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## Detecting and Preventing Fraud in e-procurement of Public Sector: A Review, Synthesis and Opportunities for Future Research

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### Abstract

The visibility of fraud losses in the public sector has harmed public service delivery. Reduced fraud can help the country's infrastructure expand by providing resources for better healthcare and education, reducing poverty, and funding security and defence. E-Government has turned the public sector into a more dynamic and diverse platform for government activity. Therefore, organizations, especially from the public sector, need to equip themselves with effective prevention and detection methods since preventing, detecting and justifying fraud is vital to combat e-procurement fraud. The most recent technology pertinent to such preventive and detection mechanisms must also be taken into account. The paper employed a comprehensive evaluation of 46 peer-reviewed studies published between 1998 and 2022 that address various areas of public sector e-procurement fraud prevention and detection mechanisms. This study supplemented the resulting state-of-the-art of e-procurement fraud prevention and detection mechanisms by integrating cross-disciplinary contributions from reviewing 10 papers on e-procurement, 22 papers on fraud prevention and detection mechanisms and 14 papers on fraud, procurement, cyber fraud, cybercrime and cybersecurity in order to assist in breaking down disciplinary silos and strengthening the management perspective. The review will be beneficial in understanding present fraud prevention and detection mechanisms practiced specifically in Malaysian government e-procurement. By identifying current government policies practises in preventing and detecting e-procurement fraud, government agencies may be able to assess the issues encountered and make amendments where necessary by providing new information in relation to good governance and strong internal control systems. The review as well finds that certain factors, such as e-procurement fraud prevention and detection methods implemented in the public sector, are severely underdeveloped. This study shows how the results of earlier studies executing preventive measures which contain solid control methodology like fraud detection and employers' knowledge of fraud prevention mechanisms where it actually tends to cover the research gaps which have been identified from the previous studies. In that case, it is important for directors or top management, auditors as well as the middle management to know their role in coming up with such preventive measures to overcome the e-procurement fraud cases happening at their

organizations. The paper add knowledge to the academic world, enabling future research in this field to be expanded by exploring particular prevention and also detection mechanisms in depth.

**Keywords:** e-Procurement, Fraud Prevention, Fraud Detection, Comprehensive Evaluation

## Introduction

Public procurement has been identified as one of the government's activities most vulnerable to collusion, corruption, manipulation and fraud. The Malaysian Anti-Corruption Commission (MACC) report states that public sector procurement topped the significant financial loss list through corruption and fraud between 2013 and 2018, at 43 per cent due to unlawful manipulations of the procurement process (Siddiquee and Zafarullah, 2022). According to Caulfield's (2014) findings, enormous public spending and inefficient administration among multiple public organisations have made fraud in public procurement a burden for the government. PWC (2015) estimates that 60% of fraud and economic crime offenders in the public sector are government employees. Additionally, it shows that since 2012, procurement fraud has grown in the public sector.

E-procurement has been introduced in the government in September 1999. Although the use of e-procurement increased the transparency of the procurement process, fraudsters were still able to take advantage of the system's flaws, which led to the continuation of corrupt activities. The public sector is constantly at risk from e-procurement fraud since internal officers are either directly or indirectly involved in it (Eaton and Korach, 2016). According to a study by Haron et al (2011), one of the most frequent concerns mentioned in procurement is the incompetence of a procurement officer, particularly in monitoring and auditing the progress and execution of the project tender. When performing their duties as e-procurement officers, they must act with the utmost professionalism and in accordance with the values, goals, and interests of the Malaysian public sector. According to Huda et al (2017), the lack of openness, the difficulty in accessing information, and the lack of responsibility and control at each stage all contribute to the risk of fraud in e-procurement. According to Aditya et al (2017), a lack of accountability and transparency gave users including vendors and public officials—more possibilities to flout the law in order to commit corruption.

## Discussion on Public Procurement Fraud Cases

According to the National Anti-Corruption Policy (NACP) 2019–2023 study, the public sector in Malaysia has been the most susceptible to corruption over the past five years (2013–2018). It was based on a comparison of the vulnerability rates in the public and private sectors, with the private sector's rate being only 17.06% and the public sector's being 63.30%, respectively. This result revealed a higher concerning rate for the public sector and points to poor governance in its administration, legal enforcement organisations, and procurement processes.

In addition, according to a report released by the Public Service Department (2020), 184 public employees from various ministries were found guilty and punished appropriately for 564 punitive issues discovered in Auditor-Reports General's between 2012 and 2018. According to the Malaysian Anti-Corruption Commission (MACC) (2021), 467 (46.8%) public employees were detained in 2020 as a result of corruption proceedings, compared to 572 (50.4%) in 2019 and 416 (46.0%) in 2018. In the same report, MACC disclosed that over the previous six years, civil officials were involved in half of the corruption cases in the country. MACC further stated that, according to the arrest statistics from 2015 to 2020, there were

5,652 arrests made overall, of which 2,683 or 47.5% were of civil servants.

The nation's socio political and economic structure, which is made up of a number of stakeholders, is intimately related to a string of public procurement scandals in Malaysia's public sector (Hwang, 2003; Kamal, 2012; Leong, 2014). For instance, a chairman in Malaysia who also happened to be the husband of a well-known politician was charged with squandering and misappropriating funds by buying a luxury car, two plots of land, and vacation packages (Kamal, 2012; The Star, 2012a). In yet another high-profile case of procurement fraud, a former transport minister is charged with being responsible for the overpriced land bought for the Port Klang Free Zone project for RM129.5 billion (Baharom, 2012; Ming, 2012). William Case's study in 1994 found that the government's prolonged term gives it the freedom to meddle in industry and build patronage networks in order to secure lucrative contracts and licences for its political members. In connection to the promotion of state patronage in the form of official contracts, licences, and development subsidies, Teh (2002) emphasises the pervasiveness of "money politics" in Malaysia. Last but not least, the majority of Malaysian corporations consider bribery and corruption to be essential corporate survival strategies, according to KPMG's Fraud, Bribery and Corruption Survey from 2013 (KPMG Malaysia, 2013). In general, there are poor management, theft and also suspected fraud in Malaysia's public procurement system (The Malaysian Insider, 2013a). It should be emphasised that corrupt politicians, business elites, bureaucrats, and public officials, as well as fraudulent practises and illegal operations in Malaysian public procurement, appear to be deeply established in the country's governance of the public sector (Gomez and Jomo, 1997; Siddiquee, 2010). For the following reasons, Malaysia is a particularly fascinating subject that is worth analysing when it comes to public procurement fraud.

Ab Majid et al (2014) research on Malaysian local authorities revealed that asset misappropriation is not only a top concern in the public sector but also a common perception within the organization. According to their study, using government vehicles for personal purposes appears to have the highest rating, while using the office phone is one of the top four problems. The studies have reliable KPMG Malaysia report (2011) showing that, asset theft, bribery, and broken trustworthiness are the three fraud categories that consistently rank at the top of the list in the government sector. All of these should not be happening. Government employees have an ethical duty to carry out government projects using public funds, and the government's corporation cannot be separated from accountability (Sarji, 1993). Even if there are notable institutional channels and strategies to pursue when it comes to professionalism issues and public officials' ethical behaviour (Siddiquee, 2006), the government's efforts seem to provide just average results. This failure is actually one of the policy institution's challenges in an organization (Siddiquee and Zafarullah, 2022). Siti-Nabiha and Scapens (2005) in their study found that although new policies have been formally implemented in an organization, frequently the practice is simply for formal objectives only. This indicates that although decision-making and other activities continue in an unpretentious manner, policy fulfilment in the organization only occurs for the purpose of reporting and under pressure from the upper management.

One of these was the infamous Royal Malaysian Customs Department (RMCD) shoe purchase scandal, which was handled by its headquarters between 2009 and 2013 and included a sum of RM6.86 million. According to audit findings, the remaining shoes purchased in 2009 had not been distributed by the end of 2012, and a total of 7,659 pairs of shoes worth RM602,089 were to be disposed of because they were damaged (National Audit Department, 2013). The government has suffered a loss as a result of RMCD's supervision of the shoe

purchase process. Regardless of whether the incident was caused by the officials in charge of purchasing or those in charge of distributing shoes, it cost the government money and had an impact on its finances, even if the case is still being investigated.

Another alarming conclusion of the investigation was that the government has lost valuable assets like firearms and handcuffs due to the Royal Malaysian Police's lack of asset management control. If these assets are managed and secured by an inefficient internal control system, it could have devastating consequences that endanger public safety. According to the National Audit Department (2013), 309 units of assets worth RM1.33 million were reported missing between 2010 and 2012. Among the main categories of lost assets were 156 units of handcuffs, 44 units of firearms, and 29 units of vehicles. The overall management of losing assets in Bukit Aman Police Headquarters and its three Police Contingents (IPK) is unacceptable, according to the auditor general. The public has expressed concern about this outcome since it will make people doubt the police department's honesty and responsibility in preserving national security while also showing that they are unable of efficiently managing and controlling their resources.

### **Reviews on Past Studies in e-Procurement, Fraud Prevention and Detection Mechanisms as well as other related areas to fraud and procurement**

There were some past studies which has been discussed in the area of e-Procurement, fraud prevention and detection mechanisms as well as other related areas to fraud and procurement.

#### **e-Procurement**

Ten studies were done in the area of e-procurement from year 2013 till year 2021. The ten studies have been discovered through bibliometric analysis. Those ten studies mainly identified e-procurement as a tool to mitigate procurement fraud and also to carry out procurement process in a more transparent manner. The main drivers of e-procurement adoption are transaction and administration cost savings, reduced time, increased transparency, and improved communication between suppliers and buyers (Ahmad and Ismail, 2021; Neupane et al., 2014; Abdullahi et al., 2019; Rotchanakitumnuai, 2013; Said and Omar, 2017; Sholihin and Alim, 2020; Azmi and Rahman, 2015; Nawi et al., 2017; Shukla and Shah, 2016; Khan et al., 2022). All the studies are found to be from various journals such as emerald, Asia-Pacific Management Accounting Journal (APMAJ), Journal of Management and Humanities and International Journal of Supply Chain Management (IJSCM).

#### **Fraud Prevention and Detection Mechanisms**

About 22 studies have focused in the area of fraud prevention and detection generally. Those studies have been found in year 1998, 2003, 2012, 2015, 2017, 2018, 2019, 2020 and 2021 and the studies have been discovered through bibliometric search. Prevention and detection mechanisms such as internal control, data mining technology used to detect financial fraud and extensive knowledge and practice in Explain the Audit Procedure (EDP) as a part of fraud detection are all found to be the measures used to combat fraud (Abd Karim et al., 2018; Madi et al., 2021; Dangi et al., 2020; Zakaria et al., 2016; Azmi and Ismail, 2022; Alam et al., 2018; Muhamad and Gani, 2020; Ali et al., 2021; Musa et al., 2012; Aziz et al., 2021; Vanasco, 1998; Mwelu and Watundu, 2020; Quah, 2015; Alazzabi and Karage, 2020; Prenzler, 2019; Abramo and Brasil, 2003; Howell, 2017; Šnjegota, 2017; Iskandar, 2019; Al-

Hashedi and Magalingam, 2021; Donning et al., 2019; Nawawi and Salin, 2018). Those researches were from the journal of financial crime, International Journal of Law and Management, Journal of Financial Reporting and Accounting, International Journal of Ethics and Systems, Journal of Finance and Risk Perspectives and Journal of Criminological Research, Policy and Practice.

The remaining of 14 studies were in the area of fraud, procurement, cyber fraud and cybercrime. The studies have been covered in year 2011, 2013, 2014, 2015, 2016, 2017, 2019, 2020, 2021 and 2022 and all the studies have been discovered through bibliometric search. Theories on fraud, weaknesses on public procurement, emergence of online attacks such as cyber fraud and cybercrime seem to be the areas discussed in those studies (Bakri and Said, 2017; Hui et al., 2011; Zainun *et al.*, 2020; Akenroye, 2013; Flynn and Harris, 2022; Owusu et al., 2021; Rustiarini *et al.*, 2019; Azmi *et al.*, 2017; Zaharon, 2021; Singh *et al.*, 2021; Alam and Said, 2015; Ahmi et al., 2014; Mohammad et al., 2022; Lagazio et al., 2014). The studies were from the Journal of Public Procurement, Journal of Money Laundering Control, International journal of Public Sector Management, International Journal of Sociology and Social Policy, Asian Journal of Scientific Research and Science Direct.

## **E-Procurement Fraud Prevention and Detection Mechanisms**

### **Preventing**

#### **Transparency and public notice**

Sound procurement procedures include concepts such as openness and public notice. While transparency ensures that procurement procedures are clear and must be followed at all times during the procurement process, public notice (publicity) enables stakeholders to examine public officials' performance. The OECD suggests that each country follow these two guidelines throughout the policy process, including taking decisive action in response to current challenges and granting unrestricted access to information (Organization for Economic Co-Operation and Development, 2016).

Transparency also allows stakeholders to keep track of performance and scrutinize decisions of procurement officials. For civil society and non-governmental organizations (NGOs) to act in a managerial capacity, appropriate data, such as bidding procedures, procurement process status, contract notices, and others, must be available promptly. In order for stakeholders to understand the priority scale utilized in policymaking and government spending, transparency also aims to ensure that the flow of public funds is apparent.

#### **Personnel in charge of procurement receive training**

Many organizations for Economic Co-Operation and Development (OECD) countries provide procurement officials with specialized training to help them apply particular standards or codes of ethics in procurement operations. It is necessary to professionalize this activity in order to improve professional qualifications and safeguard the institutional integrity of public procurement. Integrity is the attitude upholding moral values and ethical norms such as truth, professionalism, and honesty in the public procurement process, insuring equality, non-discrimination, and compliance. Public officials are therefore expected to be able to avoid conflicts of interest between their professional obligations and personal goals (Organization for Economic Co-Operation and Development, 2016). Procurement officials, in particular, must be trained to ensure that they follow the norms of public procurement, including anti-corruption methods. Additionally, it is crucial to guarantee that all procurement personnel involved in financial decisions have received training on



how to detect procurement fraud (Guile, 2013). A procurement officer as well must be able to recognize fraud indicators so that preventative actions can be implemented as soon as possible (Organization for Economic Co-Operation and Development, 2007).

### **Good Practices**

The efficient handling of public procurement is intrinsically connected to good governance. The government requires professional and knowledgeable resources in order to make the best decisions. To gain efficient resources, procurement officials must take part in training and educational programs. They thus recognize the value of sound decision-making and excellent administration. The following are examples of good practice in public procurement:

- defined responsibilities and duties for official procurement;
- processes or regulations for approving written transactions
- there are documented procedures or regulations for sanctioning transactions
- transparency
- comparing and assessing the value of the proposed offer's
- ensuring that procurement personnel are following standards and instructions as well as have attended training
- ensure that the whistleblowing system is in good working order; and
- ensure that the audit system is functioning properly (Association of Internal Control Practitioners, 2019).

### **Controls**

#### **Internal Controls**

For the public procurement process to be effective and efficient, internal control mechanisms are essential. Accounting controls for asset security and record accuracy used to be the main focus of internal control. The scope of internal controls has expanded beyond accounting. The Committee of Sponsoring Organizations of the Treadway Commission (COSO) has updated the definition of internal control to read as "a process, implemented by the board of directors, management, and other personnel, and designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance" (Tan, 2013). The five elements of COSO's Internal Control Foundation, which provide a general framework for creating an effective internal control system, include the control environment, risk assessment, control activities, information and communication, and monitoring activities (Tan, 2013). If the auditor can assess procurement documents like payment of contract, bid documents, minutes, as well as other related documents, to make sure that regulations are followed and to find any potential activities or unethical transactions, then this function will be helpful in the public procurement setting (Meagher, 2005). The duty of this position is to ensure that the guidelines and laws that control the public procurement process are uniform (Organization for Economic Co-Operation and Development, 2007). The functions of the internal control system must therefore be under the leader's supervision and observation.

#### **Additional controls**

In addition to internal parties, forensic auditors and external auditors—collectively referred to as external parties—perform the control role. The internal audit division in charge of public procurement clearly possesses the greatest knowledge of procurement techniques, but they might also become involved in the political environment (Free and Radcliffe, 2009). The actual audit work could be subcontracted by the internal auditors to external public accountants in order to avoid

political minefields when investigating potentially unethical procurement practices (Neu et al., 2013). A number of "blind spots" that internal auditors could miss can be revealed by the existence of external audit support. One of the most recommended experts in the fields of investigation and accounting is the forensic auditor. Forensic audits are often carried out when a corporation wants to make a general assessment of high-risk procurement, such as inquiries into corruption to gather evidence in court. The general public and civil society organizations must be given the authority to engage as stakeholders in public procurement in addition to auditing institutions (Organization for Economic Co-Operation and Development, 2007). Additionally, control can be maintained through the media (Organization for Economic Co-Operation and Development, 2007). Traditional print and radio media can concentrate more on concerns of fraud to reach the population that the internet neglects (Williams-Elegbe, 2018). Freedom of the press and the media are effective tools for encouraging accountability and transparency.

### **Detection**

#### **Red Flags**

Identifying fraud is a challenging task. Most scams were discovered by "chance" since internal and external auditing agencies were unable to demonstrate the fraudulent conduct (Evans, 1987). It therefore requires a detailed understanding of the characteristics and core of fraud. An alert (red flag) is necessary for the auditor to concentrate on reviewing risk performance and minimizing risk of fraud that goes unnoticed. Red flags are signs that may point to a potential concern. This indicator will direct the auditor to examine the object more closely. Red flags function as an early warning indicator for fraud detection. As a result, pay attention to any small red flags that may point to fraud, such as a close working connection with a supplier that may be closer than you think (Guile, 2013).

#### **Encouraging reporting and facilitating (system of whistleblowing)**

An investigation into a situation may occasionally start with complaints made by specific people, groups, media outlets, and members of the public. Recently, whistleblowing has emerged as a crucial system for maintaining the integrity of public accountability (Achua, 2011), as well as a very effective tool for disseminating information about corruption or bribery (Organization for Economic Co-Operation and Development, 2007). Many countries have whistleblower laws that encourage people to report illegal or unethical behaviour. These rules will protect the reporter's confidentiality and shield them from retaliation (Williams-Elegbe, 2018).

Unfortunately, few people are willing to do whistleblowing since doing so entails such a high risk. With the ratification of the whistleblower law, circumstances involving procurement corruption, such as conflicts of interest, bribery, poor planning, and poor contracts management, are likely to be averted (Williams-Elegbe, 2018).

### **Teamwork**

Public procurement requires a variety of knowledge and skills, including those in accounting, economics, law, architecture, and engineering, among others. Therefore, one of the most crucial duties of public procurement professionals is to effectively communicate with those taking part in procurement projects (Thai, 2001). If a problem occurs throughout the procurement process, the team will work together to discover the best solution. Efficient management (teamwork) is one of the best preventative strategies because it encourages accountability and openness, makes oversight simpler, and provides a strong foundation for preventing corruption (Tukamuhabwa, 2012). The team's integrity and commitment are shown through the execution of transparent and

accountable procurement actions. Remove all of an employee's current authorizations and replace them with authorizations that are appropriate for their new roles if they are transferred to different departments or functions within an organization (Guile, 2013).

### **Investigation and sanctions**

#### **Effective sanctions and regulations**

Public procurement regulations must be clear, unambiguous, and easy to understand. Strong punishments, technical execution phases, and term definitions must all be included in the rule. The best defences against bribery and corruption in public procurement are unambiguous rules and regulations followed by severe penalties that are successfully applied by public agencies and courts (Organization for Economic Co-Operation and Development, 2007). There is greater compliance with the law as a result of the increased penalties and enforcement action (Zubic and Sims, 2011). The prospect of legal repercussions is therefore essential for ensuring regulatory compliance.

#### **Investigations of multi-disciplinary**

Professionals advise that investigations should be led by a strong, knowledgeable team that can work with non-judicial experts. Some governments have brought in non-judicial experts who have expertise in certain commercial or technological fields related to procurement. These experts could offer helpful information when assessing item specifications or checking the quality standards of goods or services. For example, architects or civil engineers will be able to offer technical guidance on product specifications and quality control, while legal experts can help with the examination of processes and contract performance. Accountants or forensic auditors can investigate a company's accounts and the flow of money with other people (Organization for Economic Co-Operation and Development, 2007).

#### **International co-operation and harmonization**

Experts draw attention to the shortcomings of attempts to stop, look into, and prosecute international public procurement operations. The absence of international cooperative harmonization is the cause of these restrictions. According to experts, harmonization is essential because cross-country tender activities with different thresholds can result in circumstances that encourage corruption. Although it can be harmonized, it does have unique legal requirements. Experts think that a worldwide agreement on the connection between public procurement and corruption is required in light of these limitations. The enforcement and implementation of such international agreements must concern all nations.

Public procurement is a high-risk area for fraud, especially in government organizations (Rustiarini et al., 2019). On the surface, however, it cannot be empirically witnessed. In order to develop effective strategies to prevent procurement fraud, academics have studied a wide range of economic, social, and political issues. However, no study has clearly characterized the individual factors that contribute to procurement fraud. In order to further their own interests, procurement officials are free to offer public goods at their discretion.

### **Research Methodology**

This paper employed the Bibliometric Analysis in searching for the past literatures related to e-procurement, fraud prevention and detection mechanisms as well as other related areas to procurement and fraud.



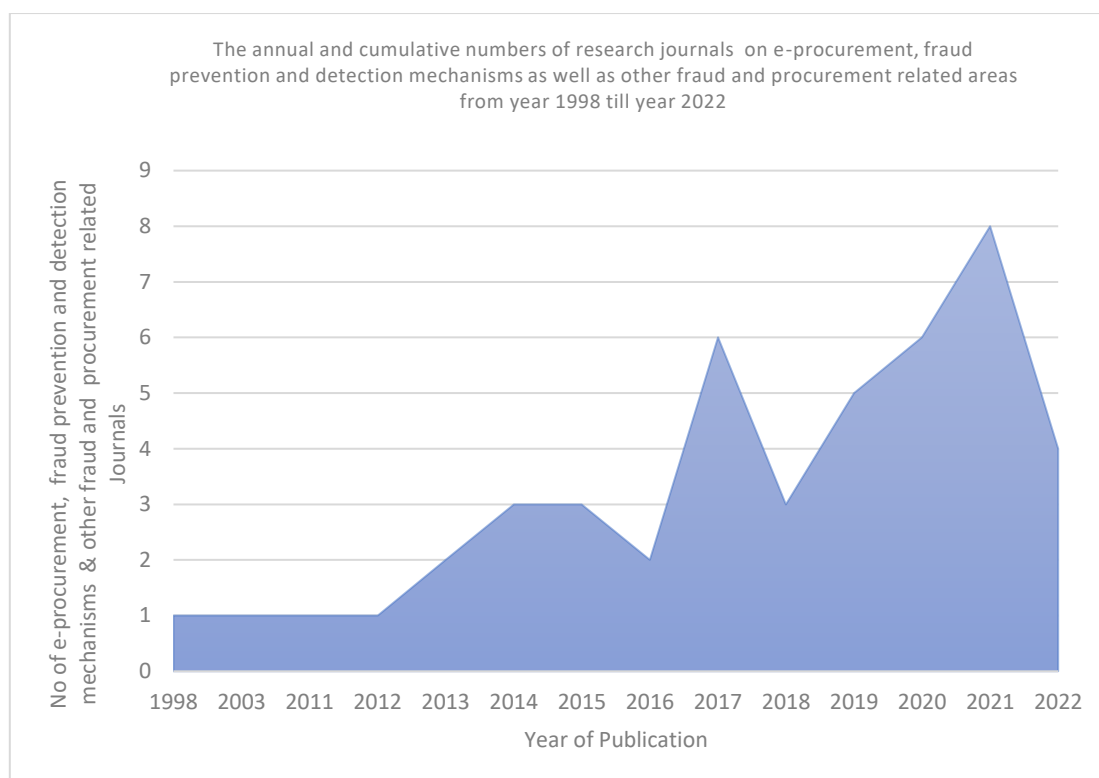


Figure 1: Number of journals published according to years

Figure 1 above shows the cumulative numbers of research journals on e-procurement, fraud prevention and detection mechanisms as well as other areas related to procurement and fraud ranging from year 1998 till year 2022. It can be seen that the number of journals published each year is not consistent where there might be difficulties in data collection or less interest is shown in this area of research.

A systematic review is defined as gathering all relevant research data, refining it by removing redundant material, and summarizing what is left (Grant and Booth, 2009). The use of a repeatable procedure and including a criterion-based literature selection from comprehensive sources, according to Cook et al (1997), distinguishes systematic reviews from narrative reviews. Even though the integration of fraud prevention and detection in cyber-fraud, procurement and e-procurement as well as its hurdles to be implemented in the Malaysian public sector are new research topics in the procurement area, there is already extensive literature available on fraud prevention and detection mechanisms and also procurement in Malaysian government in general. As a result, a systematic review was required to decrease the large number of articles in these fields in a systematic and repeatable manner. The methodology described below, on the other hand, does not simply have systematic review characteristics. It also demonstrates integrative review characteristics, as it synthesizes and integrates literature from a variety of domains to solve the study's research topic. Figure 2 shows a process flow that was created to follow a systematic and repeatable research approach. The subsections that follow describe the various components of Figure 2.

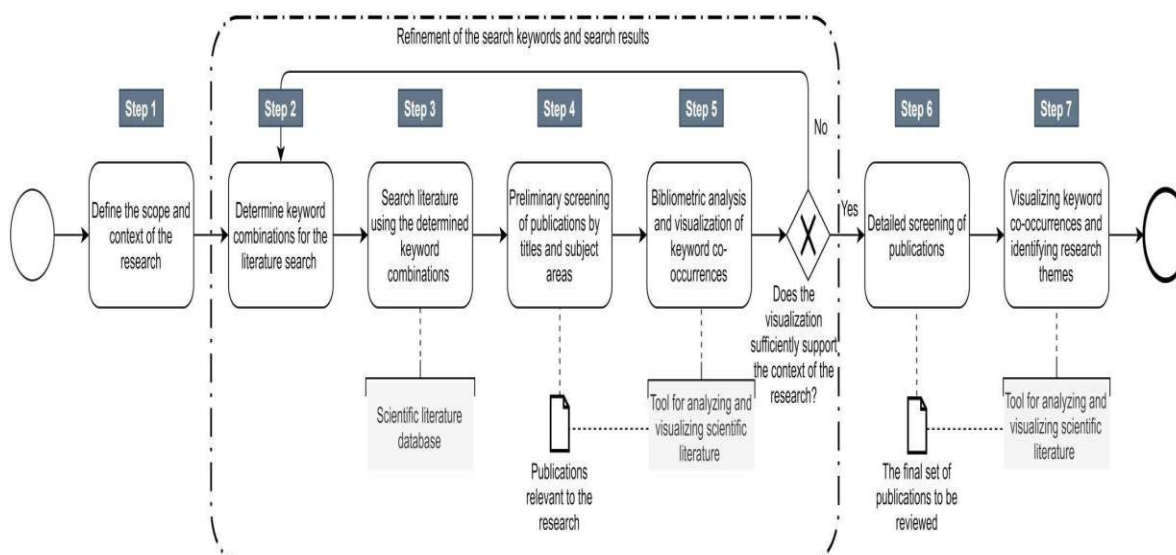


Figure 2: Main elements of the Bibliometric Analysis Process  
 Step 1: Describe the research's scope and context.

To discover search keywords and reduce the research focus, the first step in a systematic search is to define the scope (Tranfield et al., 2003). This stage is critical for directing time and effort in a variety of studies in a specific direction and identifying relevant and irrelevant publications to the study topic (Chen et al., 2018). When scoping literature, specifying the publication period is critical to avoid dealing with a massive volume of data. Furthermore, when examining a technology-related research topic, focusing on a current time is crucial to highlight the most recent innovations. The scope of this study was defined as an evaluation of the literature produced between the years of 1998 to 2022, pertinent prevention and detection in overcoming fraud which is integrated to cyber-fraud in the Malaysian public sector e-Procurement. To focus on the most recent technological breakthroughs and identify current papers, the publication period was confined to the last five years. Based on the aforementioned definitions, this study recognizes that fraud prevention and detection mechanisms are important in combating fraud in the cyberspace; as a result, fraud, cyber-fraud, procurement, and e-Procurement related publications are all included in the scope of this study. Search Keywords and Results are being fine-tuned. Before moving on to the comprehensive screening process, this section of the review will find the most optimal keyword combinations for the chosen study context and filter the search results. It was accomplished through a four-step iterative procedure.

Step 2: Come up with a list of keyword combinations for your literature search.

The first stage in the iterative refinement process for identifying the final keyword combinations to employ in the literature search is to do this. The Boolean operators AND, OR, and NOT were used to combine keywords (e.g., cyber fraud AND e-Procurement). There were very few publications that met this requirement after searching for literature relating to all three key topics of this research—fraud, procurement, e-Procurement as well as fraud prevention and detection. As a result, it was agreed that the literature search would be divided into three categories, each of which would cover a combination of two topics:

- (1) fraud and procurement,
- (2) fraud and e-Procurement,
- (3) fraud prevention and fraud detection
- (4) procurement and cyber-fraud,
- (5) procurement and e-Procurement,
- (6) fraud or e-procurement,
- (7) procurement or e-procurement,
- (8) fraud prevention or e-procurement
- (9) fraud detection or e-Procurement
- (10) fraud and e-Procurement model
- (11) procurement fraud prevention and detection model
- (12) e-Procurement fraud prevention and detection model

### Search Results

This part of the review aims to identify the most optimal keyword combinations for the defined research context and refine the search results before the detailed screening step. It was achieved by an iterative process that involved four steps.

Table 1

*Keyword combinations for the literature search after refinement*

Category	Search OR No.	Search keyword		AND		
		OR	OR		OR	NOT
Fraud	Search "e-Procurement"		—	"Procurement"	"Public Sector"	
Procurement and e-Procurement	Search "Fraud"	"Cyber-fraud"		"Model"	"Public Sector"	
Fraud prevention and fraud detection	Search "Types"					
	Search "Types"					
	Search "Types"	"Elements"			"Private Sector"	

The final keyword combinations determined after the refinement process are shown in Table 1. Search 1–5 include control system in combination with four different construction-related keywords: (1) fraud, (2) procurement, (3) e-Procurement and (4) fraud prevention and detection. As the keyword cyber-fraud is rarely used in combination with procurement related keywords in publications, it was decided to search for procurement especially e-Procurement related studies. However, to cover a broader range of publications, the keyword fraud was used instead of cybercrimes, and the results that include technical stuffs were excluded to eliminate a significant number of irrelevant publications.

### Step 3: Literature Search Using the Determined Keyword Combinations

The Scopus database, which contains over 10,500 peer-reviewed journals and over 150,000 books, is used in this step of the iterative refinement process (Elsevier, 2019). The Article title, Abstract, and Keywords fields were chosen for document searches on Scopus, WoS, and Emerald. The document type was set to ALL to cover books, book chapters, conference papers, and journal articles, and the search was limited to a date range of 1998 to 2022. All of the searches in Table 1 were run separately, and the results were saved in a comma-separated values (CSV) file. Secondary materials were also exported and used in additional research to cover related literature fully.

### Step 4: Visualization of Keyword Co-Occurrences and Bibliometric Analysis

The last step in the refinement process was to visualize keyword co-occurrences to see if the search keywords determined so far were adequate and appropriate for the research context. If the visualization did not show the research areas and their relationships clearly, the refinement process began with the first step: determining keyword combinations for the literature search. "A software tool for generating and visualizing bibliometric networks," (Van Eck and Waltman, 2017). Because CSV files output from Scopus are compatible with VOSviewer, the files gathered in the preceding steps did not need to be modified or reformatted. The keywords in the visualization were chosen by removing terms with fewer than ten occurrences, as proposed by Van Eck and Waltman (2020), as well as generic search terms (e.g., cyber fraud, and public sector).

VOSviewer created a visualisation for each iteration of the refining, exhibiting the research areas in different coloured clusters. The keyword co-occurrences in the articles and the relationship between keywords were used to create these clusters (i.e., being closely or loosely related). Without the prior and detailed screening stages, Figure 3 shows the keyword co-occurrence network generated using all search results.

Because of the large number of keywords and lack of refinement in search phrase combinations, the network in Figure 3 is ineffective in identifying significant clusters. The goal of Figure 3 is to emphasize the importance of the screening procedures. As can be observed, this network does not yield any discernible clusters or research areas.

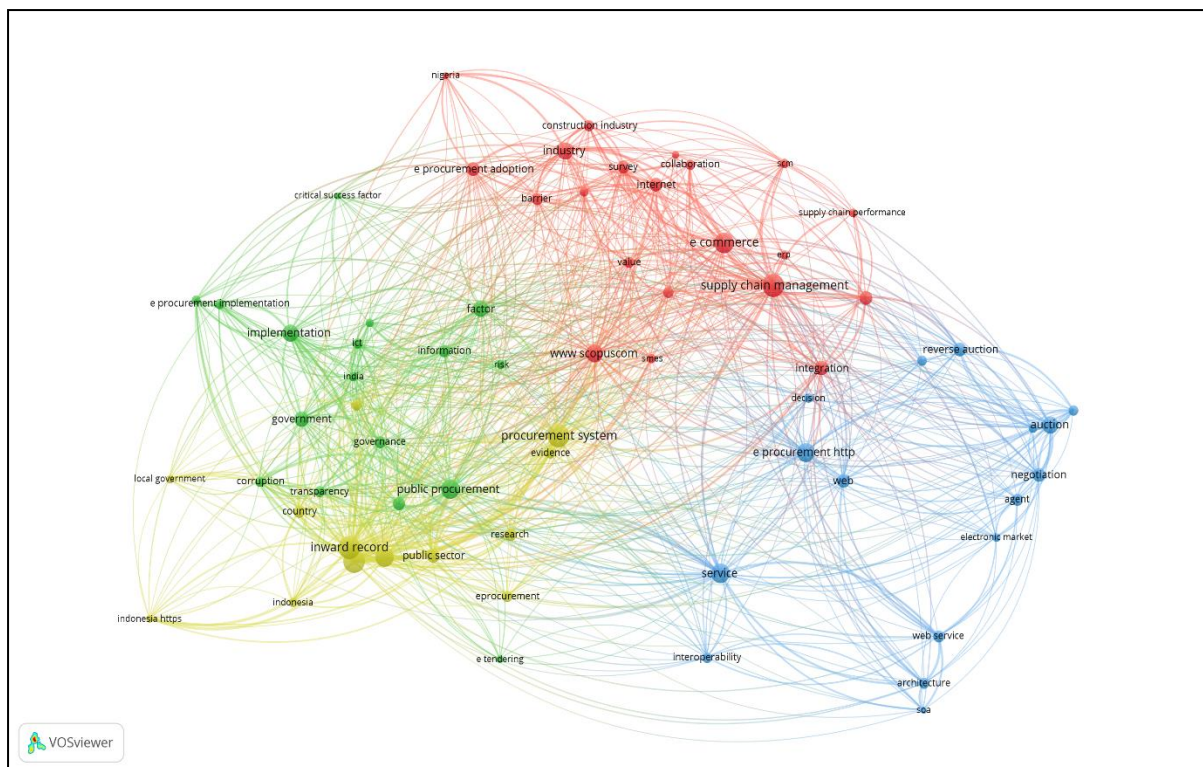


Figure 3: Keyword co-occurrence network created using the publications after the preliminary screening (46 publications)

### Future Research

Based on the discussion from the papers being reviewed, there is a need for extensive studies in the area of e-procurement especially on the types of e-procurement fraud as well as e-procurement fraud prevention and detection mechanisms. The studies which have been done earlier has not tapped in this area. Therefore, researches on types of e-procurement fraud and also e-procurement fraud prevention and detection mechanisms will be the future direction of this review paper.

### Conclusion

Previous studies on fraud prevention and detection mechanisms have concentrated primarily on the private sector (Bierstaker *et al.*, 2006; Smith, 2012; Apostolou and Crumbley, 2008; Vinten *et al.*, 2005; Oluwagbemiga, 2010; Durtschi, 2004; Rahman and Anwar, 2014). On the other hand, limited studies were conducted on fraud detection and prevention in the public sector. In addition, those researches center for the most part on fraud alertness, categories of fraud occurring in the public sector and several fraud deterrents and discovery actions. Nonetheless, not one was upheld through information gathering. Hence, this review bridges the gap by exploring the execution of e-procurement fraud prevention and detection mechanisms, suitable e-procurement preventative and detection measures based on the existing ones, and introducing improvised e-procurement prevention and detection mechanisms. In addition, the proposed element will result in enhanced e-procurement fraud prevention and detection mechanism. Validation and further extension of the enhanced framework with the proposed element through an empirical investigation will be the future direction of this research.



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