. Bidders ranked having at least two people with technical expertise in the tender committee as the most important, while procurers ranked it second. It can be concluded that there is no significant disagreement between the two groups when it comes to recommendations under the “competence of procurers” category.

4.7. Summary

This chapter presented a detailed analysis of data gathered in the first and second Delphi rounds. Thirty-seven recommendations were identified by analyzing the responses to interview questions in the first Delphi round. At the end of the second Delphi round, twenty-seven out of the thirty-seven recommendations met the predefined 70% consensus. Secondly, recommendations were given importance ranking based on their mean values. Finally, an inter-group comparison between procurers and bidders was carried out to identify any significant difference between group opinions.

5. Conclusion

This chapter presents the conclusions and recommendations identified through the data analysis, research limitations and direction for future work. Section 5.1 presents the summary of conclusions, while section 5.2 presents the recommendations. Research limitations are illustrated in section 5.3, and future research directions are explained in section 5.4.

5.1. Summary

This research aims to find similarities between the challenges faced globally and locally in public procurement of IS, identify the recommendations to overcome the challenges in the existing public procurement procedure of IS and weigh and prioritize the identified recommendations to improve their practical value. First, existing problems in public procurement were listed, and the Delphi method was identified as the research tool using a literature survey. Secondly, 14 face-to-face interviews were conducted with 05 procurers, 05 bidders, and 04 auditors to identify whether the same problems existed in Sri Lanka and to identify recommendations to overcome those challenges. Thirty-seven recommendations were generated in the interviews and circulated among an expert panel of 48 experts in the procurement of IS. Finally, the online survey results were analyzed to develop conclusions, recommendations, and future work.

Face to face interviews were used to find similarities between the challenges faced globally and locally in public procurement of IS. Experts representing procurers and bidders agreed that they have faced challenges similar to those identified through the literature survey except for two challenges. The two rejected challenges and reasons for rejection are as follows.

1. Create specifications before procurement or as a part of the procurement process

Participants commented that creating specifications as a part of the procurement process is not practical. They mentioned that it might prolong the procurement process and will result in complete failure of the procurement.

Therefore, all the interview participants mentioned that they do not see a benefit in creating specifications as part of the procurement process and preferred creating specifications before the procurement. Therefore it was concluded that such a dilemma does not exist in the Sri Lankan context.

2. Lack of feedback from unsuccessful bids

All the participants commented that getting feedback from failed bids will not be helpful as the procurers who evaluated the bids already know why a particular bid failed. Furthermore, it was mentioned that bidders who failed would not be interested in spending time to provide feedback. Therefore, it was concluded that procurers and bidders did not see the necessity of securing feedback from the unsuccessful bids and did not consider it as a challenge in the public procurement of IS.

The main finding of this study is the set of recommendations that were generated using the Delphi method. Out of 37 recommendations generated in Delphi round 01, 27 recommendations gained 70% consensus from the expert panel in Delphi round 02. These 27 recommendations are ranked according to their importance as below.

Table 5.1: Summary of recommendations obtained from the Delphi survey

Rank	Recommendation
1	Procuring entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process.
2	Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end.
3	Information systems procurement should be considered as projects with national interest, and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party.
4	Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects.
5	The sustainability of the bidder should be addressed in the bid evaluation criteria.
6	The two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation.

Rank	Recommendation
7	Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively.
8	In a straightforward IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will ensure transparency and fair evaluation for all.
9	There should be at least two people with technical knowledge in a tender committee for the procurement of information systems
10	Strict regulations are mandatory in public sector procurements to ensure transparency.
11	The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during procurement.
12	Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.
13	If the provision is given to bidders to have a telephone conversation/ emails with a nominated person from the procuring entity to clarify unclear areas of a published tender, the appointed member of the procuring entity should maintain written records of any calls/emails received and points discussed
14	In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of the rest of the project.
15	If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price.
16	If a tender committee member is given the provision to have a telephone conversation/emails with a previously nominated person from the bidder to clarify unclear areas of a submitted bid, the said tender committee member should maintain written records of any telephone conversations/emails quoting discussed points and feedback received
17	An IS procurement specialist with both IS, and public procurement knowledge should be deployed to work with the internal procurement teams of public institutes.
18	Using well-known international standards and certifications of the industry to evaluate the service level of a bidder is useful.
19	The procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka.
20	International standards requested in bid-evaluation criteria should be pre-approved for public sector IS procurements to prevent bias to a particular bidder.
21	Apart from strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure the successful implementation of such projects.
22	Letting bidders architect solutions to match the procuring entity's functional requirements will aid the procuring entity to identify the best solution for their requirement.

Rank	Recommendation
23	Implementing an e-procurement system will help eliminate the outdated procedures used in public procurement, such as sealed envelopes, bid securities, and traditional payment methods.
24	Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects.
25	If the procuring entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies
26	These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in
27	In a complex IS procurement, the technical knowledge gap between procuring entity and bidder will reduce if the procuring entity only publishes functional requirements and lets bidders architect solutions to match those requirements.

However, ten out of the thirty-seven recommendations did not reach a consensus at the end of the study. Therefore, it is essential to analyze why the expert panel held different opinions on these ten recommendations.

Recommendation 01 – The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to the intangible and volatile nature of IS.

At the first Delphi round (face-to-face interviews), all 10 participants from procuring entities and bidders mentioned that existing public procurement guidelines being not specialized for procurement of ICT infrastructure is one of the main challenges they face. However, according to the responses received in the online survey, only 45% agreed with this statement. It was clear to the researcher that most of the experts were more concerned about poor project management and top management support than the shortcomings of the procurement guidelines.

Recommendation 04 – Implementing an e-procurement system will facilitate international bidders to participate in a tender.

The expert panel reached a consensus that implementing an e-procurement system will help eliminate the outdated procedures used in the public procurement of IS. However, they have not reached a consensus on the e-procurement system facilitating international bidders to participate in a tender. However, it should be noted that this statement has reached a 67.5% agreement level. Therefore, there is a possibility of this statement reaching consensus, given there was another Delphi round. It might also result from procurers and bidders not having enough experience working with an e-procurement system and the lack of knowledge about its features.

Recommendation 08 - In a complex IS procurement, publishing clear-cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market.

This statement has reached an agreement level of 67.5%. However, 20% of the expert panel has remained neutral in answering this statement. Therefore, there is a possibility of this statement reaching consensus, given there was another Delphi round.

Recommendation 16 – Procuring entities should justify the requirement of asking for each international standard.

Using well-known international standards and certifications of the industry to evaluate the service level of a bidder and pre-approving those international standards to prevent bias to a particular bidder has reached a consensus. However, the above recommendation of procuring entities justifying the requirement for asking each standard has not reached a consensus. Nevertheless, it should be noted that this statement has reached a 67.5% agreement level. Therefore, there is a possibility of this statement reaching consensus, given there was another Delphi round.

Recommendation 18 – Bidder’s quality is not a very significant factor if the procured item is a “product”, as manufacturers thoroughly test those “products” before releasing them to market.

This statement only reached an agreement level of only 20%. Further, it was mentioned by only one procurer at the face-to-face interviews. Therefore, we can conclude that bidder’s quality is considered an essential factor by both procurers and bidders regardless of the product's quality. This may be due to the importance of the bidder's service level during the after-sales period.

Recommendation 20 – Implementing an e-procurement system will ensure that government regulations are adhered to throughout the procurement process.

This statement has achieved a 65% consensus level and still depicts uncertainty among the expert panel. This may be because procurers and bidders have not worked with an e-procurement system up to now and may have uncertainty on whether an e-procurement system will ensure that government regulations will be adhered throughout the procurement process. The panel has agreed that an e-procurement system will grant them access to using technology and eliminating outdated procedures in the procurement process. However, they may require actual exposure to an e-procurement system to decide whether it will ensure that the government regulations will be adhered to throughout the procurement process.

Recommendation 22 – Public procurement guidelines should be used as a guide only, and the procuring entity should not be restricted by the law as long as they can justify their decisions.

This statement reaching only a 40% agreement level depicts the uncertainties and ambiguities that may arise from such a provision. Therefore, most procurers and bidders prefer clear guidance provided by procurement guidelines to conduct the procurement process. Procurers may prefer clear guidelines so that they have clear directions on making decisions. It also gives them the ability to back their decisions without hassle if such decisions are queried later. Bidders may prefer clear guidelines to prevent procurers from manipulating the procedure and grant undue advantage to a particular bidder.

Recommendation 23 – It will be useful and time-saving if a tender committee member can have a telephone conversation/email with a previously nominated person from the bidder to clarify unclear areas of a submitted bid.

Recommendation 25 – It will be useful if a bidder can have a telephone conversation/email with a previously nominated person from the procuring entity to clarify unclear areas of a published tender.

Both recommendations 23 and 25 did not meet consensus regardless of being somewhat close to achieving consensus at 60% and 67.5% agreement levels, respectively. Therefore, it is clear that both procurers and bidders have ambiguity when communicating with each other regarding a published tender or a submitted bid. This might be due to any party's possibility of using such a provision to gain an undue advantage over the others. Based on the agreement levels of 60% and 67.5%, we can consider that such provisions will be helpful for both procurers and bidders during the procurement process and that the ambiguity of whether it will be used against them is preventing them from agreeing to those statements unanimously. This idea is further established because the consensus was achieved on the statements which mentioned that records should be kept by the appointed person of such communication that took place.

Recommendation 34 – It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest.

This statement has reached only an agreement level of 55%, and there is no significant difference in the way procurers and bidders have responded to this statement. Therefore, it can be concluded that both procurers and bidders believe that the most appropriate method to handle public procurement of IS is through the government entity that has the requirement. This may be because both procurers and bidders have experienced that the correct requirement can be gathered only through the actual entity that has the requirement rather than an outside party.

It is also noted that the expert panel gave more importance to the recommendations related to project management than other recommendations under main categories such as tender specifications and bid-evaluation criteria. The importance of proper project management was highlighted by the participants of the face-to-face interviews as well as mentioning that many IS procurement activities in the public sector fail due to poor project management.

Further, when it comes to inter-group comparison between procurers and bidders, it is noted that both these groups did not have any major disagreements about the way they responded to the recommendations except for two. The first such recommendation is under the main category “Government Regulations”, “Implementing an e-procurement system will facilitate both parties to use technology such as email instead of sealed envelopes and e-payments instead of traditional payments.” It is noted that bidders rated this recommendation more favourably than procurers. This depicts that bidders are ready to adopt an e-procurement system and consider it a better way to handle procurement procedures than the traditional method. Meanwhile, procurers may need encouragement and awareness-building when it comes to adopting an e-procurement system.

The second recommendation which procurers and bidders rated in a significantly different manner is “The Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during the procurement” under the main category “Collaboration among procurers and bidders”. It is noted that bidders rated this recommendation favourably than procurers. Therefore, it can be concluded that while bidders see it as an opportunity to clear ambiguities, procurers may find it as another cumbersome procedure to follow.

Out of 37 recommendations, there were only two recommendations where procurers and bidders were in disagreement. Therefore, it can be concluded that both these groups see the same issues as challenges in public procurement of IS and may agree on the same recommendations if the procurement procedure is changed to make it more suitable for IS procurement.

5.2. Recommendations

The group “auditors” had to be dropped from the Delphi survey as the researcher identified that they lacked specialized knowledge in auditing the procurement of information systems during the face-to-face interviews. They were unable to answer the questions which were focused on the procurement of IS. Therefore, it is recommended to provide auditors with specialized training to audit the public sector IS procurements. Doing so may prevent any irregularities during the procurement process and will effectively utilize public funds. Further, 27 recommendations were agreed upon by both procurers and bidders, as presented in section 5.1. It is recommended to incorporate these recommendations into the existing public procurement procedure and project implementation to make it suitable for the procurement of IS.

It is also noted that both procurers and bidders consider having the provision for communicating with each other promptly as valuable based on the agreement levels to those statements. However, the consensus is not achieved, which depicts an ambiguity among the expert panel whether such a provision will be manipulated to grant undue advantage to a particular party. Therefore, it is recommended to implement a method for procurers and bidders to communicate with each other to clarify unclear areas in a published tender or a submitted bid. Such a method should be without having to follow a cumbersome procedure while ensuring that this communication method cannot give undue advantage to a particular party.

Further, it is recommended to provide awareness sessions for the procurers regarding the implementation of e-procurement systems. It was noted that bidders are more eager towards e-procurement and are more ready to adopt such a system than procurers. Therefore, procurers may need encouragement and awareness-building when it comes to adopting an e-procurement system. Furthermore, it is recommended to give more attention to the project management aspect of public procurement, which is not addressed explicitly anywhere. According to the survey results, recommendations under project management were rated high by both procurers and bidders. Even though

particular product or a service is procured successfully, the project's implementation may fail if the project management is not planned appropriately.

Table 5.1: List of recommendations

	Observation	Recommendation
1	Auditors lacked specialized knowledge to audit procurement of IS	Provide specialized training to auditors to audit public procurement of IS
2	27 recommendations gained 70% consensus after the second Delphi round	Incorporate the recommendations presented in section 5.1 to the existing public procurement procedure to make it more suitable for the procurement of IS.
3	Both procurers and bidders valued having a rapid method to communicate with each other. However, the recommendations fell short of consensus depicting ambiguity of misuse.	Implement a method for procurers and bidders to communicate promptly to clarify unclear areas of a published tender or a submitted bid.
4	Bidders are more eager towards e-procurement and are ready to adopt such a system more than procurers.	Provide e-procurement awareness sessions for procurers to encourage them to adopt e-procurement systems.
5	Recommendations under project management were rated high by both procurers and bidders	Give more attention to the project management aspect of public procurement of IS.

5.3. Research Limitations

According to the literature, the Delphi survey's quality depends on the Delphi panel's expertise. Therefore, this study's required expertise level was defined as more than five years of experience in public procurement of IS and has handled more than five IS public procurement projects. Out of the forty responses for the online survey used for the data analysis, nine responses were from procurers and bidders who had 0 – 5 years of experience in procurement of IS and experience in 0 – 5 projects. The researcher proved no significant difference between the responses provided by these nine respondents and the rest using the Mann-Whitney U test. However, engaging experts with a pre-defined level of expertise would increase the quality of the study.

Due to time constraints, the first Delphi round was conducted with five experts from procuring entities and five bidders. However, more recommendations would have been generated if more experts were involved in the first Delphi round. Further, the Delphi survey was conducted for only two rounds in this study due to time constraints and prevent participant fatigue. Even within those two rounds, some panel members only

responded to the online questionnaire after multiple reminders. Five out of forty-eight expert panel members failed to respond to the online questionnaire despite multiple reminders through email and telephone. Conducting another round of the Delphi survey was impractical in this study due to the limited resources at hand. Therefore, it prevented more recommendations from gaining consensus.

5.4. Future research directions

To maintain the Delphi study's high-quality standards, future researchers can engage an expert panel with at least five years of experience in procurement of IS and have handled at least five IS public procurement projects. This could reduce any ambiguities that may arise about the conclusions and recommendations drawn from the survey.

Future researchers can use the Classical Delphi method instead of the Modified Delphi method. Usually, in Classical Delphi, the first Delphi round is an open-ended questionnaire distributed among the full panel of experts. This method would have generated more recommendations and provided more insight into the research question than interviewing a fraction of the full Delphi panel. However, it was apparent to the researcher that the chosen Modified Delphi method was the most suitable for this study, considering the limited resources at hand.

Further, it would be ideal if the Delphi study could be conducted for one more round so that more recommendations would have reached the previously agreed consensus level. Conducting one more round would also have allowed the experts to observe the rest of the experts' responses and re-evaluate and compare their answers. It would also have given the researcher to analyze the stability of responses and understand how the expert panel worked towards consensus.

Because public procurement of IS is an area where a large amount of public funds is utilized, investing in research that may help overcome the challenges faced in the procurement process will benefit the government. Therefore, the government can sponsor future researchers to provide monetary or non-monetary benefits to the expert panel to increase their interest in participating and keeping them engaged in the survey for multiple rounds.

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Appendix A – Pre-survey questionnaire

1. Do you think that existing public procurement guidelines is suitable to support the procurement of ICT infrastructure?
2. Have you faced any difficulties while using existing public procurement guidelines as the basis of your ICT infrastructure procurement activities?
3. Do you agree that problems faced in ICT infrastructure procurement can be categorized into the following main categories?
 - i. Preparing tender specifications
 - ii. Problems in Bid Evaluation Criteria
 - iii. Complex government regulations
 - iv. Collaboration among procurers and bidders
 - v. Project Management
 - vi. Competence of Procurers
4. Do you have anything else to add to the above main categories?
5. Do you agree that procuring entities face problems in the following areas while preparing Tender Specifications for Bidding Documents?
 - Translating functional specifications to technical specifications
 - Developing clear, straightforward, and precise requirements
 - Separating functional and non-functional requirements
 - Whether to create specifications before procurement or as a part of the procurement process
6. Do you agree that suppliers face problems in the following areas regarding Tender Specifications of Bidding Documents?
 - Detailed specifications limit bidder's opportunity to show quality

- The vagueness of specifications becomes an opportunity for suppliers
 - Receiving over specified tenders rather than outcome-based specifications
 - Need of feasible and realistic requirements
7. Do you agree that having a precise evaluation criterion has the following benefits?
- Bidders get a chance to evaluate products against the evaluation criteria
 - Bidders get a better chance to give more accurate pricing
 - Makes evaluation easier for procurers
8. Do you agree on the following factors regarding the Bid Evaluation Criteria of Bidding Documents?
- The quality of the suppliers should be given more consideration
 - Quality of product is influenced by choice of award criteria
 - Determining factor in public procurement is the price which leads to a lack of motivation from the private sector
 - Use quality-to-price scoring if evaluation is done as a combination of quality and price
9. Do you agree on the following factors linked to the complex regulations of the government?
- Has an adverse effect on bidders' interest to participate
 - Leads to less competition, less choice, and less bargaining power
 - Makes the procurement process complex and costly
 - Leads to the contradiction of following regulations vs satisfying system needs
 - Regulations are backed by motivators such as prevention of corruption

10. Do you agree on the following factors linked to Collaboration among procurers and bidders?

- Translating functional specifications to technical specifications should be done by a potential supplier
- Knowledge of external experts have a significant impact
- Government should work closely with the private sector
- Communication being prohibited between procurers and bidders is a problem
- Lack of feedback from unsuccessful bids is an issue

11. Do you agree on the following factors linked to Project Management?

- Poor change management is an issue
- Poor Risk management is an issue

12. Do you agree on the following factors linked to the Competence of procurers?

- Low competence of procurers is an issue
- The expertise of stakeholders is in a narrow field

13. Do you have anything else to add to any of the above categories?

Appendix B – Invitation letter to participate in Delphi survey

Dear Sir/ Madam,

You are invited to participate in a Delphi survey on the topic of Public Procurement Procedures for the Digital Age. This survey is organized by myself, Poboda Masakorala, a master's student at the University of Moratuwa under the supervision of Dr. Chathura De Silva. The survey is focused on finding solutions to the problems all stakeholders face in the procurement of information systems for the public sector. An expert panel with 30 panellists from procurement entities, bidders, and auditors will participate in this survey, and each panelist is an expert in the area of public procurement of information systems.

The outcome of the research is to come up with a set of recommendations to make the current information systems procurement process more coordinated and hassle-free for the stakeholders involved. That is the main reason that this research consists of expert opinions of all three main parties involved in the procurement process.

Inclusion criteria for your profession are as follows:

- More than five years of experience in public procurement of information systems
- Being involved in at least five information systems procurement projects for public sector
- Willingness to participate
- (For auditors only) Having undergone specialized training to audit the procurement of information systems.

This research will be conducted using the Delphi technique. The Delphi technique allows a geographically scattered expert panel to brainstorm and narrow down their ideas without meeting in person. Therefore, it consists of two questionnaire rounds, and after each round, the researcher acting as the moderator will provide feedback about the results of the previous round. Specific instructions will be provided for each questionnaire. The final aim is to achieve a consensus among all the panel members.

The time taken to complete the questionnaire will differ for each panelist. However, it will approximately take 15 – 30 minutes. The results will be available to you once the study concludes. Furthermore, please note that all the information you provide is treated as confidential. Your name is not recorded at any point, and you will only be identified using a unique code assigned to you by the researcher. You will also remain anonymous to other experts in the panel throughout the study.

I sincerely hope that you will find participating in this research exciting and an opportunity to gain a perspective about the viewpoints of other experts in this area.

Yours sincerely

Poboda Masakorala

MBA in IT- University of Moratuwa

Appendix C – Delphi questionnaire

3/20/2021

Public Procurement Procedures for the Digital Age

Public Procurement Procedures for the Digital Age

You are invited to participate in a Delphi survey on the topic Public Procurement Procedures for the Digital Age. The survey is focused on finding solutions to the problems all stakeholders face in the procurement of information systems for the public sector. An expert panel with 30 panelists including yourself from procurement entities, bidders and auditors will participate in this survey, and each panelist is an expert in the area of public procurement of information systems.

The outcome of the research is to come up with a set of recommendations to make the current information systems procurement process more coordinated and hassle-free for the stakeholders involved. The data gathered from the survey will only be used for the thesis requirement of the MBA in IT, at the University of Moratuwa, Sri Lanka.

If you have any suggestions, would like more clarification about the questions, or how the data will be used, please feel free to contact me using the details provided below.

This survey is collecting email address solely for the purpose of giving individual feedback. All the responses you provide remains confidential with the researcher.

Thank you very much for your time and help in making this study possible.

Poboda Masakorala
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0778120657
MBA in IT Student
Dept. of Computer Science and Engineering,
University of Moratuwa, Sri Lanka

*Required

1. Email address *

2. 1. How many years of experience do you have in information systems procurement activities for the public sector? *

Mark only one oval.

- ☐ 0-5 years
☐ 6-10 years
☐ 11-15 years
☐ more than 15 years

3. 2. In how many IS procurement projects for public sector did you get involved in during this period? *

Mark only one oval.

- ☐ 0-5 projects
☐ 6-10 projects
☐ more than 10 projects

4. 3. I am/was an employee of, *

Mark only one oval.

- ☐ a public sector procurement entity
☐ a private sector company who bids for IS tenders of public sector
☐ an auditing entity

5. 4. What is your gender? *

Mark only one oval.

- ☐ Male
☐ Female

6. 5. What is your age group? *

Mark only one oval.

- ☐ 20 - 30 years
☐ 31 - 40 years
☐ 41 - 50 years
☐ 51 - 60 years
☐ 61 or above

General

7. 6. The guidance provided by existing public procurement guidelines is not sufficient for the procurement of information systems due to intangible and volatile nature of IS. *

Mark only one oval.

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

8. 7. Procurement of complex information systems should be addressed explicitly in the procurement guidelines to support the digital transformation of Sri Lanka. *

Mark only one oval.

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

9. 8. Implementation of an e-procurement system will help to eliminate the outdated procedures used in public procurement such as sealed envelopes, bid securities and traditional payment methods. *

Mark only one oval.

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

10. 9. Implementing an e-procurement system will facilitate international bidders to participate in a tender. *

Mark only one oval.

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

11. 10. Information systems procurement should be considered as projects with national interest and necessary legal regulations should be put in place to continue such projects regardless of changes in the governing political party. *

Mark only one oval.

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

Tender Specifications

12. 11. In a complex IS procurement, the technical knowledge gap between procurement entity and bidder will reduce if the procurement entity only publishes functional requirements and let bidders architect solutions to match those requirements. *

Mark only one oval.

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

13. 12. In a straightforward IS procurement, publishing clear cut functional and technical specifications at the beginning of the tender, will ensure transparency and fair evaluation for all. *

Mark only one oval.

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

14. 13. In a complex IS procurement, publishing clear cut functional and technical specifications at the beginning of the tender will limit bidders' opportunity to present the best solution available in the market. *

Mark only one oval.

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

15. 14. If the procurement entity is expected to publish detailed functional and technical specifications at the beginning of the tender, they should be allowed to communicate with potential bidders upfront to get an idea about existing technologies. *

Mark only one oval.

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

16. 15. Letting bidders architect solutions to match the procurement entity's functional requirements will aid the procurement entity to identify the best solution for their requirement. *

Mark only one oval.

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

17. 16. In a complex IS procurement, doing a consultancy procurement upfront will aid the successful implementation of rest of the project. *

Mark only one oval.

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

Bid-evaluation criteria

18. 17. Two-stage bidding method is more suitable for complex information systems procurements, as the price bid is considered only upon completion of the technical evaluation. *

Mark only one oval.

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

19. 18. If bid evaluation of complex information systems is done as a combination of quality and price (single-stage bidding), assign more weight to technical quality and less weight to price. *

Mark only one oval.

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

20. 19. Using well known international standards and certifications of the industry to evaluate the service level of a bidder is useful. *

Mark only one oval.

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

21. 20. International standards requested in bid-evaluation criteria should be pre-approved to be used in public sector IS procurements to prevent bias to a particular bidder. *

Mark only one oval.

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

22. 21. Procurement entity should justify the requirement of asking for each international standard. *

Mark only one oval.

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

23. 22. Sustainability of the bidder should be addressed in the bid evaluation criteria. *

Mark only one oval.

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

24. 23. Bidder's quality is not a very significant factor if the procured item is a "product", as manufacturers thoroughly test those "products" before releasing to market. *

Mark only one oval.

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

28. 27. Public procurement guidelines should be used as a guide only, and the procurement entity should not be restricted by the law as long as they can justify their decisions. *

Mark only one oval.

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

Collaboration among procurement entities and bidders

29. 28. It will be useful and time-saving if a tender committee member can have a telephone conversation/emails with a previously nominated person from the bidder to clarify unclear areas of a submitted bid. *

Mark only one oval.

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

30. 29. The tender committee member should maintain written records of any such telephone conversations/emails quoting discussed points and feedback received. *

Mark only one oval.

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

31. 30. It will be useful if a bidder can have a telephone conversation/ emails with a previously nominated person from the procurement entity to clarify unclear areas of a published tender. *

Mark only one oval.

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

32. 31. Appointed member of the procurement entity should maintain written records of any such calls/emails received and points discussed. *

Mark only one oval.

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

33. 32. Right to Information Act allows bidders to clear any ambiguities they have about the decisions taken during the procurement. *

Mark only one oval.

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

Project management

34. 33. Due to the bureaucratic nature of the public sector, top management support and leadership is crucial for the successful implementation of IS projects. *

Mark only one oval.

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

35. 34. Apart from a strong leadership, assigning an employee from the public sector entity as the project champion to drive IS procurement projects will ensure successful implementation of such projects. *

Mark only one oval.

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

36. 35. Large projects such as information systems procurement and implementation should be well planned and carried out using a proven project management methodology from start to end. *

Mark only one oval.

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

37. 36. Procurement entity should complete a comprehensive feasibility study of the project, and necessary corrective measures should be implemented before starting the tender process. *

Mark only one oval.

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

Competence of procurers

38. 37. Public institutes with dedicated IT teams have a higher chance of successfully procuring and implementing complex IS projects. *

Mark only one oval.

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

39. 38. Potential users of a new system should be systematically guided to identify and present their requirements clearly and comprehensively. *

Mark only one oval.

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

40. 39. It will be useful if a single entity in the government with IS procurement specialists can overlook all government IS procurement projects with national interest. *

Mark only one oval.

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

41. 40. An IS procurement specialist with both IS and public procurement knowledge should be deployed to work with internal procurement teams of public institutes. *

Mark only one oval.

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

42. 41. These IS procurement specialists should be made liable for the successful implementation of the projects they were involved in. *

Mark only one oval.

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

43. 42. There should be at least two people with technical knowledge in a tender committee for procurement of information systems *

Mark only one oval.

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