A Continuous Compliance Awareness Model (CoCAM) for Procurement Internal Audit

Compliance management for procurement internal audit has been one of the major challenges for public sectors due to their lengthy period of manual audit history and large-scale paper-based repositories. Many practical issues and potential risks arise during the manual auditing process, including low level of efficiency, accuracy and accountability, high consumption of expense, time and labour. In order to alleviate these problems, this paper proposes a continuous compliance awareness model, CoCAM, to automatically and timely audit organisation purchases by intelligently understanding compliance policies and extracting required information from purchasing evidences using text mining and machine learning techniques. Based on the auditing results, the CoCAM is able to provide a continuously updated report demonstrating the compliance level of the procurement with statistics and diagrams. We evaluate the CoCAM on a real-life procurement dataset, and results show that it is able to process 500 purchasing evidences within 5 minutes and provide 95.6% auditing accuracy, demonstrating its effectiveness and efficiency in procurement internal audit.

Keywords: continuous auditing, traditional auditing, manual audit, compliance, procurement management

Introduction

Currently, the way how business is conducted and financial information is managed has significantly altered by the acceleration of information flows under digital economics. Meanwhile, a rapidly growing number of organisations are conducting accounting information recording and financial reports generating in real-time using powerful online enterprise resource planning systems. However, whether in public or private sector, the traditional auditing paradigm where the auditors provide ex-post financial opinions seems still remain at a pre-digital age [3]. There’s evidence showing that auditors are relatively slow in taking up new technologies. A study carried by KPMG found that bigger samples and more advanced technologies should be used to gather and analyse data advised by 80 per cent of respondents. [1]. Audits “need to adapt to the digital age” [9].

In general, traditional methods of conducting auditing activities is outdated in the current economy environment in the aspects of both efficiency and high-quality. Previous research had found that despite the increasing of auditing effectiveness and efficiency in both public and private sectors, public sectors have an obviously stronger emphasis [15]. However, the manual nature of the current procedures in public sector has constrained auditing to be a labour and time intensive business activity with an annual occurrence [6]. In addition to the low efficiency of manual audit, traditional audit approaches also reveal a
large number of fraudulent activities [12]. The report from the Association of Certified Fraud Examiners (ACFE) in 2018 has advised that merely 15 per cent of all frauds are uncovered by auditors [13].

Procurement is always a ‘big spend’ for public sectors and therefore, high financial risk area of public sector management. It can also impact on legal and reputational risk due to failing compliance rules. There are numerous examples of government procurement failure. Public sector internal auditors play an important part in identifying and mitigating associated risks. Unfortunately, public sector auditors are still suffering from the deficiencies of manual checking process including high consumption of time and labour.

In order to discover the practical issues during the procedure of traditional public sector procurement auditing, this study takes an insight into a large-scale public sector purchasing system and investigate whether the organisation’s auditing function to the daily procurement procedure is operating at high quality and efficiency level. By putting ourselves in the position of an auditing team and manually comparing the purchasing sample data (unit price, quantity, foreign currency, etc.) from the organisation’s purchasing system against the corresponding evidences which are supposed to be uploaded, the study will provide a clear vision that the current purchase auditing process in this organisation can be time consuming, costly, inadequate and lack of high assurance level.

This investigation is meaningful as the results offer a clearer and more scientific view for the purchase evidence audit, which can facilitate in providing recommendations and suggestions to the procurement managers of the organisation for auditing process and policy improvement. Also, addressing the audit and management issues discovered in this study can also be considered as the motivations for developing automatic and continuous auditing in compliance and risk assurance management. Finally, according to the deficiencies of traditional audit procedures in actual audit work, we propose a continuous compliance auditing model which will significantly improve efficiency and quality of public sector auditing and help to remain a proper risk level of procurement process.

Related Work

Same as general auditing, Main goals of public procurement audit is to assess how efficiently, effectively the procurement process is in areas of compliance with requirements of laws and established ethical standards and detecting possible frauds and misuses based on sufficient and proper evidence. It is undoubtedly vital in providing reliable assurance of useful financial procurement information and can have a significant preventive effect on detecting misusing and fraudulent procurement behaviours. However, studies has shown that the current auditing practice is not able to provide high level of assurance for corporation business behaviours efficiently and effectively. DeWayne(2003) indicated seven types of audit wastes possible in the traditional audit profession, namely over auditing, waiting time, time delays,
the audit procedure, work-in-process, review process as well as errors and mistakes[14] which are also applied to public sector procurement activities. In the following section, a literature review will be conducted regarding to current procurement auditing process’s quality, efficiency and assurance level. The first part of this section will provide a clear view of current procurement audit deficiencies, which will thus benefits the establishment of our continuous auditing method. In the second part, a review of previous continuous/real-time auditing methods and practices will be conducted to provide a better understanding of the advantages of our CoCAM methodology.

Specific to this study, in the auditing quality study includes works related to whether current auditing approach is operating effectively in the aspects of detecting corporate frauds to maintain a proper risk level and controlling unintentional audit errors. Auditing efficiency study involves auditing resource occupation analysis in terms of time, money and labour. Auditing assurance study contains the aspects of auditing scope and reporting frequency. The general framework of the literature review is shown in Figure 1:

**Figure 1. Framework of Procurement Auditing Methods Review**

The scandals like Enron, WorldCom, Parmalat and Xerox exposed disadvantages in the traditional financial reporting and auditing system and also illustrated the importance of auditing quality [3]. Unfortunately, current audit approaches and sampling methods are not able to be fully relied on to uncover the majority of transaction errors or occupational fraud [17].

The Association of Certified Fraud Examiners (ACFE) found that only 15 per cent of financial frauds are uncovered by auditors, while a large percentage of 40 per cent were detected by anonymous tips [13]. The reason behind is that financial report auditing only been conducted on a yearly basis and most auditing procedures are based on small transaction sample data sets over fixed financial periods. This method is outdated due to the significantly increased transactions happening in the current economy. Thus, the sampling method is not sufficient for evaluating internal control risks or for detecting and eliminating fraud any more. In the meantime, high levels of assurance won’t be provided if auditors still rely on costly substantive testing and neglect analysis of transactions or utilising computer technologies [11].

In addition to the low rate of detection of human fraud risks, current audit procedures do not perform effectively in uncovering unintentional financial
errors caused by information overflow in current business industry. It has been proposed that, the quality of auditor’s judgement will initially increase followed by a decline when the amount of relevant pieces of available information increases [16]. This conclusion has also been approved by later researchers using empirical studying model [7]. In the context of big data, auditors under current auditing practice all face a similar situation of information overload and can produce cognitive errors, which will eventually result in the selection of irrelevant or insufficient accounting information to support a high quality auditing opinion [2].

Studies of Auditing Efficiency

The current auditing approach reflecting the twentieth century methodology would be described as a time consuming process. This process normally begins with auditing planning between auditors and customer companies after the establishment of an auditing contract. During the auditing planning stage, a company risk assessment and the objectives and scope of the auditing activities will be settled. After this, auditors will be assigned to collect, analyse evidence and provide professional opinions about the authenticity of company’s financial statements and provide further management advice regarding to internal controls and assurance levels. At the final stage, auditors will present a formal auditing report expressing their opinions [4].

It is clear that traditional auditing practice is costly and labor-intensive regarding to resource occupation level during the procedure. Searcy (2003) argues that the traditional auditing is inefficient in the whole audit process, from the auditing planning stage all the way through to final auditing report is provided. Some of the waste are caused by redundant steps, inexperienced staff and inadequate data. Also there are also stops during the process that add cost without value [14]. Rachard (2010) believes the manual testing and auditing of internal controls in current auditing process demand high big amount of time and labour expenses and advises that the automation of controls should be considered, which can provide a more accurate, more cost-efficient way of achieving complete accuracy and integrity in financial reporting [10].

Studies of Auditing Assurance

According to Paul(2018), the current auditing approach are making client companies suffering from high costs and significant time delays in the aspects of information collection, processing and reporting. Nehmer(2003) argues that only timely information can be relied on to make effective business decisions [14]. In the current economy era, traditional auditing methods are not able to generate real-time information in higher frequency because of its time lag character during the process. While, the real-time transactions are happening everyday which are providing real-time and continuous feed-backs to relevant
stockholders. This trend has been recognised by auditing academicians and professionals who are trying to provide more appropriately solutions to help auditing to adapt to this speeding business environment [5]. Chan (2011) mentioned currently financial information is normally reviewed on an annual/half yearly basis in the traditional audit practice. As a result, material errors, omissions, or fraud can easily be covered up for a relatively long time before detected by auditors [6]. This is how audit lag happens and remaining a high level of auditing assurance level in this information overflow environment becomes difficult.

Grover(2011) argues that heavily relied on current auditing module, small sets of transactions sampling on a limited time period and data set is not enough for evaluating entity’s internal controls or for detecting and eliminating fraudulent activities [11]. Also, by relying primarily on substantive testing and ignoring analysis of transaction details or just doing computer auditing mechanically, financial audits are not only not able to provide high levels of assurance, but maintain current auditing cost at a high level due to the complicated substantive testing process.

Studies of Continuous Auditing

Researchers and practitioners of auditing domain have widely recognised that the next stage in auditing development is the use of continuous auditing combining the technologies of computer science. So far, researchers and practitioners have provided great solutions to the development of continuous auditing in the aspects of theory and applications. The large amount of contributions have been published in a number of top academic publications of multiple disciplines, including accounting, accounting information systems, management information systems and computer science[8]. Academic researchers have made great contributions in the development of theories and the applications of continuous auditing Several enabling technologies have been identified for continuous auditing, which include belief functions (Srivastava and Mock 2000, Gillett and Srivastava 2000, Sun et al 2006), databases (Rezaee et al 2002, Murthy and Groomer 2004), expert systems (Zhao et al 2004, Bell et al 2002), intelligent agents (Kogan et al 2002, Bovee et al 2005), neural networks (Lin et al 2003, Baker 2005, Viaene et al 2002), real time accounting (Alles et al 2004, Rezaee et al 2000) and XBRL/XML (Murthy and Groomer 2004, Bovee et al 2005).

Traditional Manual Audit Investigation

This study focuses on large-scale Australian government organisations. Public sectors spend big amount of money every year on procurement activities which normally happens on a daily basis as new resources are continually demanded by all the departments for efficient operation and consumption. When the purchased items are not in use, they are usually stored
in multiple warehouses in different locations, which not only makes it difficult to keep track of where all stocks are but also not sure if the delivered items are actually received from the correct suppliers. To verify the authenticity and accuracy of the purchase activities and stock-in procedure, purchasing evidence audit needs to be conducted quarterly as required by related regulatory authorities.

Manual auditing has been utilised for years in public sectors to check whether the purchases have occurred correctly without any wastage of funding. Normally, multiple operational staff are involved in auditing one purchase, which are the auditing officer and the purchasing officer (There are also managers involved in the middle of the process, but they are not discussed in this study as their roles are not related to the investigation). When a quarterly audit initiates, purchase records happened in the last quarter are sampled from the procurement system database to be audited. The related supporting evidences could include purchase orders, tax invoices, supplier quotes and supply contracts. Upon receiving these documents, two major objectives of the auditing procedure are to check 1) whether the purchase evidences requested by the Corp D’s procurement policy are sufficiently provided by the purchasing officers and 2) whether the unit price, quantity, total price, purchase date and foreign currency amount (if applicable) described in the evidences are matched to purchase records in the system database. According to the procurement auditing policy, one purchase is considered as compliance only when both of the above conditions are satisfied, otherwise it is noncompliant.

This manual auditing process generally takes a long time every quarter to finish due to many practical problems. For instance, the auditing process has to consider what currency was used when the item was purchased, meaning the exchange rate might also need to be considered. Along with the price being in a foreign currency, the price might also be presented as the price per unit bought or the total combined price of every unit. The correct purchase date is sometimes hard to find as there could be several dates on one tax invoice and the auditing officer needs to locate the one matching that in the database, which also costs time. Many purchases could be contained in one tax invoice which also makes it costly to find the correct one.

CoCAM Framework and Methodology

As discussed in the last section, currently auditors are provided with a certain number of evidence folders corresponding to the purchase records in the corporation system based on the sampling method. Manual check is conducted and go through everything provided in the evidence folders of each purchase order. The auditor should look for evidence to verify the entire procurement process. Common purchasing audit evidence includes purchase contracts, purchase orders, invoices, receiving documents, inspection documents and supplier statements. This rather low efficiency process may lead to increasing errors and mistakes.
Thus, in this study we propose a continuous compliance awareness model (CoCAM). By using this model, interest parties can upload documents continuously and automatically and generate up-to-date compliance reports without time lags. CoCAM is designed to consecutively accomplish data extraction, documents classification and compliance checking. The overall workflow of CoCAM is demonstrated in Fig. 2. Overall, after purchasing officers upload their procurement evidence documents into the system according to related policies, CoCAM will immediately and automatically extract the data from both evidence documents and organisation policies. The extracted data/information will be stored in a Document based database and classified into different document type groups to determine their corresponding compliance levels of the process. In the meanwhile, when auditors receive the purchasing check list or all transaction records from the organisation database, CoCAM will match the extracted data with the checking list. Finally, by comparing both, a compliance report will be given.

To be more specific with the compliance report in the last stage of the CoCAM workflow, we propose to refine the auditing results from compliant and non-compliant to five compliance levels based on semantics, including totally non-compliant, non-compliant, poorly compliant, partially compliant and totally compliant as shown in Table I. By doing this, we are able to discover the specific issues that lead to different results and fully understand the issues and risks that may occur during the manual auditing procedure. The criterion for each level is defined accordingly in the right-side column of the table. Using this table, different compliance levels are given to every purchase order. According to our recent investigation of the public sector procurement cases, we also discovered the manual auditing progress is in low efficiency in terms of labour and time occupation.
Table 1. Types of Compliance Levels

<table>
<thead>
<tr>
<th>Semantic type</th>
<th>Criteria</th>
</tr>
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<tbody>
<tr>
<td>Totally non-compliant</td>
<td>Empty / no evidence</td>
</tr>
<tr>
<td></td>
<td>Irrelevant evidence</td>
</tr>
<tr>
<td>Non-compliant</td>
<td>Invalid evidence</td>
</tr>
<tr>
<td></td>
<td>100% mismatch info</td>
</tr>
<tr>
<td>Poor-compliant</td>
<td>Qty mismatch, unit price match</td>
</tr>
<tr>
<td></td>
<td>Unit price mismatch, qty match</td>
</tr>
<tr>
<td></td>
<td>Qty &amp; Unit price match, description partially match</td>
</tr>
<tr>
<td>Partially compliant</td>
<td>Qty &amp; unit price &amp; description match, EXR mismatch</td>
</tr>
<tr>
<td></td>
<td>Qty &amp; unit price &amp; description &amp; EXR match, date mismatch</td>
</tr>
<tr>
<td>Totally compliant</td>
<td>All info match</td>
</tr>
</tbody>
</table>

Regarding to the quality of the auditing approach, the current sampling method can only cover a relatively small portion of the large volume of purchase transactions occurred each quarter. In our recent case study, there are only 400 samples being checked compared to triple that amount of total purchase orders. We noticed there are material transactions not included in the sample which are significant to the organization’s procurement activities risk assessment. Besides, the auditing happens every quarter in some public sectors which is more frequently compared to the yearly auditing in public companies, but considering the needs for monitoring public funding expenditure, even with all the efforts to conduct procurement auditing every quarter, such ex-post monitoring activities have not been effective in controlling risks and reducing non-compliant rate. Public sectors are eager to receive continuous feedbacks to ensure a high compliance rate of purchasing activities. In addition to the problems we detected above, the investigation also faced with problems like lack of consistent lodge guidelines, insufficient supporting documentation and inappropriate internal control systems. In contrast, by adopting the CoCAM, we are able to achieve a full transaction continuous auditing by automatically reviewing every purchasing happened in real time and a compliance report will be available in the meantime.
Algorithm 1. Investigation Approach

```plaintext
Algorithm 1: Investigation approach

Input: list of the samples
Output: List of compliances
compliances ← [];
for sample in samples do
  evidences ← getEvidences(sample);
  if number of evidences is zero then
    compliances.append(0);
  else
    if sample.getPrice() are not evidences.getPrice() then
      compliances.append(1);
    else
      if sample.getQuantities() are not evidences.getQuantities() then
        compliances.append(2);
      else
        if sample.getDescription() are not evidences.getDescription() then
          compliances.append(3);
        else
          if sample.getDate() is not evidences.getDate() then
            compliances.append(4);
          else
            compliances.append(5);
      end
    end
  end
end
return compliances;
```

Specifically, the detailed algorithm for our investigation process can be found in Algorithm 1. We audit the evidence folders individually. Firstly, we filter out all the empty folders by considering them as totally noncompliant. Secondly, if the folder is found containing valid evidences, we look through the provided evidences to find the price that was paid for the items. This then will be checked against a central database that contains the ground truth for the test evidences. If the price matches, the compliance level will be raised to one. If this doesn’t match, the evidence will be classified as totally non-compliant.

Next, if the correct price is found, the evidences will be searched to locate the quantity of items that are purchased and compare that to the quantities that are received. If this match, the compliance level will be raised to two. In contrast, if this doesn’t match, the compliance level will be left at one and the algorithm will be stopped. If a correct quantity is found, the evidence will be scanned for the description of what the item is. If the found description matches the description provided in the ground truth, the compliance level will be raised to three. In contrast, if it doesn’t match, it will be left at two. After that, the algorithm searches for Date where the purchase occurred. If this doesn’t match, the compliance level will be raised to four, while if it does match, then it will be raised to five.

It is clear that our CoCAM model is able to provide an effective and efficient method to conduct continuous auditing when combined with text mining and machine learning techniques. Without human intervention, CoCAM is also able to detect new uploaded evidence continuously,
simultaneously extract the necessary data information, automatically match it with the entries in all purchasing transactions rather than a sample list, and finally provide an consistently updated compliance report.

**Evaluation Results**

In this section, we will evaluate CoCAM under a real-world dataset provided by a large-scale public sector of Australia. This sector conducts procurement activities on a daily basis and currently suffering from difficulties caused by traditional auditing methods. Normally, the auditing procedure includes requesting procurement evidence from purchasing officers, receiving purchasing sample lists, comparing the data (date, unit price, quantity, currency, total amount, etc.) in both evidences and system records and compliance report generating.

In this case, the public sector provided 500 purchasing records and the corresponding evidence folders for evaluation. The records (checking list) are listed in an excel form with basic items like date, unit price, quantity, total amount, exchange rate, etc. While the evidence folders contain different evidence forms, for example, invoices, receipts, purchase orders, price list, etc. There are total 1120 files in the total evidence folders.

To evaluating the efficiency and effectiveness of CoCAM, a classification approach will be employed to compare the compliance results provided by the proposed CoCAM against the baseline. We will use a confusion matrix to define the classes of four situations, namely True Positive (TP), False Negative (FN), True Negative (TN) and False Positive (FP). Accordingly, we will measure three classification rates including Effectiveness, False Positive Rate (FPR) and False Negative Rate (FNR).

\[
\text{Effectiveness} = \frac{TP + TN}{TP + FN + TN + FP}
\]

\[
\text{FPR} = \frac{FP}{FP + TN}
\]

\[
\text{FNR} = \frac{FN}{TP + FN}
\]

Based on the results given by our evaluation procedure, the effectiveness shows in Fig. 3. According to the figure showed in the matrix, CoCAM achieved an effectiveness rate of 95.6% by auditing the sample of 500 purchasing records. This represents that CoCAM has a chance of 95.6% compared with the true situation. In the same time, the FPR is 0.9%, which means the chance that CoCAM miss any non-complaint record is less than 1%.
In addition to the effectiveness rate of the CoCAM, we also take time and labour consumption into consideration as well, refer Table 2. Regarding to the time and labour spend on doing the compliance auditing, CoCAM only took a couple of minutes by one operator to achieve a 95.6% of accuracy. While the corresponding manual check took two people more than 90 hours to finish. Therefore, we can conclude that the CoCAM can be very reliable when doing compliance checking and in the meanwhile it can save considerable time and labour as well.

<table>
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<tr>
<th></th>
<th>Baseline</th>
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<tbody>
<tr>
<td></td>
<td>Compliance</td>
<td>NON-compliance</td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>Compliance</td>
<td>TP: 262</td>
<td>FP: 2</td>
</tr>
<tr>
<td></td>
<td>NON-compliance</td>
<td>FN: 20</td>
<td>TN: 216</td>
</tr>
</tbody>
</table>

**Table 2. Comparison between CoCAM and Manual Audit**

<table>
<thead>
<tr>
<th></th>
<th>Processing Time</th>
<th>Labour Consumption</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>CoCAM</td>
<td>5 minutes</td>
<td>One operator</td>
<td>95.6%</td>
</tr>
<tr>
<td>Manual Audit</td>
<td>90 hours</td>
<td>Two auditors</td>
<td>90%</td>
</tr>
</tbody>
</table>

**Conclusion**

Auditing had made great contribution to maintain corporation reporting risk levels and providing proper assurance to all interests parties, but it seems that the traditional auditing approach has not kept pace with the real-time economy at this information overflow era. The current auditing approaches and techniques that are proved to be valuable in the past now becoming increasingly outdated. Many practical issues and potential risks arise during the manual auditing process, including low level of efficiency, accuracy and accountability, high consumption of expense, time and labour.

To address this problem, we proposed the continuous compliance awareness model (CoCAM) which can automatically and timely audit purchasing activities by intelligently understanding compliance policies and extracting required information from purchasing evidences. Professionals and academics should continuously developing more efficient methods of conducting audit activities that will help to allow their scarce and valuable resources to be utilised in the most cost-effective manner.
References


