Development of vendor management and e-Procurement systems using android platform

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Abstract. Supply chain management has become a crucial aspect of the performance of industries and companies as it manages the flow of goods, services, and information in order to fulfil customers need while reducing the total costs. In order to reduce the production total cost, e-procurement is introduced. E-procurement means of reducing cost is by shortening cycle time and create a simpler procurement process. The aim of this research is to develop a vendor management and e-procurement system using the Android platform. The developed system is hoped to be able to even shorten the cycle time, ease vendor selection and provide a more flexible and convenience procurement process. Through data measurement and documentation review, the developed system was tested against these three parameters for their validity. In the end, this research summarizes the test result and conclude based on the test result that those parameters are achieved in the developed vendor management and e-procurement system.

Keywords: Technical, Economic, Feasibility, Solar, Cathodic

1. Introduction

Supply chain management has been the most interesting field for engineers and researcher in developing the interaction of vendor, industry, and customer. Supply chain management has been introduced in order to minimize the length of delivery time to customer and to reduce the cycle time in producing the services or products. The main purpose of the supply chain management is to reduce the total cost in supply chain activities. One of the supply chain activities is procurement. Procurement is the act of obtaining or buying goods and services process that include preparation and processing of a demand as well as the end receipt and approval of payment [1]. Procurement is vital to company especially in manufacturing company as procurement is the key for determining the overall cost and quality of the produced product. Due to increasing of competitiveness nowadays, company is demanded to be able to make a fast and accurate decision in choosing qualified and appropriate vendor in procurement process. Other than that, flexibility and time needed in responding the tender from the vendor is also a priority.

Nowadays, the application of information technology has been widely used in manufacturing industries. With the vast development of information technologies, traditional procurement process is slowly being replaced with the newer electronic procurement (E-procurement) process. E-procurement is part of the business-to-business (B2B) commerce being conducted on the internet, in which buyer can make a direct purchase from the vendor through their website by using software packages or through e-marketplace, e-hub and trading exchange. By using e-procurement, companies can lower transaction costs, overall goods costs, labor costs, faster ordering and delivery times [2]. However, the e-procurement process is still considered having some flaws such as inflexible and slow response by some
vendors and having a hard time selecting a qualified and appropriate vendor in tender bidding process caused by the lack of vendor information. To counter the existing flaws, mobile based e-procurement system is suggested. Through the newly designed e-procurement system that consists of developing framework for e-procurement system which is directly integrated with the vendor management system with vendor scoring system, hoping to reduce the flaws of the previous procurement system.

The main essential of supply chain management is the optimization of material flows and associated information flows involved with an organization’s operations. The three types of flow that need to be managed are product and service flow, information flow, and financial flow [3]. One of the supply chain activities that will affect the total cost and overall companies’ performance is procurement. Procurement is the process of obtaining supply or process of purchasing goods and services from vendor for the production needs [2]. With the development of information technology, e-procurement is introduced and is slowly replacing the traditional procurement process. E-procurement is a collective term for a range of different technologies that can be used to automate the internal and external processes associated with the sourcing and ordering process of goods and services [4]. E-procurement is often considered similar to E-commerce, but still they have big difference such as e-Commerce often faces a large number of individual consumers, while e-procurement usually involves dealings with companies [5]. Study confirmed that through using automated procedure for purchasing through e-procurement enables a company to save up to 8%-12% of total purchases [6].

The process of procurement is a critical process for almost all company especially manufacturing company as procurement determines the quality, cost, delivery of raw materials and most importantly the ongoing production operation of manufacturing company. To ensure everything goes smoothly depend on a right and appropriate vendor selection process. The selection and evaluation of vendors have been a widely discussed topic in the literature. Based on previous study, vendor is ought to satisfy a widely known standard of the 7 Rights Rule, which is: right product, condition, quantity, time, customer, place and costs [7]. The most popular criterion considered by the decision makers for evaluating and selecting the most appropriate vendor is quality, followed by delivery, price/cost, manufacturing capability, service, management, technology, research and development, finance, flexibility, reputation, relationship, risk, and safety and environment [8]. There are four most influential criteria that should be noted and evaluated in order to acquire the best and appropriate vendor to take on the procurement, which are: items quality, items delivery, items cost and item productivity [9].

A detail review and comparative analysis of different Smartphone’s operating systems has been made. The compared operating system consist of android, iOS, Symbian, Blackberry, Windows Phone, WebOS, Ubuntu and Firefox. Out of all the compared operating system, android operating system gets 80.7% and is the best Smartphone OS in the world today [10]. Android is an open-source mobile operating system developed by google that runs on the Linux Kernel. Android Mobile Application Development is based on Java language codes, as it allows developers to code in the Java language. With the vigorous development through Android, mobile applications have been widely used on the various mobile devices. Android mobile applications are evolving at a meteor pace to give a rich and fast user experience [11].

Currently, most of industries have been focused on how to manage the vendor database in order to select the best vendor with good qualifications to procure their services or products. However, there is lack of information due to the number of vendor that has been increasing significantly until now. In general, the problem statements of this paper to support the procurement response from the vendor during procurement process, lack of vendor information for selection in procurement process, and inflexibility in procurement process. From these reasons, the aim of this paper is to develop a vendor management and e-procurement systems using android platform in order to carry out the problem in current procurement process.
2. Materials and Methods
In this study, there are two main parts of system development. Figure 1 shows the vendor management and e-procurement frameworks that to be developed using android platform.

![Vendor management and e-procurement framework](image)

Figure 1. Vendor management and e-procurement framework

An account is required before client can access the server and take part in bidding process. The account consists of a username and password. Clients are unable to register on their own for a new account. So if clients want to take part in the tender bidding process, they will need to apply an account from the host. The host will then request all the information and documents needed to check for the validity of the client. Host will then input all the client information into the database and create an account for the client. After installing the software, the client can start checking for their performance, new tender and also participate in a tender bidding process. When a new tender is available, it will be displayed in the software. By accessing the new tender, client will be able to see the detail of the new tender such as due date and contents. A price offering option is also available in the tender screen. By inputting the offered price, the client will be able to take part in the tender bidding process. After taking part in the bidding process, the client needs to wait for the host to accept the offer. If the offer is accepted, it will be shown in the active tender list.

Host also need an account to access the server. Same as the client the account consists of a username and password. After login in, the host can check for every registered client’s information, active tender, new tender that needs approval and also posting new tender. Host need to fill in the due date and the content of the tender before posting the tender. After the posting completed, the host will need to wait for the client to participate in the new tender. If new participant is available, it will be shown in the tender approval and host will be able to pick the best participant based on their score and offered price.

In order to overcome the problem of slow procurement response from vendor in procurement process, a parameter for measurement is needed. Procurement process time cycle is then assigned to be measured in this problem. In this parameter, an approximately time needed for vendor to be notice and respond to new tender is measured. The main purpose is for showing the needed time for vendor to respond to new tender. For the problem of lack of vendor information for selection in procurement process, a parameter
for measurement is needed. A vendor scoring mechanism is then design to overcome this problem. By applying the vendor scoring mechanism in the system is hoped to overcome the lack of vendor information problem. The applied vendor scoring system will be discussed here. The discussion consists of how the vendor scoring system work and help the vendor selection process. The purpose of this discussion is to show how the vendor scoring system eases the vendor selection process.

In order to overcome the problem of inflexibility in procurement process, a parameter for measurement is needed. Inflexibility and convenience of the system is assigned as the parameters for this problem. These parameters are measured by conducting journal research and articles. The main purpose is for showing the use of mobile phone can increase the efficiency in procurement process. Flexibility in this parameter is addressed by easy and fast respond from the vendor in the bidding process by using the mobile phone.

3. Results and Discussions
The host software consists of three main screens which are all vendor lists screen, ongoing tender screen, and tender approval screen. The user can select each main screen by sliding to the left or right. User can also directly entering the new tender posting screen from every main screen by clicking on the new tender button that is available in every main screen. Figure 2 shows the host software main screen.

![Figure 2. Host software main screen](image)

In the first main screen, the all vendor list screen, host can see a list of all registered vendor in the screen and by selecting each one of the vendor, host can see its information such as vendor company name, owner, score of overall performance, and history. Apart from vendor information, there are two buttons at the bottom of the screen which are SMS and call button that can directly contact the vendor’s person in charge. In the second main screen, the ongoing tender list screen, host can check on the entire list of active tender. All the tender that have been approved by the host will be mark as active and be shown here. By selecting on each tender, Host can see its detail such as tender title, tender due date, tender detail, vendor that is working on this tender and offered price. A complete tender button is located at the bottom of the screen for ending the tender and removes the tender from the active tender list.

In the third main screen, the tender approval screen, host can check on the entire list of posted and unapproved tender. When the host selects one of the posted tender, it can check on the tender title, tender due date, tender detail and a list of vendor that participate in the tender bidding. In the participant list, the host can approve one of the vendors to handle the tender based on the score and offered price. A tender that is approved will be removed from the approval list and moved to the active tender list. Host will be directed to new tender post screen if the new tender button is pressed. In the new tender post
screen, host will see a few brackets that need to be filled in order to post a new tender. The brackets are tender title, tender due date, and tender detail. After host has filled all of them, host can submit and post the tender using a post button that is located at the bottom of the screen. When the post button is pushed and has successfully posted the tender, the new posted tender will be moved to the approval tender list to wait for new participant. The host will then be automatically directed back to the main screen. The software consists of three main screen which are welcome screen, ongoing tender screen, and tender participation screen. Clients can select each main screen by sliding to the left or right. Figure 3 shows the client software main screen.

In the first main screen, the ongoing tender list, clients can check for the list of currently on going tender with the host. All the tender that the client participate in and get approve by the host will be shown here. By selecting each of the tender, clients can check for its information such as tender title, tender due date, tender details and price offered for the tender. In the second main screen, the welcome screen, clients will be able to see their company’s owner name, history and overall performances scores. In the third main screen, the tender participation screen, clients can check for the list of new tender that is posted by the host and has not been assigned to a vendor yet. When accessing the tender, the client will see the tender title, tender due date, tender detail. Apart from that, a price offering option is available which consist of a brackets for price offers and a participate button located at the lower part of the screen. By filling in the bracket with best offer and hit the participate button, vendor will automatically participating in the tender bidding with the offered price. After successfully participating in the bidding, clients need to wait the approval from the host.

In order to measure the time needed for vendor to notice and respond to the new tender, a simple test is done. In an ideal condition where the Smartphone is connected to the internet and having a good signal reception, a SMS and E-mail blast is sent from the host to every registered vendor in the system to notify them to check the new posted tender. Upon receiving the SMS or E-mail, vendors can immediately launch the vendor management software from their phone to check the detail of the new tender. If the vendor knows the exact market price, they can immediately participate in the tender bidding by offering their best price for the tender. Excluding any interruption that prevent vendor to access the Smartphone such as Smartphone’s battery is depleted, left in the office or home, and broken, the approximate time needed for vendor to aware and check the new tender is less than three minutes. Another five minutes is needed for vendor to confirm the tender market price and participate in the tender bidding. The total approximately time is less than ten minutes. Considering the needed time, using e-tender and e-bidding on Smartphone is proven able to shorten the overall procurement cycle time.
A vendor scoring system is implemented in the vendor management software to assist in vendor selection. The most popular criterion considered by the decision makers for evaluating and selecting the most appropriate vendor is quality, followed by delivery, price/cost, manufacturing capability, service, management, technology, research and development, finance, flexibility, reputation, relationship, risk, and safety and environment [8]. The four most influential criteria in evaluating the vendor are: item qualities, item delivery, items costs and item productivity. Therefore, the vendor scoring system uses these four criteria to assess the performances of each vendor [9]. According to Parthiban, Zubar, & Garge, the weight for each of the criteria is as follow [9]:

| Performance Criteria | Weight | Maximum Score |
|----------------------|--------|---------------|
| Quality              | 4.0    | 35.71 points  |
| Cost                 | 3.2    | 28.57 points  |
| Delivery             | 2.4    | 21.43 points  |
| Productivity         | 1.6    | 14.29 points  |
| **Total**            | **11.2**| **100 points**|

With the maximum score of 100 points, each criterion will be assigned a maximum score based on the weight. The total score of each vendor will be graded in a four alphabetic form with different score range as shown in the Table 2.

| Grade | Value | Colour | Score range |
|-------|-------|--------|-------------|
| A     | Best  | Green  | 80 – 100 points |
| B     | Good  | Yellow | 60– 79 points  |
| C     | Warning | Red  | 40 – 59 points |
| D     | Bad   | Black | < 39 points    |

The calculated score will then be implemented into the vendor management software for vendor score check and assisting with vendor selection in procurement process. By showing the vendor grade directly in the vendor management software can speed up the selection process as the host need not extra effort in looking for the vendor performance in the other department or software. Figure 4 shows the vendor performance and selection screenshot.
Due to the vast development over years, today Smartphone we are using is more powerful than most of the desktop 10 years ago. The Smartphone progression is causing the shipments of Smartphone increasing every year. In 2011, market results shown that 73 million more units of Smartphone are being sold that year hence resulting the first time Smartphone outsold personal computers [12]. According to Goldman, having a Smartphone is like having both a mobile phone and computer at the same time [13] because the Smartphone enable user to do things that they never thought possible without laptop or desktop [14]. Apart from to be able to do almost everything that a laptop or desktop can do, Smartphone are able to be used on any place and any time without the need to find a fixed docking place. Hence, with the flexibility nature, the users have become more dependent to the Smartphone than before [15].

Convenience is about adding comfort or saving time in doing any work such as useful, handy or helpful device, article or service. A Smartphone is powerful enough to offer various functionalities comparable to a computer or laptop. With the various available functionalities, there are some examples of user in using the functionalities in their work such as; tax practitioners who are able to provide adequate tax advice to their client even without in their office thus making their job more convenient and effective. Some of the information worker would even use their Smartphone as their primary working device until a personal computer is necessary. Judging at the ways Smartphone is being used in the example, flexibility, time saving and usefulness of usage on Smartphone can be added as the advantages of the Smartphone. Time saving and flexibility is having the ability in aiding the job when and where ever they are. As for the usefulness is having the ability to complete tasks quickly and performs various pc-related tasks. A UK telecommunication industry called Ofcom released a statistic of Smartphone usage in the United Kingdom [12]:

a) 37% of adults and 60% of teens admit they are highly addicted to their Smartphone.
b) 51% of adults and 65% of teens say they have used their Smartphone while socializing with others.
c) 23% of adults and 34% of teens have used their Smartphone during mealtimes.
d) 22% of adult and 47% of teens admitted using or answering their Smartphone while in the bathroom.

The result shows 57% of users are using their Smartphone during their mealtimes and 69% of users admitted using their Smartphone while in the bathroom. Even though it is not a good circumstance for using Smartphone but still by looking from another point of view, these circumstances has proven that Smartphone usage is more flexible and convenience than desktop or laptop.
4. Conclusion
This research found that by using the developed vendor management and e-procurement system on android Smartphone, companies can shorten the overall procurement cycle time. The procurement cycle time is shortened by implemented a vendor scoring system in the system hence user can made a fast and accurate vendor selection directly from the system without needing extra effort in looking for the vendor performance in the other department or software. Apart from shortening cycle time, the developed system is proved to be more flexible and convenience in assisting the user in procurement process. Flexibility is addressed to the ability of able to be used on any place and any time without the need to find a fixed docking place. As for convenience is addressed to adding comfort or saving time in doing any work such as useful, handy or helpful device, article or service.

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