

Application of an Agile Methodology using a Scrum Framework for a Pharmaceutical Inventory System

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ABSTRACT

Company ABC is a pharmaceutical company, and we discovered that it has problems in their business with regards to their manual business process. The current system uses Microsoft Excel as its inventory tracker and product database. Through the use of an Agile driven approach, we were able to identify the company's issues. Through the use of this technique, the system we built is well aligned to address the issues that were identified. This is done through an iterative approach of interviews and feedback on their business process, possible solutions and constraints, and the system. With this medicine-based inventory, it provides a system that keeps track of the company's sales, inventory movement & management, sales invoice creation, stock replenishment, and client contracts. After a sprint, validation is done through a client survey and feedback to improve the system. Our results showed that the Agile Methodology approach is effective in identifying problems with their business process and designing client-centric solutions. Based on our results, we were able to move in the right direction in solving the research problems and objectives. This research is a follow-up to our initial report regarding the development of a Pharmaceutical Inventory System through an Agile Methodology.

KEYWORDS

Inventory, Agile, Pharmaceutical Inventory Computerized Program (PCIP), Medicine

1 INTRODUCTION

As with our initial paper [16], Company ABC is a pharmaceutical company that deals with the distribution of certain medicines within the Philippines. They have 15 products in their inventory. From meeting with the head of the accounting department, we were able to identify that Company ABC uses a manual process that is labor intensive.

During the first few meetings with the client, she stated that because the company's business process focuses a lot on manual operations, most of the problems that are found within their business process are results of human error. One of these problems lies in the physical checking of the medicines. As the inventory staff goes through the physical inventory count every month, he tallies all of the medicines in an excel spreadsheet. There are problems in this regard.

If he does not update the spreadsheet, or if the count is wrong, there lies an illusion where there are enough medicine stocks, when in reality, these medicine stocks actually need replenishment.

After identifying the initial list of problems, we subdivided the system into sprints. According to Rehkopf [1]: A sprint is a short, timed-box period when a scrum team works to complete a set amount of work. Each sprint lasts for 30 days, and the tasks to be completed per sprint are already set. After the sprints, we came up with the functions of the inventory staff which deals with accessing and recording with the inventory database, salesperson which deals with generation of sales invoices and the Accounting staff which deals with the creation of contracts between the company and their clients. We were successfully able to create the system by applying the agile methodology and using the scrum framework. With our final validation results from the client in all three sprints which were positive, we assessed that we were successful in developing a system that improved upon Company ABC's business process.

2 REVIEW OF RELATED LITERATURE

Hayes [3] defines inventory management as the process of ordering, storing and using a company's inventory. Kefabo & Shebo [1] talk about the importance of good inventory management practices at medical centers. They concluded that in an area where there is poor inventory management, in effect there would be less essential medicines available. An inventory management system is a software that is helpful for the businesses that operate hardware stores, where the store owner keeps the records of sales and purchases [5]

A pharmacy computerized inventory program (PCIP) also works similarly as inventory management but for use in medical areas. One of the features in the PCIP is the ability to sort medicines based on their name, dosage, route (oral or injectable), quantity, and expiration date. These sorting functions ultimately determine which medicines need to be resupplied, and which medicines are still available. The conclusion made by Holm, Rudis & Wilson was that an efficient, customizable, and cost-sensitive PCIP can improve drug inventory management in a simplified and sustainable manner within a resource-constrained hospital [4]. Muslihat talks about how Agile methodology is a type of project management process, mainly used for software

development, where demands and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customers[12] [13].

3 RESEARCH OBJECTIVES

The objectives of the researchers were the following:

- Identify the problems with regards to the client's current business process.
- Propose a system design that will solve the aforementioned problems.
- Ensure that the software functionality features eliminate bottlenecks of the current business process.

4 METHODOLOGY

This section discusses the process that the researchers underwent in order to create the inventory system. We are applying the same processes from our previous paper [16].

4.1 Research Design

Firstly, we used the Agile Driven framework in order to keep collaboration open with the client. We contact the client once a week to discuss their business process further, as well as identify the various roles and responsibilities within that process. A sprint lasts for 30 days, and during the end of each sprint, we present their system design to the client. Then, the client provides feedback needed for the system, in which we take into account and implement within the next sprint.

4.2 Research Participants

We interviewed two members from the accounting staff in charge of sales, one member from the inventory staff, and the system admin.

4.3 Data-Gathering Procedure

Due to the ongoing coronavirus pandemic, we were not able to visit their company's office as lockdown protocols were being implemented and observed. However, we were able to contact the client through regular calls, ensuring that there would still be a way to get the necessary information from the client regarding their business process, as well as how the company wants the system to be designed.

We would conduct scrum meetings twice a week, this being every Wednesday and Saturday. These scrum meetings last 3 hours since we do not have a daily scrum set up. They are held so that we can work on their designated assignments related to documentation and coding the system. During these scrum meetings, we update each other about what is going on in their respective lives, and they adjust depending on how serious these matters are.

4.4 Treatment of Data

The data we gathered regarding the client's manual business process helped us understand the environment that the company is immersed in and how they are being impacted because of the pandemic. We also discovered the sequence of tasks that each staff member runs. These staff

members are the inventory staff, accounting staff in charge of sales, accounting staff in charge of accounts receivables, salesperson, sales manager and system admin.

At the end of each sprint, we conduct an end of sprint presentation, where they present their current system design in front of the client through the use of Zoom. During the presentation, we acquire the feedback provided on the event itself with regards to the system's overall design and functions, as well as what other things need to be improved to be stored on cloud storage..

4.5 Validation

We delivered a prototype that is centered on addressing the company's main problems, such as manual tallying of medicines on an Excel spreadsheet, and validated the prototype at the end of each sprint. The researchers used the Scrum Framework of the Agile Methodology.

After every sprint presentation, the client is given an evaluation form which is due the week after. In the evaluation form, the client rates the system design based on its four attributes, mainly (1) usability, (2) dependability and security, (3) efficiency, and (4) acceptability. According to Sommerville [14], these four attributes make up a good software. The said attributes are based on ISO 25010 [15] with our primary concerns being usability and security for this system and still gave focus to the other characteristics. The survey metrics use a Likert Scale, in which 1 is deemed as the lowest grade and 5 as the highest grade. These scores are added up and then the researchers get the average of each core attribute. An average of 3 and below is considered unacceptable, while 4 and above is considered acceptable.

5 FINDINGS

Company ABC's process heavily revolves around a manual, movement-based process. As their business process is labor intensive, most of the problems found within that process involve human error. To start off, only the inventory staff is in charge of tallying the medicines and adding stocks in the excel sheet upon doing a physical inventory check. This happens every month, and it can be problematic since the virtual count and physical count is usually different. If the excel spreadsheet is not updated, it will give the illusion that there are enough stocks for a certain medicine, when in reality, they are actually close to hitting its critical point.

Also, in terms of restocking medicines, the inventory staff needs to get the predicted restock calculation correctly. Otherwise, it can lead to overstocking or understocking, which means that the company is either forced to dispose of the medicines or order another stock again. In terms of disposing of the medicines, the minimum cost would be Php 70,000. However, if the calculated restock is predicted correctly, this will prevent overstocking or understocking and save up to Php 200,000.

The salesperson is in charge of inputting the details of the client in the sales invoice, but sometimes there are

transactions that include incorrect details like wrong client address and wrong discount computation. According to our client, this does not happen frequently. However, it usually takes 15 minutes to do so.

These software functionality features address these core problems and reduce the labor intensity that the company’s process is currently using. These features are distributed throughout the three sprints, as seen in table 1. Both features centered on the problems of manual tallying in an excel sheet and human errors in the sales invoice were both finished on the first sprint.

Table 1: Problems and Software Functionality features, from [16]

Problems	Software Functional Features
The manual tally of the inventory data is heavily centered on an Excel Sheet.	<p>The system must provide an efficient way of updating inventory data based on the inventory tally.</p> <p>The system must be able to reflect all the changes in the inventory when transactions are made.</p> <p>The system must be able to reflect all the changes in the inventory when restocks are made.</p>
The transactions include wrong details such as wrong client address and discount computation.	<p>The system must be able to identify the current contract agreement with the client.</p> <p>The system must use the current contract agreement to verify the orders of the client.</p> <p>The system should be able to track the outstanding balance of the client.</p>
The company may be prone to overstocking when the inventory staff gets the predicted restock incorrectly.	<p>The system should be able to predict the ideal amount of medicine to be restocked for the month.</p> <p>The system should be able to notify the user if the medicine stock is approaching the critical</p>

	point or when it is near expiry.
Human errors are found frequently in inputting the details of the sales invoice.	<p>The system is able to input the correct details regarding the client’s information in the sales invoice.</p> <p>The system is able to compute for the correct discounts as indicated in the client’s contract agreement.</p> <p>The system is able to include package deals as indicated in the client’s contract agreement.</p>

5.1 Software Context

Software Context diagram shows the context of the inventory system and how the system is connected to the different actors.

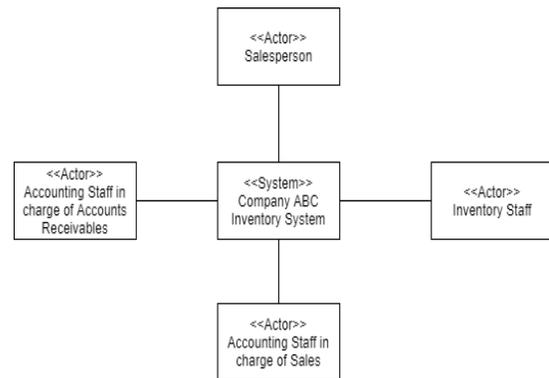


Figure 1: Software Context Diagram, from [16]

5.2 Entity Relationship Diagram

Figure 2 shows the relationship of the different data entities that are used in the development of the system. These entities are used to store and retrieve data from the system. The entities come in the form of tables that have different attributes: primary and foreign keys. The attributes are used to connect the different entities. Each table will store the different data gathered when a user inputs the information in the system, such as the client’s first name, last name, and the like. Most of the relationships of the entities are “one to many.” This is due to the fact that there are some fields that are needed in another entity. The entity relationship diagram described in this section was previously covered in [16].

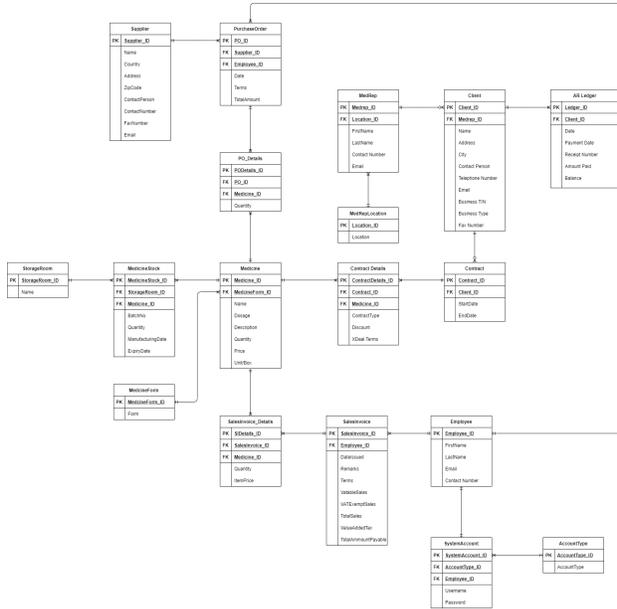


Figure 2: Entity Relationship Diagram, from [16]

5.3 Software Architecture Diagram

The architecture diagram from [16] shows the layered structure of the system: what user interface, user communications, information retrieval and system database will be used.

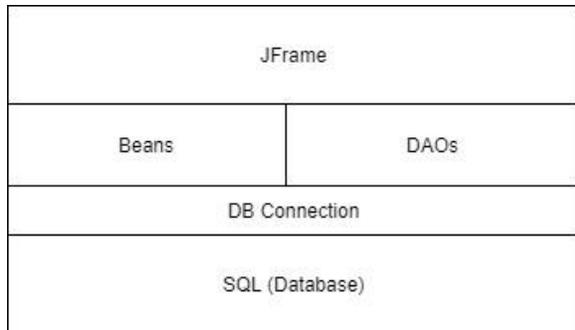


Figure 3: Software Architecture Diagram, from [16]

6 RESULTS AND DISCUSSION

Based on the data in Table 2, we met with Company ABC for three sprints. Each sprint meeting was able to inform and discuss to the client about the issues, clarifications, and changes needed in order to fulfill the deliverables needed by Company ABC.

Table 2: Client Remarks

Sprint Client Feedback	
Sprint 1	- Change UI colors to Blue/Grey -Add words to the buttons

	<ul style="list-style-type: none"> -Business TIN must be 12 digits -Total Unit of specific medicine (Running Total of Inv) -Add Sort by Medrep for Client -Make Storage Room clickable and shows inventory inside of storage room - Remove mL combo box portion of dosage (So they can input themselves the specific dosage) - Remove SRP -Add if VAT inclusive or exclusive -Change price to be editable (price can be changed) -No need to add discount to sales invoice
Sprint 2	<ul style="list-style-type: none"> -Change date formats to MM/DD/YY to be inputted by user -Remove InternationalTax (not important) -Add Search functionality to supplier -Add sort by supplier: name -Remove end date and date created (not as important) -Add Others text box when creating a contract (note like function) -Add Contract reference (one contract can have many products) -Add a delete function for past contracts (but old contracts must still be searchable) -Generated Sales invoice needs batch#, expiry date, customer TIN#, business type and medrep
Sprint 3	<ul style="list-style-type: none"> - Add Client: The 5 business types should be indicated either as distributor, dispensing, drug store, hospital, or others -Add MedRep: There should be only one location per MedRep

	<p>-Sales Invoice: The sales report is monthly and annual, meaning that it should also indicate a year alongside the month (ex. September 2020)</p> <p>-Storage Room: Near expiry is indicated as 6 months</p> <p>-Inventory Report: Indicate the beginning quantity of a medicine in the storage, list down the sales, and the quantity after the sales.</p> <p>-Inventory Report: Remove the medicine description</p> <p>-Purchase Order: Make a tag if the purchase order is rejected, but don't delete it.</p> <p>-Accounting in charge of Accounts Receivable be able to export Sales Invoice</p> <p>-Add an Expired Inventory Report</p>
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Using Agile Methodology, we were able to work with Company ABC in order to fulfill the needs and deliverables that were discussed at the start of the collaboration. The scope was kept in mind.

Based on table 3, the overall mean score is 4.33 out of 5 which is at the level of above average. This means that the software product presented for all three sprints is acceptable. However, when it is broken down into the different criteria, we can see that the lowest mean score lies on the usability portion of the software product. This is expected because the staff have not been thoroughly able to test the system for themselves because the demonstrations given were merely done through Zoom presentations, something that may easily be rectified upon deployment in the field.

Table 3: Mean Score of the Criteria out of 3 Sprints

Criteria	Mean Score (out of 5)
Usability	4.24
Dependability and Security	4.52
Efficiency	4.30

Acceptability	4.27
Overall Mean Score of Software Product	4.33

7 CONCLUSION AND RECOMMENDATION

Based on the final results that we gathered, we believe that the implementation of this system will help improve the business operations of company ABC. We identified the problems of their current system, the manual tally of the inventory data is heavily centered on an Excel Sheet, the transactions include wrong details such as wrong client address and discount computation, the company may be prone to overstocking when the inventory staff gets the predicted restock incorrectly, and lastly human error when inputting data in the sales invoice, All of these initial problems that made the company less efficient, were all addressed by the Inventory System we had developed through an Agile Methodology. Using the Agile Methodology, we were able to focus on the deliverables per sprint and Company ABC was shown a product that met the initial requirements that were discussed.

Due to the COVID-19 Pandemic, we were unable to reach the full potential of the research, which would have had us present the system in front of the client in the office, Company ABC would be able to assess the system properly and that users of the system would be able to test and evaluate the system according to their preferences. Moreover, Company ABC did not have a work-from-home schedule, and although this made scheduling for sprint meetings an issue, we were still able to meet with them. If we were also physically present during the research it is possible that we would have assessed the company and its business process firsthand. In the event of another pandemic we would suggest the usage of a premium Zoom account which will allow the client to be able to view and test the system for themselves. In the case of not being physically present to learn more about Company ABC's business process an alternative could be the request of actual documents relating to it as to further understand the process with clarifications to be sent to the client. Although limited by the pandemic, we were able to deliver the requirements and expectations set by Company ABC.

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