

Data Mining Technology: An Opportunity for Public Sector Accounting

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Abstract

This paper discusses the opportunity for Malaysian public sector to increase efficiency and effectiveness through the utilisation of data mining technology. Few studies have investigated the implementation of data mining technology in Malaysia. These studies have been within the private sector. However, in the public sector there have not been any. A data mining utilisation model is constructed combining information and communication technologies (ICT), knowledge management (KM), data warehousing (DW) and data mining (DM) for application in the Malaysian public sector and the benefits of adopting such a model are considered.

Keywords: Data mining; Data warehousing; Information and communication technologies; Knowledge management; public sector accounting.

Introduction

Over the years, there has been widespread change in the adoption and utilisation of new technologies in both the private and public sectors. Data mining technology is one of the new technologies that have become increasingly popular. It is *the process adopted to undertake a thorough analysis of the data, in particular financial data, available to the firm to select the information (identifying patterns and relationships amongst data) to allow the provision of information required by users and, in so doing enhance information available to the decision-making process. A data mining approach will use a variety of technological techniques and tools to explore (summaries, comparison, analysis, forecast, estimate) the data.* Nowadays, data mining technology becomes an important business tool for a private sector. While in a public sector, among others data mining is used in audits and investigation of government's project and programs, and fraud prevention and detection.

Background

Technology has allowed the production and storage of vast amounts of information. Added to this, information has become a key resource in today's business world and an ability to effectively manipulate information has become vitally important to management. It is of

concern to organisations to identify approaches to critically analyse information in order to improve decision making. In the business world for example, information obtained from market segmentation, customer profiling, trend forecasting and cross-selling can help decision makers to learn more about their customers. In the public sector, information obtained from similar activities helps in understanding client needs and identifying how to improve delivery systems. Technology provides the key to collating, classifying and manipulating this vast repository of information.

One of the systems which collates and classifies data collected by organisations is the Accounting Information System (AIS). This system provides financial information that can be used to plan, evaluate and diagnose the impact of operating activities and identify the financial position of the organisation. Given that organisations today collect vast amounts of data, this data can be 'intelligently' analysed by data mining technologies - sophisticated and powerful cutting-edge technology that enables the extraction of hidden predictive information from a large database (Kurt, 2004).

Data mining technology is relatively new and requires awareness of the technology, readiness to implement it, and appropriate skills for its effective usage to be developed. Awareness and readiness in accepting this new technology is an important issue. The user of any new technology will act as a primary player in utilising the technology to the best advantage of the firm. The AIS which provides input for the decision making process would benefit from the features offered by data mining technology. The role of the AIS has become increasingly important with rapid change in technology which has created new information alternatives that may assist and change the way decisions are made. The AIS benefits from the use of information technology, therefore, accountants and other stakeholders who relate to the AIS need to be aware of the opportunities arising with technological advances and acknowledge that the technologies will influence their decisions. Data mining provides a methodology for problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning and innovations (Hedelin & Allwood, 2002, Liao, 2003).

Data mining is capable of answering questions about the past (what has happened), the present (what is happening), and the future (what might happen) (Nemati & Barko, 2002). Data mining and other technology such as data warehousing, database marketing, and statistical sales analysis are a few information and communication technology (ICT) tools which give more capacity for the organisation to integrate and access their history or knowledge. Data mining permits analysis and identification of "hidden" relationships in large datasets. By permitting this, the previously uncovered information is now discovered and available to provide more support in the process of decision making. Carlson (1999) claims that ICT can increase productivity, facilitate changes and improve workforce abilities. Data mining is a part of ICT extensively used in many applications within industries particularly in the enhancement of organisational intelligence and decision-making and contributes towards making the organisation more agile.

A number of studies have been undertaken to identify the reasons corporations choose to adopt or not adopt data mining techniques and to identify their status in implementing such technologies (Chang *et al.*, 2003, Nemati & Barko, 2003, Wah & Abu Bakar, 2003). Literature on data mining adoption in organisations in various countries indicates that variables such as organisational size, culture, attitude to data resource and style of decision making can play a role in adoption decisions (Chang *et al.*, 2003). Other variables identified as influencing the decision to adopt include structure, strategy, management systems, human capital, technological factors, and competitiveness of outside environment (Spanos *et al.*, 2002, Chang *et al.*, 2003, Wah & Abu Bakar, 2003). In exploring the extent of data mining utilisation within organisations, identification of attitudes toward current systems, influential factors in the decision to adopt such technology and also understanding the reasons for not adopting such technology are important.

Prior studies of data mining readiness and implementation have been undertaken in the private sector. Evidence suggests that personnel within private sector firms are aware of and ready to implement this technology. Studies in the area of telecommunication, banking, and insurance companies indicate that there is a level of optimism and innovativeness among employees indicating the potential to adopt data mining techniques. Readiness can be seen in terms of the adoption of or intent to adopt data mining technologies (Berger, 1999, Chye & Gerry, 2002, Dahlan *et al.*, 2002, Chun & Kim, 2004). However, there is no such evidence available to indicate whether or not personnel in the Malaysian public sector are also aware of and ready to adopt the concept of data mining. In seeking to access the best information for better decision making the Malaysian government acted to implement E-Government which has also seen significant technological improvements in general within business, and increasingly within accounting and audit departments seeking to improve their accounting information system and implement new technologies. The implementation of new technology such as data mining within the accounting environment is expected to be helpful and to enhance the quality of information available in decision making.

There have been many studies of the AIS that have focused on internal controls, audit, and the accounting model (Dunn & McCarthy, 1997, Geerts & McCarthy, 1999). Studies on the implication of information technology within the AIS have incorporated the decision making process (Benford & Hunton, 2000, O'Donnell & David, 2000). Although there have been a few reports by government organisations such as the General Accounting Office in the United States of America (US) on the utilisation of data mining technology they have not shown how this technology could enhance capability in different environments. However, there do not appear to be any studies of data mining technology within the AIS in the public sector in Malaysia. This paper seeks to redress this gap in the literature by providing insights into the adoption and implementation of data mining techniques within the accounting information system in the public sector. The literature that addresses data mining including related concepts such as ICT, Knowledge Management (KM) and also AISs are reviewed.

The remainder of this paper consists of two sections, as follows. The next section presents

a literature review on ICT, the AIS, and data mining. It provides the background to ICT development in Malaysia and the potential use of data mining in the Malaysian public sector. This leads to the development of a general definition of data mining and its use within AIS. A proposed data mining utilisation model for application in the Malaysian public sector is also presented in this section. A summary is provided in the last section.

Literature Review

Most of the research on data mining technology focuses on the development, and implementation of various technologies, the process of data mining and its applications on general framework, cross-sales, deviation detection, organisational learning, interface, consumer behaviours, data quality, health care management, prediction of failure, marketing, software integration, knowledge warehouse, and hypermedia (Liao, 2003). It seems that, most of the studies undertaken have been by information system, expert system, or database management researchers. There has been little research which has addressed implementation within auditing, finance and banking. For example, Lampe and Garcia (2004) have raised discussions on data mining issues which should be considered by the internal auditor in both large and small organisations. Other studies exist which describe the use of data mining to forecast the foreign exchange time series process, analysing financial reports, and as an early warning system of economic crisis (Vojinovic *et al.*, 2001, Kloptchenko *et al.*, 2004, Kim *et al.*, 2004).

What is Data Mining?

Data mining is the activity of extracting data obtained from a variety of sources, usually held in a central data warehouse, for evaluation to assist in responding to questions posed, for example, by management. In technological terms, the concept of data mining is known as the process of discovering new, valuable information from a large collection of raw data (Fayyad *et al.*, 1996, Brabazon, 1997, Firestone, 1997) and should enable better decision making throughout an organisation (Berry & Linoff, 1997, Nemati & Barko, 2002, Fong *et al.*, 2002, Wen, 2004). Other terminology that has been used to find useful patterns in data includes knowledge extraction, information discovery, information harvesting, data archaeology and data pattern processing (Fayyad *et al.*, 1996). Because the architecture of the data mining model integrates various techniques and fields, it has meant different things to different people and it is not surprising that different ways of looking at the concept have taken place.

In defining data mining, the ultimate aim is to identify the core elements that should be present if data mining is to be effective – these are an ability to find, analyse, extract, discover, and identify patterns or relationships from data. The ultimate goal of data mining is to allow the evaluation of data to provide information that allows a better understanding of what has happened, why it happened and to some extent predict what will happen. This knowledge would assist in the process of making decisions and assist the firm in identifying approaches to increasing competitiveness.

To achieve this ultimate goal, data mining utilises various fields of technologies such as artificial intelligence, neural networks, computer science, machine learning, database management, data visualisation, mathematic algorithms, and standard statistical techniques. The combination or integration of these techniques via up to date technologies is employed to search for useful information through an automatic or semiautomatic process. However, the automation process of data mining does not appear to be an important measurement for those authors in defining data mining as only four out of the seventeen definitions reviewed mention this issue. The definitions of data mining appearing in the relevant literature are presented in Table 1.

Table 1: Data Mining as Defined in the Literature

Author	Definition
Fayyad et al., (1996)	Data mining is a step in the knowledge discovery in databases (KDD) process and refers to algorithms that are applied to extract patterns from the data. The extracted information can then be used to form a prediction or classification model, identify trends and associations, refine an existing model, or provide a summary of the database being mined.
Newing (1996)	Data mining is the process of extracting valid, previously unknown and ultimately comprehensible information from large databases and using it to make critical business decisions.
Brabazon (1997)	Data mining is the discovery of new, non-obvious, valuable information from a large collection of raw data.
Firestone (1997)	Data mining is traditional data analysis methodology updated with the most advanced analysis techniques applied to discovering previously unknown patterns.
Berry and Linoff (1997)	Data mining is "the process of exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns and rules."
Fabris (1998)	Data mining is described as the automated analysis of large amounts of data to find patterns and trends that may have otherwise gone undiscovered.
Chung and Gray (1999)	"The objective of data mining is to identify valid, novel, potentially useful, and understandable correlations and patterns in existing data."
Two Crows Corporation (1999)	Data mining is a process that uses a variety of data analysis tools to discover patterns and relationships in data that may be used to make valid predictions.
Greengard (1999)	Data mining is a group of analytical applications that search for hidden patterns in a database.
McVey (2000)	Data mining is an automated approach for discovering or inferring hidden patterns or knowledge buried in data. "Hidden" mean patterns that are not made apparent through casual observation.

Nemati & Barko (2002)	Data mining is a process that uses statistics, artificial intelligence and machine learning techniques to extract and identify useful information, and subsequent knowledge, from large databases.
Fong et al., (2002)	Data mining is the process of discovering interesting knowledge from large amounts of data that can be used to help companies make better decisions and remain competitive in the marketplace.
Smith (2002)	Data mining is a process that uses a variety of data analysis tools to discover patterns and relationships in data and using them to make valid predictions.
Liao (2003)	Data mining is an interdisciplinary field that combines artificial intelligence, computer science, machine learning, database management, data visualisation, mathematic algorithms, and statistics. Data mining is a technology for knowledge discovery in databases. This technology provides different methodologies for decision making, problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning and innovation.
Wah and Abu Bakar (2003)	Data mining is a variety of techniques such as neural networks, decision trees or standard statistical techniques to identify nuggets of information or decisionmaking knowledge in bodies of data, and extracting these in such a way that they can be put to use in areas such as decision support, prediction, forecasting, and estimation.
Wen (2004)	Data mining is the process of discovering patterns in data. The process must be automatic or semiautomatic. The patterns discovered must be meaningful in that they lead to an increase in the quality of decision making.
Landry et al., (2004)	Data mining is a variety of tools and processes that can work independently or together to analyse and discover relationships in collections of data.

While the difference between definitions can be identified as the way data mining tools are executed, the aims across definitions are consistent. The aim is to provide the means to find, analyse, extract, discover, and identify patterns or relationships from the data to enhance the decision making process. Interestingly a number of researchers indicate this assembly of data should embrace interdisciplinary fields and be able to utilise a variety of data analysis tools, and a few indicate that a feature of data mining should automate the process.

Artificial intelligence (AI) researchers, statisticians, management researchers and economist have different ways of looking at this term. Therefore, data mining can be viewed as a combination of ICT, statistical and data analysis, and knowledge management. Consequently, Lampe & Garcia (2004) suggested that there is no universal agreement of the definition of data mining. In Table 2 the common elements of the definitions are identified.

Table 2: Common Elements of Data Mining Definitions

Author	Ultimate aims of the process	Characteristics	
	To find, analyse, extract, discover, and identify patterns or relationships from the data to enhance decision making process.	Interdisciplinary fields, updated and variety of data analysis techniques, tools	Automatic or semiautomatic
Fayyad et al., (1996)	✓		
Rod Newing (1996)	✓		
Brabazon (1997)	✓		
Firestone (1997)	✓	✓	
Berry and Linoff (1997)	✓		✓
Fabris (1998)	✓		✓
Chung and Gray (1999)	✓		
Two Crows Corp (1999)	✓	✓	
Greengard (1999)	✓	✓	
McVey (2000)	✓	✓	
Nemati and Barko (2002)	✓	✓	✓
Fong et al., (2002)	✓	✓	
Smith (2002)	✓	✓	
Liao (2003)	✓	✓	
Wah and Abu Bakar (2003)	✓	✓	
Wen (2004)	✓	✓	
Landry et al., (2004)	✓		

Data Mining of the Accounting Information System

Decisions made as a result of information generated by the AIS rely on the presented information and the ability to ascertain that it is reliable; for example, assurance assessments in relation to the content of financial statements. A good financial statement can be produced with the availability of the right data. The need for integrated systems with the capability of producing timely information and the ability to meet reporting deadlines has also put a

pressure on the organisation (Carrigan *et al.*, (2003). An appropriate implementation of new technology and upgrading agencies within the core financial management system will improve financial reporting capability, which will not only help managers to make better decisions by obtaining timely information, but will help them meet new accelerated reporting deadlines. ICT infrastructures will provide a platform for the AIS in terms of collecting, exchanging data, coordinating activities and sharing information (Moxon, 1996, Liao, 2003). This suggests that an accounting database which is able to store large amounts of transaction data is important to decision makers in providing the ability to generate information to assist in choosing the best course of action. This is where the use of statistical and data analysis tools together with a good knowledge of management policies is likely to be useful and where data mining would play an important role.

Weber (2002) argues that data mining is not only important as a transaction tracing tool in financial auditing but also in offering the ability to undertake overall testing of systems and controls to ensure the firm can produce good financial statements. The implementation of this tool within the AIS should enable the accounting department to expand the information that can be made available for decision making. The increase in accounting information available through the internet has made data mining important in ensuring users are able to retrieve accounting information with high levels of accuracy and reliability (Debreceeny *et al.*, 1999). It also enhances the capabilities of the AIS to play a role in effectively collecting transaction data, providing information for decision makers and assisting in the assurance of internal controls (Burns, 2003).

Stakeholders with an interest in the AIS within organisations in both the private and public sectors should consider the implementation of data mining in their operations and decision making process. Informed accounting knowledge aided by the AIS with analysis presented via data mining tools would help in forming financial decisions. Data mining allows the reiteration of processes facilitating revision and the refinement of queries by users of this information. The AIS captures a wide variety of transaction data and is used as a primary source of information for an organisation to use in meeting their goals and objectives. Incorporation of data mining technologies within the AIS would enhance this process. Mckie (1997) noted that applying data mining software can improve a department's role as a provider for decision makers since the majority of accounting software does not have specific data mining capabilities built-in.

ICT and the Utilisation of Data Mining in the Malaysian Public Sector

In this section a review of ICT and the importance of the management of data in the Malaysian public sector are presented. In particular, some observations on the utilisation of data mining within the public sector are discussed before focusing on the potential utilisation of such technologies within the Malaysian public sector AIS. A utilisation model is developed to facilitate discussion on the application of data mining technologies within the AIS in the Malaysian public sector.

ICT Background: The Country

Malaysia has a strategic location as a major crossroad linking the East and the West. It has a diversity of cultures, languages, religions, politics and social beliefs resulting from the influences of, and settlement of early traders and merchants from China, India, the Middle East and colonial influences from the Portuguese, Dutch and British. Malaysia is a multiracial and multilingual country. Bahasa Melayu is the official language, but English is widely used in business and government. The other major languages are Mandarin, Chinese dialects, and Tamil (Raman & Yap, 1996).

Historically, the Malaysian economy was based on agriculture and natural resources. The focus has shifted since the 1980s towards an economy which is productivity-driven in terms of industrial development and the utilisation of high technology. ICT has become a catalyst for national development for many nations including Malaysia. To enter the globalised world it is necessary for Malaysia to become part of the "information society" (Raman & Yap, 1996, Goebel & Gruenwald, 1999, Bose & Sugumaran, 1999, Raeside & Walker, 2001) to be able to compete and leverage the benefits of information technology innovation. This is due to the increase in the application of information technology adoption across the world in both the private and public sectors and has resulted in significant changes in facilitating communication and the exchange of information and data to organisations.

ICT: Its Importance for Management of Data in the Malaysian Public Sector

In an attempt to facilitate the country's participation in the global environment the Malaysian Government has actively encouraged the development of and application of technology. The Malaysian government took the initiative to establish National Information Technology Agenda (NITA) and the Multimedia Super Corridor (MSC) (Awang, 2004). This is inspired by the belief that ICT would enable organisations to create, manipulate and distribute information and communications more effectively resulting in an improvement in the quality and effectiveness of both private and public sector information access and communication leading to efficient and effective decision making.

The adoption of technology and advances in technology are of interest to all organisations since information technology usage fundamentally alters the domains within which it is implemented (Danziger & Andersen, 2002). Technology may impact at both the individual level such as how public sector employees, managers or citizens complete their work and also at the collective level which embraces a group of individuals such as workgroups, department, state agencies and ministries (Danziger & Andersen, 2002). In alignment to this view the Malaysian government has focused attention on the adoption of ICT technologies within its ministries, agencies and departments. In efforts to achieve this, the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) was created. Through MAMPU the Government acknowledges the challenges in planning the implementation of ICT. The

challenge for the public sector is to identify and implement the objectives to deliver government services with the aid of ICT to:

- provide an efficient, expeditious, secured and quality service electronically;
- leverage on ICT and multimedia to enhance productivity in the Public Sector;
- facilitate the sharing of resources among Government agencies; and,
- be citizen-centric in the delivery of its services.

In an attempt to achieve these objectives the Malaysian government requires that every public sector department works toward a system that provides integration of systems in the generation of information and aspires to support each other while leveraging ICT to achieve these ends. The exploitation of the benefits of ICT is further accelerated under the Electronic Government (E-Government) flagship under which all departments and agencies (within Putrajaya – a province of Malaysia) will be linked to create a multimedia network and paperless administration. It is envisaged that through these efforts, there will be more integration and sharing of information in soft copies rather than in hard copy paper based communication between agencies.

Data mining technologies are fundamental to the adoption of ICT under E-Government projects as the concept of a common database is one of the considerations in electronic government. For example, the Project Monitoring System which was developed to monitor the efficiency and effectiveness of the implementation of government development projects will work in a collaborative environment with workgroup computing, workflow management systems, common database access and messaging services. Data mining technologies play an important role within these databases to satisfy the different kinds of monitoring activities required such as the handling of different types of information and media, information sharing capability among and within the agencies and keeping track records and know-how to facilitate the sophisticated management of project monitoring. Besides the Project Monitoring System, other projects within E-Government initiatives include the Human Resource Management Information System (HRMIS), General Office Environment (GOE), Electronic Government-Accountant General (EG-AG) and E-Services such as the electronic delivery of driver and vehicle registration, licensing and summons, utility payments and Ministry of Health on-line information (www.mampu.gov.my).

All such systems provide a technological environment for the collection and management of various data: with this data managerial decisions can then be taken. In the decision making process functions such as statistical trend analysis, forecasting, simulation and data mining are acknowledged to be important. Data mining enables the agencies to classify and synthesise information into various levels with various viewpoints (MAMPU, 1997a, 1997b). In the case of the accounting department, for instance, the use of ICT will result in increased available data being transferred to the audit department for analytical purposes. An accounting system can be seen as a system of accountability, in maintaining, analysing and contributing to the process of decision making within departments (Llewellyn, 1994). By utilising data mining

technologies the productivity of an accounting department in their management of data can be enhanced. The accounting department would be enabled to provide an efficient, speedy, and secure process offering quality services with better integration and sharing of information between departments.

The good management of financial data via an effective use of data mining technologies would help to ensure that the information flow between departments was effective, reliable, and accurate. However, organisation theory suggests that management of data, information, knowledge and decision making are constrained by the ability of the decision maker (Nemati & Barko, 2002) to organise and successfully integrate data mining into the organisation. In addition, good internal integration across departments with appropriate technological infrastructures would be expected to improve the speed and quality of government services to the public.

Utilisation of Data Mining Technologies Within the Public Sector: Some Observations

The public sector has an interest in developing the use of data mining technology because of the ability offered by these technologies to perform work related to:

- **Audits and Investigation of Government's Project and Programs**

Data mining technology would increase confidence by enhancing the process of audits and investigation of government's project and programs. For example, the US General Accounting Office used data mining to perform audits and investigations work on federal credit card programs, purchase and travel card programs, Department of Defence's (DOD) vendor pay systems, Army military pay systems, Department of Housing and Urban Development housing programs, and Department of Energy national laboratories (GAO, 2003). Data mining was also implemented within the public sector through the demonstration program undertaken by the US Office of Naval Research (Kostoff & Geisler, 1999). They found that data mining (textual) would be of benefit in the integration of their databases, would support strategic decisions and allow the creation of usable databases. Other organisations such as NASA, National Institutes of Health, and intelligence agencies (i.e. FBI, CIA), Department of Defense (Army, Navy, Air Force and Marine Corps) were amongst the adopters of data mining (Carbone, 1998).

- **Fraud Prevention And Detection**

Data mining technology has the ability to profile common usage scenarios and detect new or different patterns for the prevention of fraud and to improve further investigations. In the US, data mining was adopted by the Illinois Department of Public Aid to identify health care providers that were billing for services provided in excess of 24 hours in a single day. This enabled the identification of violators and the referral of cases to law enforcement agencies.

- **Empowered E-Government Initiatives**

Data mining technology also has the ability to turn data into actionable information that government can use to transform interaction with service recipients. It gives the government the ability to proactively make changes based upon future needs. A number of key business issues should be taken into account in the consideration of the use of data mining strategies that align with ultimate government goals in attempts to launch “E” projects.

Tax agencies have made frequent use of data mining technology in the United Kingdom and Australia to assist in identifying taxpayers evading obligations and to assist in making effective resource allocation decisions (Micci-Barrera & Ramachandran, 2004). Moreover, with the predictive modelling capability offered by data mining tools, tax agencies are more able to identify noncompliant taxpayers in a more efficient and effective manner. It is expected that data mining technology would assist agencies in refining their traditional audit selection strategies to produce more accurate results.

In the case of Malaysia, the Inland Revenue Board would also benefit from data mining tools. The implementation of a self-assessment method (Sistem Taksiran Kendiri) for tax payments identifies an area in which there is a large quantity of data collected and data mining will assist in generating revenue through efficiencies in their operations. Efficiencies in collecting tax with minimal problems on noncompliance would increase the benefits for the country as a whole.

Organisations such as Road Transport Department, Royal Police of Malaysia, Immigration Department, National Registration Department, Health departments, other departments and ministries can also be potential users of data mining application and technology in synthesising their data. For example the Malaysian Ministry of Health is collecting scientific data for analysis to improve the health systems and medication required for the treatment of various diseases. Data mining could be used to assist in making decisions about the best treatment to use for different diseases. It can be argued that data mining utilisation would benefit many public sector departments in improving their capability, efficiencies, effectiveness and their delivery services to the general public. Further, the Accounting General’s Department, Audit General’s Department and the Ministry of Finance have various financial data: these departments have the potential to adopt data mining technology to synthesise all financial information that is available to assist in decision making and those of the agencies relying on them.

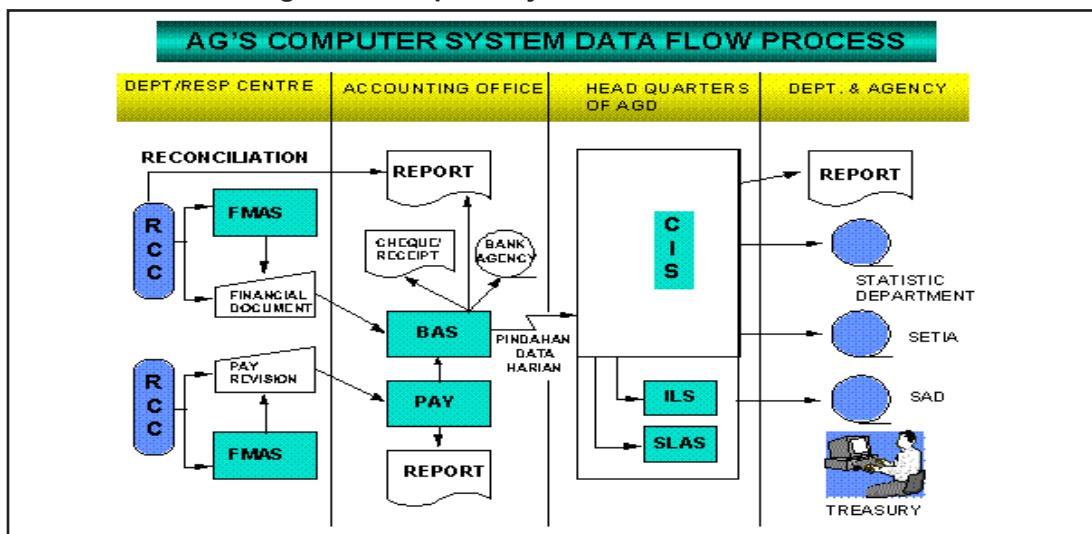
The Malaysian Public Sector Accounting Information System and Potential Uses of Data Mining

The application of data mining technologies would be of great benefit in assembling information required, for example, in increasing operational efficiencies, fraud detection and in enhancing the overall decision making in organisations including public sector organisations (Nemati &

Barko, 2002, Lampe & Garcia, 2004). Accounting and financial systems within public sector agencies are one area in which knowledge based improvements can be made by acting to create both improved and additional financial information, and to improve access to this information. The use of data mining technologies will enhance decision making made by accounting, finance and audit departments within the public sector.

The Accountant General's Department in Malaysia is the main department responsible for monitoring and managing accounting related data for the public sector. The systems used by the department are shown in Figure 1.

Figure 1: Computer System Data Flow Process



Source: Accountant General Malaysia website (www.anm.gov.my)

They include the Branch Accounting System (BAS), Payroll System (PAY), Central Information System (CIS), Investments and Loans System (ILS), Subsidiary Ledger Accounting System (SLAS) and Financial and Management Accounting System (FMAS). In Malaysia the data repository focuses on a centralised information system. The distribution of data (and information) emanates from the headquarters of the Accountant General's Office, data warehouse or CIS. Data mining technologies, on request for access to data, can then play a role in analysing, interrogating and mining the data for decision making. Data mining has many potential uses in accounting in the public sector: it could assist in dealing with the government's payments to suppliers, government expenditures, for example, on assets, and it would increase the efficiencies and effectiveness of departments in their operations and enhance their accountability. Data mining use in audits of accounting and financial data could reduce unethical practices and misconduct of civil servants involving bribery and other financial misconduct.

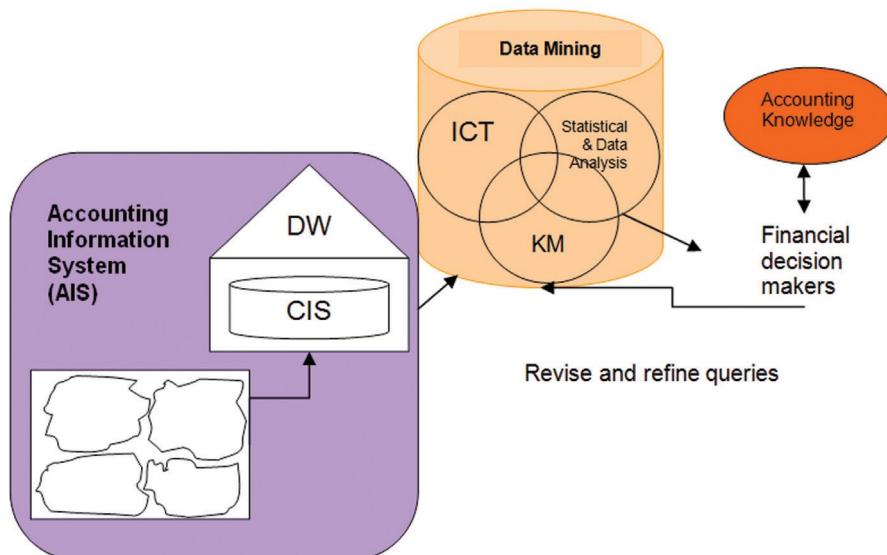
The utilisation of data mining to manage, exploit and analyse the data from the centralised data warehouse will increase the performance of reports produced by the department which are then distributed to other departments and agencies, for example to the statistics department, self-accounting department (SAD) and the finance ministry for ministerial decisions. Financial performance could be anticipated with data mining technology (Kloptchenko *et al.*, 2004).

In sum, data mining technologies could be used to analyse the public accounts, and the financial performance of each government department in reaching their objective and controlling their budgets. The technology will increase the ability to access and assess financial performance of departments in the management of financial resources. Data mining techniques and neural networks for example, have been applied extensively to the task of predicting and forecasting financial variables which assist the assessment of overall systems (Vojinovic *et al.*, 2001, Chun & Kim, 2004). Data mining plays an important role in various fields including financial accounting, management accounting and auditing and in determining profitability, ratio analysis, cost analysis and department productivity, analysis of management fraud, and examining the effectiveness of the business as a whole. The ability to utilise data mining may offer a competitive advantage to users and in the public sector result in better performance in the ability to offer services to the citizens of the country.

Data Mining Use Within the Accounting Information System

In order to identify the use of data mining technology within the accounting information system in the Malaysian public sector an utilisation model is presented (see Figure 2). The figure illustrates the flow of data from the accounting systems through to the ability to make informed decisions.

Figure 2: Data Mining Use Within Accounting Information Systems



The AIS manages transactions, produces reports and supplies other functions which can integrate with the various systems operating in the agency. This includes the Financial and Management Accounting System (FMAS), Payroll System (PAY) and Branch Accounting System (BAS) which then contributes the information to a Centralised Information System (CIS). From this it then integrates with the Investment and Loans System (ILS) and Subsidiary Ledger Accounting System (SLAS).

As proposed by this model, the function of the CIS will act as a master database or data warehouse (DW) which will contain all the data from various accounting systems. Through this, the application of data mining technology which integrates ICT, statistical data analysis tools and knowledge management (KM) would enhance the accounting knowledge for the related decision making process.

Conclusion

This review has presented a broad picture of ICT and the AIS leading to a discussion of data mining technology within the public sector. In addition, the review leads to a proposed utilisation model of data mining within AIS. The public sector in Malaysia has an opportunity to increase efficiency and effectiveness by endorsing the implementation of such technology. As in the private sector, the public sector accounting information systems is a major information provider, and the availability of data mining can play an important key role in the decision-making process. It has been argued that data mining could be used to enhance accounting information and improve the capability of government departments to make decisions about financial matters. However, there is a limited knowledge about the status of data mining activities, its utilisation within accounting information in the Malaysian public organisation. Therefore an exploration of data mining utilisation amongst accounting related departments such as the Accountant General's Department, Auditor General's Department and the Ministry of Finance would offer insights into the adoption and intention to adopt technology and data mining techniques.

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