Computer-Based Multi-Layered Monitoring Systems on Textile Manufacturing Processes

Achmad Prabowo Sitepu¹, Faiza Renaldi², Herdi Ashaury³

Department of Informatics, Universitas Jenderal Achmad Yani, Cimahi – Indonesia

Email: ahmadprabowo1996@gmail.com¹, faiza.renaldi@unjani.ac.id², herdi.ashaury@lecture.unjani.ac.id³

Abstract. Monitoring is a set of activities carried out to measure the achievement of objectives. One area that requires a monitoring system is the production process, this aims to ensure that production can be controlled and run as it should. Lack of monitoring of production can cause problems. Although there has been a lot of research on the production monitoring system, so far there has not been much mention regarding the provision or sharing of information on the progress of production implementation in more detail between the production department and the parties involved, especially in sharing information handling errors that occur during the production process. This is important because mistakes that occur during production can cause delays in shipping and will have an impact on the valuation or reputation of the company. The results obtained from the implementation of the system based on user acceptance testing is getting a level of acceptance of 81.5% of 42 test scenarios for 4 types of users. Implementing a production monitoring system can help in monitoring production. More interesting studies can be further carried out especially in the area of artificial intelligence for monitoring production systems.

Keywords: Sub-sections monitoring, information systems, textile manufacturing.

1. Introduction

Production is the process of creating goods and services carried out by an industrial company to meet human needs. Several factors determine the success rate of production such as natural resources, labor, capital, and technology [1]. The quality of the products produced greatly influences the level of success of companies in the industry. In this case, the company is required to be able to produce a product following the desires of consumers to produce products per expectations, then the company must monitor the production process so that production can be monitored and run as it should [2].

Monitoring itself is a monitoring process carried out to measure the achievement of objectives. Besides, monitoring will also provide information on the status carried out repeatedly from time to time to check the process or conditions in achieving the objectives [3]. In other words, monitoring is one of the processes in a very important organizational activity that can determine whether or not an organization's goals are implemented. The purpose of monitoring is to ensure that the main tasks of the organization can run according to a predetermined plan [4]. Monitoring systems have been widely used in various fields such as industrial fields that produce furniture [5], clothes [6], shoes [7], in the financial sector [8], in the health sector [9] and much more. This proves that the monitoring system can help carry out the process of monitoring an organization in running business processes.

In previous studies, the monitoring system was used to monitor the production of bottled drinking
water. The monitoring system that will be applied to the production machine is to display the process and production parameters of the Bardi machine in the form of graphs that can be seen anywhere using the internet network in real-time in the form of a website [10]. Other research also discusses the use of a monitoring system in the process of monitoring convection that is producing textile products. The monitoring system is used to monitor production activities, both material procurement, production scheduling, and data collection of each product produced [11]. Furthermore, monitoring systems have also been used in agriculture, using IoT and web-based systems can control the amount of water needed by a plant [12]. Although there has been a lot of research on production monitoring systems [10] [11] [12], but until now there has not been much mention about the provision or sharing of information regarding the progress of the implementation of production in more detail between the production department and the parties involved, especially in sharing information handling errors that occur during the production process. This is an important issue because any mistakes that occur in the production process will have a detrimental impact on the company such as delays in shipping or hamper other production processes. Then the application of status updates and reporting errors handling production online by displaying the status of production in each section can provide information about production progress. The solution can be used in monitoring the production process. We use PT. CCH Indonesia as our case study here in this study. It is one of the industrial companies that produce various kinds of hat models under the Nike brand name. At PT. CCH Indonesia, there are several stages of the production process, such as receiving purchase orders, making production schedules, hat production, quality control to delivery to goods to customers. But some problems occur in the production process that is often the occurrence of production errors in each sub-section of production, resulting in a mismatch of the number of products that should have been produced by the production department and cause delays in shipping goods to the customer. This is due to the lack of monitoring in each part of the production and the lack of information regarding the status or progress of the production course. From these problems will have an impact on the assessment or reputation given by the customer to the company.

2. Research Methods

Data collection is the activity of finding data needed in the software engineering process which can be done by interview and observation [13]. Data collection methods carried out in this study through several ways, namely observation by observing and recording what is in the production process in the company both from the system used and the activities carried out to obtain a clear picture of the problems that occur in the production process by coming directly to PT. CCH Indonesia in the West Bandung region. Then the interview where the process is face to face and ask questions with parties involved in managing the production process of QA employees (Quality Assurance) who has a task in managing the production process such as recording and checking the results of caps that have been finished producing and checking the quality of the production results, production planning employees who have the task in managing the production process such as adjusting production time with the due date of delivery of goods. The interview time itself is carried out by adjusting the schedule of the interviewees.

2.1. Business Process Identification

In software development, the process of identifying business processes is one of the stages that needs to be done to find out the processes involved in the organization [14] [15]. PT. CCH Indonesia is an industrial company that manufactures caps. The business process of hat production activities begins with the marketing department that receives the purchase order (PO) from the customer, then the PO is sent to the production manager for approval. After the PO is approved by the production manager, then the PO will be sent to the planning of production to be carried out the confirmation stage of the availability of raw materials and the production schedule. When raw materials are not yet available, the PO will be temporarily pending until a certain time. After the confirmation process and the making of the schedule, the product will begin to be processed following the PO by the production department which starts from the fabric, laminating, cutting, sewing, accessories, and QA sections. There are several problems with business processes that are in the Table 1.
| No | Problem found                          | Description                                                                 |
|----|----------------------------------------|-----------------------------------------------------------------------------|
| 1  | The resulting product is not suitable   | The number of products produced does not match the amount indicated on the purchase order |
| 2  | Production status information          | Lack of information regarding the status of production progress             |
| 3  | Delays in delivery                     | Late delivery of products to customers                                      |

Table 1. Problems found during identification of business processes

From the results of the problem that have been outlined, the objective is obtained that can solve the problem. The objective of a system must have information technology capability, knowledge capability, organizational agility, and information intensity [16]. The objectives of building this system are in the Table 2.

| No | Objective description                                      | Solving problem no |
|----|-----------------------------------------------------------|--------------------|
| 1  | To manage and monitor production in subsections           | 1, 2               |
| 2  | aims to notify the production sub-section by granting status | 1, 2               |
| 3  | The web-based system can be accessed by all sub-sections of production for monitoring purposes | 1,2,3              |

Table 2. Objectives of the Integrated system monitoring production

2.2. System Design

System design is the design process that will be carried out using a variety of techniques and includes architectural descriptions and component details and will also be explained using the implementation [17] [18]. The system design process is carried out to describe the system requirements to be built and the system design depends on the results of the analysis in the previous stage. For example, in this study, the structure of the production table, purchase order, and planning are listed in Table 3, Table 4, and Table 5.

Table 3. Designing a production table database

| No | Field Name   | Type | Length | Index | Remarks |
|----|--------------|------|--------|-------|---------|
| 1  | Id_production| Int  | 11     | PK    | Not Null|
| 2  | Kd_production| Text | 50     | FK    | Not Null,|
| 3  | Po_id        | Int  | 11     | FK    | Not Null|
| 4  | Material_id  | Int  | 11     | FK    | Not Null|
| 5  | Schedule_prd | Date | -      |       | Null    |
| 6  | Status       | Text | 50     |       | Not Null|

The production table is used to store production data that has been created by the production planning department which will later become a worksheet for the production sub-section. This production table will be used by the production department to update production progress. So the production manager can monitor the progress of the production.

Table 4. Database design of the purchase order table

| No | Field Name | Type | Length | Index | Remarks |
|----|------------|------|--------|-------|---------|
| 1  | Id_po      | Int  | 11     | PK    | Not Null|
| 2  | Name       | Text | 50     |       | Not Null|
| 3  | Tlp         | Text | 50     |       | Not Null|
| 4  | Address    | Text | 50     |       | Not Null|
| 5  | Note       | Text | 50     |       | Null    |
The purchase order table is used to store order data sent by the marketing department. Purchase order data will be sent to the production manager and the production planning department for the approval process and the raw material stock confirmation process. This purchase order data has a status that can be used to view its status, whether the PO can be produced or postponed due to the unavailability of raw materials.

Table 5. Production planning database design

| No | Field Name  | Type | Length | Index | Remarks |
|----|-------------|------|--------|-------|---------|
| 1  | Id_planning | Int  | 11     | PK    | Not Null|
| 2  | Id_po       | Int  | 11     | FK    | Not Null|
| 3  | Customer    | Text | 50     |       | Not Null|
| 4  | Model       | Text | 50     |       | Not Null|
| 5  | Type        | Text | 50     |       | Not Null|
| 6  | Material    | Text | 50     |       | Not Null|
| 7  | Number      | Int  | 11     |       | Not Null|
| 8  | Due_date    | Date | -      |       | Not Null|
| 9  | Status      | Text | 64     |       | Not Null|
| 10 | Explanation | Text | 64     |       | Not Null|

The production planning table is used to store the order data that has been sent by the production manager, the order data will be sent by the production planning department with diversions to add to the schedule and the order data will be sent to the production sub-section. so that the production department can carry out the production process according to a predetermined schedule. This production planning data can be created when the production planning department has confirmed that the PO has a status of being produced.

2.3. Actors Identification

The software to be built must be under the needs of the user. Analysis of the running system user is an explanation of who are the actors involved in the running system and is one of the steps that must be taken in analyzing the use case [19]. Analysis of the running system user is an explanation of who are the actors involved in the running system. Based on the results of the analysis of the system running at PT. CCH Indonesia has done it, so it can be concluded who are the actors involved in the system with their respective duties. The identification of actors is shown in Table 6.

Table 6. Actors identification

| No | Actors            | Process                                                                 | Mentioned in                        |
|----|-------------------|-------------------------------------------------------------------------|-------------------------------------|
| 1  | Production Manager| Carry out a process of monitoring the production of caps that are currently running and carry out the approval process for the PO to be produced | Interview questions 4 parts Production planning |
Table 7. Functional analysis

| No | Function                          | Description                                      | Solving objective no |
|----|-----------------------------------|-------------------------------------------------|----------------------|
| 1  | Manage PO                         | Perform the process of giving and receiving PO   | 1,3                  |
| 2  | Manage planning production        | Making production planning following PO          | 1,3                  |
| No | Function                                      | Description                                                                                           | Solving objective no |
|----|----------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------------|
| 3  | Manage fabric selection                      | Conduct fabric selection process that will be used as material for making hats by PO                   | 2,3                  |
| 4  | Manage installation accessories              | Perform the process of installing accessories that are under the PO on the fabric that has been selected in the previous process | 2,3                  |
| 5  | Manage laminating on the fabric              | Doing the laminating process, which is the process of pressing on the fabric that has been given accessories in the previous stage | 2,3                  |
| 6  | Manage fabric cuts                           | Fabric cutting process following PO that has been laminated in the previous process                   | 2,3                  |
| 7  | Manage hat stitching                         | Carrying out the process of sewing fabric that has been cut before per PO                            | 2,3                  |
| 8  | Manage the inspection of production results  | Conduct a process of quality inspection of production results                                          | 2,3                  |
| 9  | Manage reports                               | Reporting the results of production at each stage of the production section and reporting of production completion | 2,3                  |

2.5. System Design

The software that has been built will be implemented and tested [21]. Before running this software, some things must be considered, namely the software requirements. In this study, testing is carried out using a personal computer, given that it will facilitate the testing of applications made to test based on the functional aspects of the program. The operating environment of the system used is the environment used to implement the results of the design that has been made in this study web-based software based on the PHP programming language with the editor is Sublime Text and uses a MySQL database and Apache Web Server that is in the XAMPP application, Google Chrome / Mozilla Firefox as a Web Browser media, Code igniter Framework for PHP.

3. Result and Discussion

Implementation of software design and development is carried out for approximately 4 months with testing and implementation of testing carried out using 2 methods, namely system testing and user acceptance testing. System testing is done to compare the initial objectives with the final results. While acceptance testing is carried out by actors who are directly related to the production process.

3.1. Production Monitoring System

The applied interface is the result of the system design that has been carried out on the previous hold [22]. The monitoring system is used to monitor the production process carried out by the production manager, marketing, production planning, fabric section, laminating section, cutting section, sewing section, accessories section, and QA section. Each user must first fill in their username and password as depicted in Figure 1.
There is also a page on managing PO on the part of the production manager to monitor the current hat production and to approve the PO to be produced. After that, there is a production planning management doing the production planning process of the PO that will be produced by the production department by making a production schedule to fit the specified time, as seen in Table 8.

**Table 8. Test case scenario function add PO**

| Use Case ID | PRD-11 |
|-------------|--------|
| Use Case Name | Add PO (Purchase Order) |
| Test Scenario | Test the use case of managing PO on the PO added function |
| Test Case | Enter data in the correct and complete format |
| Pre-Condition | PO (Purchase Order) data is empty |
| Test Steps | 1. Press the add PO button  
2. Input data PO  
3. Click “submit” |
| Test Data | 1. Input name <"PT.Anidia”>  
2. Input telephone <"0822132132”>  
3. Input address <Nigeria>  
4. Input model <Casual Heritage>  
5. Input material <Cotton Red>  
6. Input number <100>  
7. Input due date <30-07-2020>  
8. Input note <-> |
| Expected Result | Notification "Order Data Successfully Added" |
| Post Condition | "Order Data Successfully Added" |
| Status (Pass/Fail) | PASS |
| Actual Result | |

**Fig. 1. Production monitoring system**
On the PO management page, there is a process where the marketing department processes the receipt of POs from the customer and gives the manager to follow up. After approval by the PO production manager will be sent to the production planning department to make a production schedule then the schedule will be sent to each section of production and at each stage of production will provide production status (see Table 9). After the production is complete, the QA part checks the finished caps to ensure the quality of the caps that have been finished. The results of the checks will be reported to the production manager.

Table 9. Test case scenario function confirmation PO

| Use Case ID | PRD-12                                      |
|-------------|---------------------------------------------|
| Use Case Name | Confirmation PO (Purchase Order)            |
| Test Scenario | Test cases using PO confirmations on functions that approve PO 
perform confirmation use case testing on the PO approve function |
| Pre-Condition | PO (Purchase Order) has not been approved |
| Test Steps | 1. Click icon detail PO (Purchase Order) 
2. Display PO detail data 
3. Click “Button approve” |
| Expected Result | Notification " PO successfully approved" |
| Post Condition | " The PO has been successfully approved " |
| Status (Pass/Fail) | PASS |
| Actual Result | ![](image) |
3.2. User Acceptant Testing

User acceptance testing is a process of testing carried out by the user with the results of the output of a test document that can prove that the software has been received and has fulfilled the required needs [23]. User acceptance testing in this study was conducted by testing 42 test codes for 4 types of users, namely marketing, production manager, production planning, and production. The results of implementing user acceptance testing are listed in Table 10.

| No  | User/Tester         | Acceptance Rate | Notable comments                                           |
|-----|---------------------|-----------------|------------------------------------------------------------|
| 1   | Marketing           | 76.19%          | “I still have difficulty in Operating the system especially the PO add function” |
| 2   | Manager Production  | 85.71%          | “Very helpful”                                             |
| 3   | Planning Production | 85.71%          | “Very nice”                                                |
| 4   | Production Department | 80.95%        | “There are some problems, I am still not familiar with the status updating processes” |

Average acceptant 81.5%

Based on Table 10, the acceptance test results obtained produced some of the highest percentage acceptance rates, namely in the production manager division and production planning at 85.71%, from these results indicate that the two divisions were greatly helped by the existence of a production monitoring system, albeit some minor problems occurred during the systems testing, which is very normal happened in most implementation cases.

4. Conclusion

Based on the objectives of this research the system has been able to assist in the process of monitoring the production process. So that the process of hat manufacturing can be carried out as it should and be able to produce hats following the targets that must be achieved. With the implementation of the Production Monitoring System can answer all existing problems and be able to achieve the expected goals. Based on table 10 the acceptance test results obtained produced some of the highest acceptance rate percentages, namely in the user Manager of production and production planning at 85.71%, from these results indicate that in both divisions was greatly helped by the existence of a monitoring system. More interesting studies can be further carried out especially in the area of artificial intelligence for monitoring production systems.

References
[1] J. Heizer and B. Render, Manajemen Operasi, 2005: Selemba Empat, Jakarta.
[2] M. N. Daud, "Analysis of Inventory Control of Wilton Kuala Simpang Bread Production Raw Material," vol. 8, no. 2, pp. 184-198, 2017.
[3] Z. Hakim, M. I. Dzulhaq and R. Utami, "Design of Information Systems Planning and Monitoring of Shoe Shoe Production Schedules on," Journal Sisfotek Global, vol. 8, no. 1, 2018.
[4] A. Herliana and P. M. Rasyid, "Monitoring Information Systems Software Development In Web-Based Development Stage," Journal Informatika, vol. III, no. 1, 2016.
[5] P. Octaviani, T. H. Pudjiartoro and I. Santikarama, "Design of Production Monitoring Information System in CV. Savana," SNIA, vol. 4, pp. 47 - 52, 2020.
[6] M. R. Arini, N. Y. Setiawan and A. Rachmadi, "Evaluation of Garment Production Business Processes Using the Quality Evaluation Framework (QEF) Method," Journal Pengembangan
[7] Samsoni, "Designing Shoes Production Control Information System," Journal Informatika Universitas Pamulang, vol. II, no. 3, 2017.

[8] K. E. E. Ondang, Y. D. Y. Rindengan and a. sambu, "Online Monitoring of Village Funds in South Minahasa Regency," E-Journal Teknik Informatika, vol. 12, no. 1, 2017.

[9] M. Falah, F. Renaldi and F. R. Umbara, "Development of Monitoring Information System of Health Patients of TB Out Patient Hospital Al Islam Bandung," in Proceeding SNST, Semarang, 2019.

[10] H. Haryanto, E. Permata and N. R. Nainggolan, "Production Process Monitoring System for Bardi Machines at PT. Tirta Investama (Danone Aqua) Sukabumi Web Based," SETRUM, vol. 3, no. 1, 2014.

[11] A. Firdaus and S. Widaningsih, "Analysis and Design of Convection Production Monitoring System (Case Study in C.V Nors Wear Cianjur)," Media Journal Informatika, vol. viii, no. 2, 2016.

[12] F. Karim, F. Karim and A. frihida, "Monitoring system using web of things in precision agriculture," ScienceDirect, pp. 402-409, 2017.

[13] N. Dita and E. Mahendrawathi, "Analyzing Linkage Between Business Process Management (BPM) SMEs," Procedia Computer Science, vol. 161, pp. 935-942, 2019.

[14] J. Chernia, R. Martinho and S. A. Ghannouchia, "Towards Improving Business Processes based on preconfigured KPI," Procedia Computer Science, vol. 164, pp. 279-284, 2019.

[15] A. Dennis, B. H. Wixom and R. M. Roth, System Analysis and Design, John Wiley & Sons.

[16] H. Mao, S. Liu and J. Zhang, "How the Effects of IT and Knowledge Capability on Organizational Agility are Contingent on Environmental Uncertainty and Information Intensity," Information Development, vol. 3, no. 4, 2014.

[17] E. Vareilles, T. Coudert, M. Aldanondo, L. Geneste and J. Abeille, "Coupling system design and project planning: Discussion on a bijective link between system and project structures," in IFAC Proceedings, 2012.

[18] G. Booch, J. E. Rumbaugh and I. Jacobson, "The Unified Modeling Language User Guide Second Edition," 2005.

[19] V. Mantzana, M. Themistocleous, Z. Irani and V. Morabito, "Identifying healthcare actors involved in the adoption of information systems," in European Journal of Information Systems, vol. doi: 10.1057/palgrave.ejis.3000660, 2007.

[20] S. P. M. PhD, A. H. T. MD, N. K. RN and G. B. MD, "Surveillance Monitoring Management for General Care Units: Strategy, Design, and Implementation," The Joint Commission Journal on Quality and Patient Safety, vol. 42, no. 7, 2016.

[21] C. S. Saunders and J. W. Jones, "Measuring Performance of the InformationSystems Function," Journal of Management Information Systems, vol. 8, no. 4, pp. 63-82, 2015.

[22] B. H. Sellers and J. M. Edwards, The object-oriented systems life cycle, doi: 10.1145/83880.84529.: Commun. ACM, 1990.

[23] F. D. Davis, "User Acceptance of Information Technology: System characteristics, user perceptions and behavioral impacts," University of Michigan, no. 38, pp. 475-487, 1993.