Inventory and Order System Development at PT.X

Steffi Ratanadewi¹,² and Marsellinus Bachtiar¹,³

¹Industrial Engineering Program Atmajaya Catholic University, Campus 3 BSD, Serpong, Indonesia
²STEFFI.2015043010@student.atmajaya.ac.id, ³marsellinus.bachtiar@atmajaya.ac.id

Abstract. PT X is Indonesian cutting tools importer, which sells various kinds of cutting tools, such as Carbide End Mill and Reamer. This company is facing two problems. The first is inefficient order process. The second problem is inefficient inventory update, which takes about eight minutes. Logistic Manager double checks the product quantity by counting physical product, to make sure that the quantity is updated. This process affects both order and procurement process. The objective of this study is to propose a new system, which will be able to perform simpler business process and reduce completion time. Modified Waterfall Approach of System Development Life Cycle (SDLC) was chosen, as it is suitable for well – understood processes, where doing overlapping phases is permitted. This study develops UML Diagrams, also medium and high-fidelity prototypes. User Interface Testing, (consists of learnability, error, memorability, and satisfaction measurement) was done to examine system performance. Result shows that the proposed system performs better than current system. The completion time of create order is reduced 27.51% to 3.11 minutes, availability check is reduced 75.99% to 2.3 minutes, incoming inventory update is reduced 99.67% to 7.69 seconds, and outgoing inventory update is reduced 94.95% to 12.46 seconds.

Keywords: inventory, order management, system, SDLC

1. Introduction

We are living in the middle of Industry 4.0. It is a representation of the fourth revolution in manufacturing that makes it possible to gather and analyse data across machines, also enabling faster, more flexible, and more efficient processes to produce high quality goods at lower costs. The technological transformations can lead a country into its economic development. Administrative and manufacturing tasks such as manual data inputting, quality checking, and product packaging would be declined as they could be helped with a network of machines that connects and shares information to each other.

PT X, which was established in 1996, is a cutting tools importer. The business is considered as trading, which buys different kind of products from another country and sells them to the consumer afterwards. PT X sells various kinds of cutting tools, such as Carbide End Mill, Carbide Ball Nose, Drill, Reamer, Tap, and HSS End Mill. Cutting tool is used to do material removal on a work piece. This company has two suppliers, one in Taiwan and the other in Czech Republic. It sells its products to ten manufacturing companies, which are located in Jabodetabek area. Each customer usually buys 30 up to 40 pieces of cutting tools per month. The selling price ranges IDR 80,000 up to IDR 1,700,000 per piece. Thus, the business model is B2B. Note: The time delay from importing is excluded under this paper.
PT X has two main problems: first is about customer order and the second one is about inventory update. Customer order process starts when a customer sends its Purchase Order (PO) to company e-mail. After receiving the PO, Sales Manager checks the product types and prices on the catalogue. This process is performed to make sure that the customer didn’t write wrong product information on PO. PT X sells more than 100 product items, whose price cannot be memorized one by one. Moreover, the prices change often. As an importer, PT X needs to adjust the price according to the exchange rate. Sales Manager sends the updated catalogue to customers by e-mail, but sometimes the customer still wrote the older version of price on the PO. It makes Sales Manager had to check each PO detail of every Customer. This activity, which takes about four minutes, is considered to be inefficient because it is actually a non-value-added task. The completion time extends if customer writes the wrong information, because Sales Manager needs to inform the customer, then customer needs to fix the PO before the order is processed.

The second problem is inventory update. Sales Manager needs to wait for another eight minutes to get the product availability information. The process starts when Sales Manager asks Logistic Manager to check product quantity. Then Logistic Manager checks the quantity on the inventory report, which is still manually written. Logistic Manager usually continues checking the physical inventory to make sure that the products are available. This happens because sometimes the quantity on report does not match with physical inventory. This process is considered to be inefficient either, because it is a non-value-added activity.

It does not only affect the order process, but also procurement. This process is done by Procurement Manager. Procurement Manager is responsible to order product from supplier when DOI (Days of Inventory) number has reached safety stock, so company will be able to provide sufficient product items whenever needed by customer. Procurement Manager updates the DOI daily, thus Procurement Manager needs to wait for Logistic Manager to give product quantity information. Procurement Manager then calculates the DOI of each product item. This usually takes more than two hours, because there are so many items, and the calculation is still done manually. Another problem arises when Procurement Manager calculates the number incorrectly, hence it affects the order process.

These problems are addressed by using one of Industry 4.0’s building blocks: cloud computing. Using an integrated system, PT X will get benefit of shorter, easier, and more efficient process. A business process analysis will be performed to identify the inefficient activities, so the process can be simplified and human error can be reduced. Therefore, the completion time will be reduced. Company may use the spare time to do value-added or more important activities.

The main objective of this research is to propose an integrated system model that connects customer order and inventory update process. Special feature such as order tracking will be built to help Customer see whether the order has been dispatched or completed. This research will be conducted using System Development Life Cycle (SDLC) methodology. It provides detailed, step by step plans to follow, which are needed for making an organized and goal-oriented project. The Modified Waterfall Approach of SDLC is chosen as it is suitable for creating a simple, predictable system, but flexible enough to enable revision of the previous phases.

The proposed system will be created using UML Diagrams. The diagrams will help researcher to define the business process, scenarios, and information flow. A basic user interface prototype will be created using Axure RP to show the display and basic information flow. Then an updated version of prototype will be built to test the functional and usability factors. The system must work well and easy to use, so the process can give shorter completion time.

2. Methods

2.1. Research Object

The research object is PT X, which is located in West Jakarta. This company is chosen using non-probability sampling (convenience sampling), because of its willingness to provide information and improve business process by developing information system.
2.2. Preliminary Study
Preliminary study was conducted in three days (22 October 2018, 23 October 2018, and 25 October 2018). Researcher came to the company for the first time on 22 October 2018 to ask for permission, gather company profile information, main problems, overall business process, and conduct feasibility study. On 23 October 2018, researcher collected information about company organizational structure with responsibilities and authorities of each employee. On 25 October 2018, researcher collected information about customers, suppliers, and products.

2.3. Scope of the Research
This research defines research scopes and limitation as follows:
1. This study focuses on improving order and inventory process.
2. This study doesn’t cover financial aspects of PT X.
3. This study only gathers the estimated completion time of the current system.
4. This quantity used for DOI calculation is taken from April 29th, 2019.
5. This study ends in the first phase of usability testing. It doesn’t cover system installation.
6. The diagrams and basic prototype were built from January to April 2019, while the updated prototype and testing were conducted from May to June 2019.

2.4. Research Design
This research is considered as an exploratory case study. An exploratory study is one kind of studies, which needs some preliminary works to be done in advance. Thus, the solution ideas or models could be developed based on the preliminary work. This research could be considered as a case study as its objective is to solve company problems.

This research collects data using both of unstructured and structured interviews. Unstructured interview was conducted on the first day of preliminary study, while structured interview was conducted on the second and third day of preliminary study and during data collection phase.

2.5. Modified Waterfall Method
The Modified Waterfall Approach provides more flexible steps as it contains overlapping phases and enables going back to the previous phases [1]. The overlapping phases also increases the process efficiency, because some phases could be done at a time. This study is more well – understood as it has clear processes, so most of the requirements can be predicted on the beginning phases. Moreover, this study has time and budget limitation. The limitation of this approach will be overcome by creating programmer schedule. The Modified Waterfall approach will be used for this study. Its four phases are explained as follows:

2.5.1. Project Planning. Project planning is identifying the scope of a new system, ensuring the project’s feasibility, developing schedule, planning resources, and budgeting for the whole project. The activities and tasks shown in a schedule, see Table 1.

| Activities                        | Day     |
|----------------------------------|---------|
| Identify Current Business Process| D1-D8   |
| Design New System                | D1-D24  |
| Create Prototype                 | D24-D57 |
| Review Planning, Analysis and    | D24-D57 |
| Design Phases                    |         |
2.5.2. Analysis. Analysis is made by understanding current business processes of PT X, which consists of order and procurement process. The business processes are gathered by doing face to face interview with Director and observation. This phase was done on 9 January and 10 January 2019. Researcher created basic flowchart, which consists of start, end, arrow, process, and decision symbols, to visualize the business processes. Then researcher analysed the shortcomings of current processes, inefficient and non-value-added activities which can be improved. Later, system needs are defined based on the shortcomings, and detail requirements are defined based on discussion with Director and all managers, on 14 January 2019.

2.5.3. Design. Design is the phase of developing the solution system algorithms. The first thing to do is defining system features. UML was created through activity diagram [2], use case diagram, use case description, domain model class diagram, multilayer diagram and design class diagram.

2.5.4. Implementation. This study creates the basic and updated prototype and conduct just one phase of functional and usability testing. Researcher created basic prototype from 15 April until 29 April 2019 using Axure RP. The updated prototype is built using PHP programming language, Laravel framework, and MySQL database constructor. Prototype was built by programmer from 10 May 2019 to 4 June 2019. Testing uses the updated prototype as object.

Usability testing [3] [4] [5] consists of learnability, error, memorability, and satisfaction - is conducted once by Director and managers, to ensure that the system is easy to use. First, researcher prepares testing scenarios, then users are given short demo of how the system works and what they have to do. Then learnability test is done by following the scenarios. Researcher needs to write down the completion time. At the same time, researcher needs to see if users make any mistake. Memorability testing is conducted seven days after doing learnability testing, by doing the tasks on the same scenarios. Satisfaction is conducted using System Usability Scale (SUS) questionnaire after completing memorability testing. SUS is a personal administered questionnaire, which is filled by the user oneself.

3. Result and Discussion

3.1. Current Business Process
PT X’s business process can be divided into two big parts: order activity and procurement activity. Both are still done manually, without using an integrated system. Figure 1 shows two general business process flows, explaining both activities. Order activity starts when customer sends PO [6]. Customer will need to confirm the order. Later on, company will ship the order, and customer will have to pay in 30 days after accepting the products. Procurement activity starts when Procurement Manager needs to order from supplier. Procurement Manager will have to send PO and confirm the order afterwards. The difference between order and procurement activity lies in the payment. Use Case diagram (figure 2) shows the relation of activities and actor within the inventory cycle.

3.2. System Requirement
This step defines system requirements and the users [1] [2][7]. Table 2 summarizes three main activities which needs improvement, each with stakeholder, actor, time, current performance, and consequence.
3.3. Proposed System

The proposed system will provide four features: online catalogue, online order, inventory update, and order tracking. The features will perform real-time business process updates [6].

- **Online catalogue.** Customers will be able to open online catalogue on the website to see product list, descriptions, and price. The catalogue will be updated by Sales Manager. Shortly after the update has been saved. Customer will be able to access it.

- **Online order.** Customer will be able to create order on the website, by choosing the product on catalogue, entering the quantity and also payment method. The order will be generated into PO, delivery order, and invoice.

- **Inventory monitoring.** Logistic Manager can get automatic inventory updates from the system, by confirming every incoming and outgoing order notification. The notification is created by the system.
after Customer or Procurement Manager placed the order. This feature will also have Procurement Manager get automatic DOI updates. Procurement Manager will be informed if the DOI has reached safety stock, so he will be able to create decisions faster.

- **Order tracking.** Customer will can see whether the order has been placed, dispatched, cancelled, or finished.

### 3.4. Prototype Design

The user interface is be divided into six parts, based on different roles:

- **Customer.** Customer is able to sign up, login, create order, and view profile on the website.
- **Sales Manager.** Sales Manager is able to login, access order documents, update order status, update catalogue, view inventory, and view profile.
- **Finance Manager.** Finance Manager is able to login, access order documents, update order status, view inventory, view catalogue, and view profile.
- **Procurement Manager.** Procurement Manager is able to login, update order from supplier, view inventory, view catalogue, and view profile.
- **Logistic Manager.** Logistic Manager is able to login, update outgoing and incoming inventory, view catalogue, view inventory, and view profile.
- **Director.** Director is able to login, view customer order, view order from supplier, view inventory, view catalogue, and view profile.

Figure 4 – 7 show the user interface of updated prototype.

#### 3.5. Comparison of Current and Proposed System

Three main activities including create order, availability check, and inventory update, are used to compare current and proposed system.
A. Create order

- **Task.** Create order in current system consists of three tasks. On the other hand, it consists of six tasks in the proposed system. All six tasks of the proposed system can be summarized into one task, which is equal to the first task of current system. Customer doesn’t need to send the PO while performing the proposed system, because the PO is automatically generated and accessed by Sales Manager. Sales Manager doesn’t need to check product name and price while performing the proposed system either, because the PO is automatically generated from the updated catalogue. The proposed system provides one task only, and therefore it is simpler than the current system.

- **Time.** The first two tasks of current system are not able to be measured or estimated, because researcher does not contact the Customers. On the other hand, Sales Manager usually takes four minutes to check product name and price (assumed that Customer orders five product items). The overall completion time of current system is more than four minutes, because definitely Customer takes seconds to create and send the PO. The completion time of proposed system is taken from the average of memorability testing results. The completion time is 162.63 seconds (3.11 minutes), and therefore it is shorter than current system.

B. Availability Check

- **Task.** The availability check in current system consists of three tasks: Sales Manager gives PO to Logistic Manager, Logistic Manager checks product availability, and Logistic Manager informs Sales Manager about the availability. On the other hand, the proposed system consist of the second task.

- **Time.** The overall estimated time of current system is 8 minutes (assumed that Customer orders five product items). On the other hand, estimated time of the proposed system is 138.07 seconds (2.3 minutes), which is the average of memorability testing results. The proposed system has shorter completion time, because it has only one actor and there is no physical inventory check. Logistic Manager usually performs physical inventory check, so it takes longer.

C. Inventory Update.

- **Task.** This activity consists of the same actor and task in both current and proposed system. The difference is only Logistic Manager updates the inventory on book and counts the quantity manually. On the other hand, Logistic Manager updates the inventory by confirming the outgoing and incoming notifications, in the proposed system. The proposed system has a formula which adds and subtracts product quantity after a notification has been confirmed. Therefore, the proposed system provides easier task.

- **Time.** It takes about five minutes to update outgoing product (assumed that Customer orders five product items), according to the Logistic Manager. The incoming product update takes about two minutes (assumed that only one item received). On the other hand, the estimated completion time of updating outgoing product is 12.46 seconds, while the incoming product update takes 7.69 seconds. Therefore, both activities performed using the proposed system take shorter completion time than current system.

3.6. Limitation of the Prototype

Both functional and user interface testing show good results, however, this proposed system still has some limitations. First is about the notification display. Notifications and orders are set in list view, which shows the oldest to the newest list. It will make the users take longer and put more effort to find the newest order or notification. However, this has not been fixed because of time limitation.

Second is about user interface testing, which has not been performed by customers, but Sales Manager instead. Having the customers test the system will give detailed perspective of the proposed system, as they are the main stakeholders of this system. Customers have different background, culture, and skill, which will be able to share rich insight before going further with the system. Testing can be done by gathering the customers or by conducting separate tests in each place.
The third one is about web hosting. The proposed system is built using local hosting, whose program and database are stored internally on desktop. Not only having to download the installer and program, users also have to perform several steps every time. These steps take time to be performed, compared with web hosting.

4. Conclusion
The problems regarding the order and inventory process are inefficient processes, such as PO detail check, inventory update, and DOI calculation. These problems are addressed by creating an integrated information system. UML Diagrams are built to identify the new business process [8], user interface design, and information flow. The basic prototype is created using Axure RP before developing the updated prototype, which represents the final user interface. Functional and user interface testing show that all features of the system work properly and system is easy to use.

5. References
[1] Munassa NM and Govardhan A 2010 A Comparison Between Five Models Of Software Engineering. *International Journal of Computer Science* 7(5) p 94-101.
[2] Satzinger JW, Jackson RB and Burd SD 2005 *Object-Oriented Analysis and Design with the Unified Process* (Boston: Course Technology).
[3] Hornbaek K 2006 Current Practice in Measuring Usability *International Journal of Human-Computer Studies* 64(2), pp 79-102.
[4] Maramba AC 2019 Methods of Usability Testing in the Development of eHealth Applications: A Scoping Review *International Journal of Medical Informatics* 126 pp 95-104.
[5] Marien S, Legranda D, Ramdoyald R, Nsengad J, Ospinad G, Ramond V and Spinewinea A 2019 A User-Centered design and usability testing of a web-based medication reconciliation application integrated in an eHealth network *International Journal of Medical Informatics* 126 pp. 138-146.
[6] Croxton K 2003 The Order Fulfillment Process. *The International Journal of Logistics Management*, 14(1), 19-32.
[7] Dennis A , Wixom BH and Roth RM 2012 *Systems Analysis & Design* (New Jersey: John Wiley & Sons, Inc.)
[8] Birkmeier DQ, Klöckner S and Overhage S 2010 An Empirical Comparison of the Usability of BPMN and UML Activity Diagrams for Business Users. *European Conference on Information Systems* (Pretoria: Scholar One), pp. 1-12