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The Business Process Improvement Of Production Schedule And Daily Schedule Adherence By Designing Integrated System In The Die Cut Area At PT.DEF

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ABSTRACT

PT. DEF is a company that engage in developing children toys. Currently, PT. DEF is implementing industrial 4.0 technology. All machines need to implement automation system, especially in the die cut area. In order to assign the job order from customer, the schedule was prepared manually and lack of parameter considerations. Consequently, planner should revise the schedule because they did miscalculation that will impact on job order distribution and unscheduled die cut part. Starting from January 2021 – September 2021 there are 420 die cut part numbers should be assigned to the die cut machine. Since the schedule is prepare manually, PT. DEF experience loss and it reached IDR 236,376,000,00. Thus, integrating the production planner schedule and daily schedule adherence (DSA) should be conducted and followed by user requirements consideration. This research uses business process improvement as the improvement method. New integrated system that developed using visual basic for application (VBA) can reduce the manual activities and human error issues. By reducing manual activities, according to measurement of cycle time, the new system can operate 102.46 minutes faster than previous system which is 123.58 minutes. It also can reduce 100% unscheduled part every month in the die cut area at PT. DEF. Overall, the saving cost of new integrated system when calculated based on time reduction and unscheduled part number is Rp 10,667,211.93 per month or equal to Rp 128,006,543.14 per year.

Keywords: Integrated Production Planning, Business Process Improvement, Daily Schedule Adherence (DSA), Weekly Production Schedule, Visual Basic for Application (VBA), Cycle time

ABSTRAK

PT. DEF adalah perusahaan yang bergerak di bidang pengembangan mainan anak. Saat ini, PT. DEF menerapkan teknologi industri 4.0. Semua mesin perlu menerapkan sistem otomasi, terutama di area *die cut*. Untuk menetapkan pesanan pekerjaan dari pelanggan, jadwal disusun secara manual dan kurangnya pertimbangan parameter. Akibatnya, perencana harus merevisi jadwal karena mereka melakukan kesalahan perhitungan yang akan berdampak pada distribusi pesanan pekerjaan dan bagian *die cut* yang tidak terjadwal. Mulai Januari 2021 – September 2021 ada 420 nomor bagian *die cut* yang harus dijadwalkan ke mesin *die cut*. Karena jadwal disusun secara manual, PT. DEF mengalami kerugian dan mencapai Rp236.376.000,00. Dengan demikian, mengintegrasikan jadwal perencana produksi dan *Daily Schedule Adherence* (DSA) harus dilakukan dan diikuti dengan pertimbangan kebutuhan pengguna. Penelitian ini menggunakan *business process improvement* sebagai metode perbaikan. Sistem terintegrasi baru yang dikembangkan menggunakan *visual basic for application* (VBA) dapat mengurangi aktivitas manual dan masalah *human error*. Dengan mengurangi aktivitas manual, menurut pengukuran waktu siklus, sistem baru dapat beroperasi 102,46 menit lebih cepat dari sistem sebelumnya yaitu 123,58 menit. Selain itu juga dapat mengurangi 100% *unscheduled part* setiap bulannya di area *die cut* di PT. DEF. Secara keseluruhan, penghematan biaya sistem terintegrasi baru jika dihitung berdasarkan pengurangan waktu dan nomor bagian tidak terjadwal adalah Rp 10.667.211,93 per bulan atau setara dengan Rp 128.006.543,14 per tahun.

Kata Kunci: Perencanaan Produksi Terintegrasi, *Business Process Improvement*, *Daily Schedule Adherence* (DSA), Jadwal Produksi Mingguan, *Visual Basic for Application* (VBA), Waktu Siklus

1. Introduction

As the development of global market, business environment has become more uncertain and complex. All companies have to adopt business process improvement strategies (Martins and Zacarias, 2017). This condition has forced companies to manage their resources properly. Improving the quality, cycle times, and customer satisfaction has become more crucial. Mehdouani (2019) stated that improvement of the business process will help a company in making better decisions.. The top management is expecting to create integrated system

which can manage all of the data for emerging new opportunities. Thus, they realize the implementation of information technology (IT) is needed and it will change the way company run its business.

Engaging in producing toys and fashion dolls, PT. DEF can produce about two million toys and fashion dolls every year. Making children toys especially fashion dolls is quite take times. It needs around six weeks starting from cutting the materials until become finished costumes. There are various type and size of costumes design which should be prepared to support the fashion dolls. The costume will be prepared into small die cut part and will be sewn in house or deliver to sub contract.

In the current business process of creating production schedule, the production planner prepared it manually. The die cut part will be assigned into die cut machines according to production planner schedule manually. Currently, PT. DEF has 12 cutting machines which be able to cut various pattern and fabric types. In order to assign the job order, the schedule was prepared manually and lack of parameter considerations. Consequently, planner should revise the schedule because they did miscalculation that will impact on job order distribution and unscheduled die cut part.

Starting from January 2021 – September 2021, there are 420 die cut part numbers should be assigned to the die cut machine. Since the schedule is prepared manually, PT. DEF experienced loss and it reached IDR 236,376,000,00. The lost cost is the total of ten unscheduled part numbers or equal to 93,800 die cut parts. The price of each die cut part is IDR 630,00. The price including labor cost, material cost, and delivery cost. The factors that caused loss is the planner did not consider about machine parameters such as: amount of fabric plies, the maximum length of fabric, material availability, tools availability, and machine hours. Those parameters need to be considered also, otherwise the company will experience more loss. Moreover, the manual schedule also impact the company's daily schedule adherence (DSA) target which is 100%. DSA is created by the company to track actual output of production. The DSA will compare planner schedule and actual production output. The average DSA results of die cut area every month are 66%, which means there is 34% gap from company goals. Manual input and missed cutoff time are the main contributors of low DSA percentage. In each shift, the operators should record around 30 part numbers and they need to complete it in one hour before end shift. Hence, the total end shift inventory is not accurate and cannot being used as a valid reference.

In the manufacturing sector, the role of integrated production planning is one of the critical factors. A recent research and study by Chen & Li (2013), integrated production planning control (PPC) was developed to reduce the cycle time and optimize production processes. The proposed framework can optimize the production process and detract amount of cycle time. Consequently, 50% cycle time successfully reduced.

In this research, integrating the system within PPC are discussed, followed by user requirements consideration. Integrating production schedule and DSA are needed to overcome the issues. Therefore, the uses of technologies within planner schedule and DSA are developed to improve the business process.

2. Methods

2.1 Production Planning and Control (PP&C)

Production planning and control (PP&C) is the most important thing in the company. PP&C ensures the availability of materials, every part are assemble at the right place, time, and quantity (D.R.Kiran, 2019). The aim of production planning and control (PP&C) is to give direction about production process and is according to predetermined schedules at the lowest costs. Since PP&C is the part of production system, then the deeper knowledge about production system is needed. PP&C department is collaborated with procurement, manufacturing, engineering, supply chain to create plans and fulfill customer requirements.

Production planning and control is combining all the production aspects, starting from daily production activities to the ability to achieve on time delivery for the customers. The effectiveness of production planning will lead manufacturing process to utilize its full potential. In addition, production planning sometimes not possible to achieve 100% production output according the planner schedule. There may be numerous factors that possible to influence the production system and that will cause a deviation from actual schedule plan. According to (D.R.Kiran, 2019), the factors that may affect production system consist of:

1. The availability of materials
2. The availability of machine tools and machine breakdown
3. Various demand and short orders from customer
4. Absenteeism of workers

5. Lack of communication between departments

2.2 Business Process

Business processes are interrelated activities to create products and services. All companies have to manage its business processes properly (Wannes and Ghannouchi, 2019). In several companies, managing business process is the challenging and difficult tasks. Thus, the company will hire a developer to provide robust and sophisticated software system to increase customer satisfaction and reducing cost when running the business. Observing each product that offer by company to the market is the way business process works. Implementing business process will organize all company activities and improve the understanding the sense of the business itself (Weske, 2019).

The most important role when implementing business process is the use of information technology. The role of information technology in creating new system is integrated all of the activities in the company are consisted of information systems and contains many data to manage. The advantages of involving information technology in business process is internet-based transformation, the company able to update news about products and adapt with rapid change of market.

2.2.1 Business Process Model Notation

Business Process Model offer many tools for creating an automation of business process. The tools starting from analysis, design, execution, and audit of processes. Nowadays, many companies in larger enterprises have implemented automation. Align with the development in technology, BPMN has known as business process modeling notation that lead the participants about the activities and execution time (A.Cummins, 2017). BPMN have been adopted by many companies in their business process management initiatives (Martins et al., 2019).

BPMN has been widely accepted as a business process modeling notation (ie, a form of expression) for prescriptive business processes—those that tell participants what to do and when. Figure 1. shows the graphical elements of BPMN.

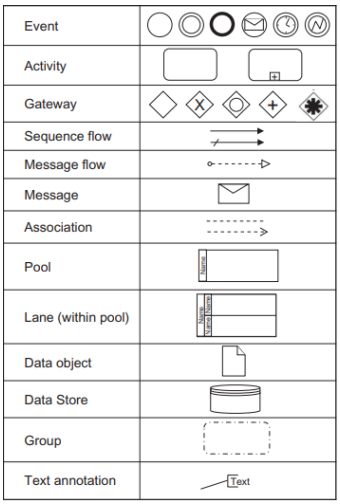

Figure 1. BPMN Graphical Elements

1. Event

An event will explain about the flow of business process whether it is start or stop. Three types of event are: simple circle (start), bold circle (stop), and double circle (intermediate event). The other supporting events are designates with envelope (message), clock (timer), lightning bolt (error).

2. Activity

An Activity will explain about the flow of business process when the activity is done. Two types of activity: the simple square (task) describes simple activity or no detail specification. The next sub process is denoted with plus sign in the middle of square. It describes the activity is contain more detail specification process, by meaning the notation can share the outside activity with other processes.

3. Gateway

A gateway will divide the process converge or diverge. There are five types of gateway. The first one is empty diamond. This notation describe input flow move into a single output path (exclusive or). In some case, the

multiple paths are exist, but only one can considered as outgoing paths. The X symbol in the middle also describe exclusive or. The plus sign diamond describe an and gateway. This sign will use when there are some simultaneously inputs and outputs (parallel paths). Fork is used to define multiple outputs or join for multiple inputs. The last one is use to describe complex computation and the notation is designated with an asterisk.

4. Sequence Flow
There are two types of sequence flow: the solid arrow and hash arrow. The solid arrow describe the execution flow of activity, event, and gateway from the start until finish. While, the hash arrow is describe the alternative paths that comes from exclusive or gateway.

5. Message Flow
A dashed arrow is the symbol of message flow. The dashed arrow will connect in and out at business entity. Messages can be switched between processes or between a system and a process.

6. Message
A message describes the way company communicate with an external parties. The communication run in a store and straight forward, so the related partied not necessary available.

7. Association
There are two types of association notation: a dashed line and an arrowhead. A dashed line will connect the document or object that will be associated together. While, an arrowhead connect the input or output to other associated element.

8. Pool
A pool is the symbol to place for the entity in the business process. The flow process of business process is bound in the pool, when there is a message it should be connect with outside of the pool.

9. Lane
A lane is the part of a pool, it describes the task of an organization or individual who is responsible for the flow process that available in the lane. Commonly, a lane describes the role of organization (e.g., IT, planner, analyst).

10. Data Object
The symbol of data object is a page with folded on the top right corner. This notation represent the document in business process, the document may physical or already digitalize. Data object is exist as long as direct process.

11. Data Store
All of the information about business process will be placed in the data store. Data store is connected with several activities which aim to transfer the data from data store to other component in business process model. The data flow also updated in the data store. The notation of data store is a tube like common symbol of database.

12. Group
The group in BPM is notated with dashed square. This contains information about the group for elements in a business process. The group of element can be created if the elements have some common characteristic.

13. Text Annotation
Text annotation is used to add some note to business process. The additional information should be write in the figure of text annotation. Text annotation will be shown directly on the diagram, the client can see and understand clearly about the content of and model element.

2.3 Visual Basic for Application (VBA)

The results of collaboration Microsoft's event programming language and Microsoft office application is Visual Basic for Application (VBA). The collaboration output are the applications such as Microsoft. Excel, Microsoft. Word, Microsoft. Power Point, and etc. Understanding the integrated development environment (IDE) in the Microsoft. Excel, the developer able to execute program and increase the ability of the application.

Visual basic for application (VBA) can be accessed in the Microsoft excel by opened visual basic editor window. Basically, a macro is VBA code that can execute any actions needed. In excel also provide whether the macro will be written or recorded (Alexander & Kusleika, 2019). Recording a macro is like saving someone number in the smartphone. At first, input the number and save it. Then when contact them again, press the redial button

and the number will be appeared. Recording the macro help the user to become fast learner with VBA, because the actions will be recorded and the VBA syntax will appear.

3. Result and Discussion

In this section, the proposed business process is discussed. After several improvements, the new business process already integrated between planning schedule and DSA. Figure 2. shows detail flow about proposed business process. All the actors are integrated each other to contribute in the new business process.

It starts with creating a schedule by production planner. The process of creating schedule adopted the automation schedule. There is no manual activity, except setting the requirements. All of the calculation are calculated using VBA program. After all the calculation complete, the schedule will be exported to DSA file. However, if there is any revision schedule, the production planner need to ask revise schedule to production planner manager. After that, production planner will check the machine capacity whether it is enough or not. if the capacity is enough, then the schedule will be locked and send it back to the production planner. If the propose revise schedule rejected, the production planner need to set the requirement again and run a new schedule. After final schedule received by production planner, the schedule will be released to the production. Here, the admin production will refresh the DSA and input the remarks if there is any issues occur in the production line. After DSA file finished, the production planner staff will get the DSA percentages and summary issues, then those data will be reported to high level manager.

Figure 2. shows the integration automation planning and DSA can reduce manual activities significantly and can connect the planning schedule and production output. It is easier to track the production schedule with automation DSA. Moreover, creating production weekly schedule also easier than manual schedule. The production planner is not necessary to assign job order into available machine, estimate schedule quantity, and calculate machine utilization. All the requirements already provide in the automation planning. The manager also can secure the final schedule and reduce frequency of schedule revision from production planner because of human error. The production planner staff is not necessary to wait until production finish in order to get the result of DSA, and also already provided with week, day, shift, and issues historical data.

The same with the manual schedule, creating weekly schedule for production from beginning until finish will be measured using cycle time. The cycle time after improvement need to be measured and compared with cycle time before the improvement. In this research, the cycle time was conducted in the die cut area. The measuring time of cycle time will start from the first time the production planner do his job.

The cycle time will describe only for the process of operating automation planning schedule. The cycle time for each machines will have different results due to total part number that need to be scheduled. Moreover, the time for the production planners to find the data is also different, because they need to remember the location of the file. Table 1. shows the result of cycle time when operating automation planning schedule.

Table 1. Cycle Time Automation Schedule

No	Activities	Time (min)
1	Create New Weekly Schedule	0.03
2	Setting Requirement	0.3
3	Refresh schedule	2.3
4	Run schedule	5.7
5	Export schedule	4.4
6	Save schedule	0.3
Preparation Time		**0.33**
Processing Time		**12.4**
Finishing Time		**0.3**
Total Time		**13.03**

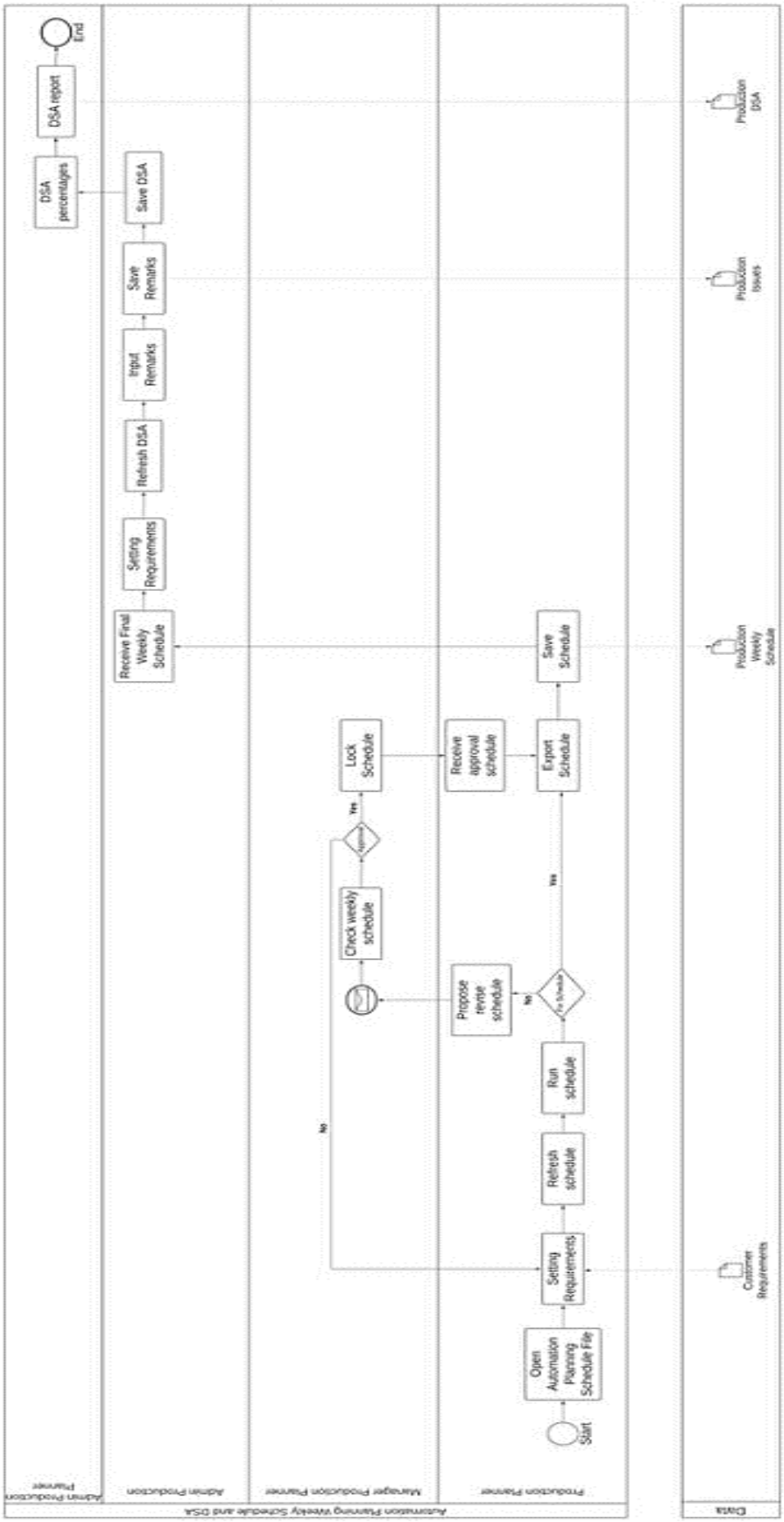

Figure 2. Proposed Business Process

Table 1. shows the detail information about the process operating automation planning schedule. In the process of measuring automation planning schedule can be divided into three processes, which are preparation time, processing time, and finishing time. Creating one weekly schedule for production department, the production planner spend 13.03 minutes. It consists of 0.33 minutes preparation time, 12.4 minutes processing time, and 0.3 minutes finishing time.

The same with manual DSA, creating daily schedule adherence (DSA) aims to track the production output and to aligned it with the planner schedule. The different is the admin not necessary to collect the DSA output from production. The admin only need to refresh the automation DSA to track production output and compare with planner schedule. Table 2. shows detail information about cycle time of automation daily schedule Adherence (DSA).

Table 2. Cycle Time Automation DSA

No	Activities	Time (minutes)
1	Open DSA file	0.09
2	Setting Requirement	1.1
3	Refresh DSA	6.2
4	Input Remarks	0.5
5	Save Remarks	0.3
6	Save DSA	0.2
Preparation Time		**1.19**
Processing Time		**7**
Finishing Time		**0.2**
Total Time		**8.39**

According to Table 2., there are six activities that production admin must do before getting the DSA results. The same with the cycle time in the automation planning schedule, total time will be divided into three main activities such as preparation time, processing time, and finishing time. Processing automation DSA, the admin production spend 8.39 minutes. It is consists of 1.19 minutes preparation time, 7 minutes processing time, and 0.2 minutes finishing time.

Designing new system needs to transfer the user requirement into the system architecture to identify the software that needed and also input output of the system. System architecture emphasis on how system information build which includes application that will be used by company. Figure 3.2 shows the system architecture of integrated system.

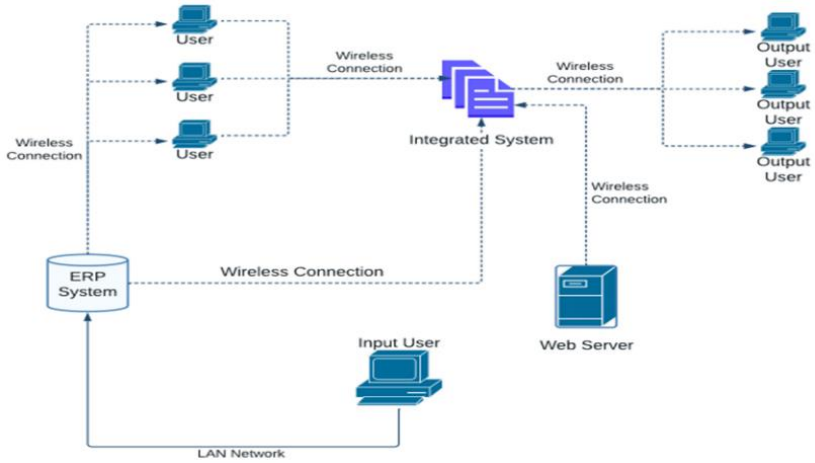

Figure 3. System Architecture

According to Figure 3. the production administration staff will input DSA results to the ERP system. The input process is done by computer user and connected with LAN network to the ERP system. After the input process, the user or production planner will get the requirements from ERP as parameter of integrated system to be

calculated. It requires also to transfer from web server to get actual output from production. This result will be compared with planner schedule to calculate percentage of DSA. At the end, the production schedule and DSA will be released to the end user. After that, the visualization of the new system will be designated. The design will connect the user with the system. Interface design is include shapes, colors, fonts that will be designed as attractive as possible. The interface design is very important because it will affect the user experience when interacting with the system. If the interface design is difficult to understand, it will force the use to do a mistake and affect the system.

In this research, there are two interface design which are automation planning schedule and automation DSA. In the automation planning schedule there will be four buttons such as refresh, run schedule, lock, and export.

Meanwhile, in the automation DSA only have two buttons such as refresh and save remarks. All of the features have different function that capable to support the integrated automation system.

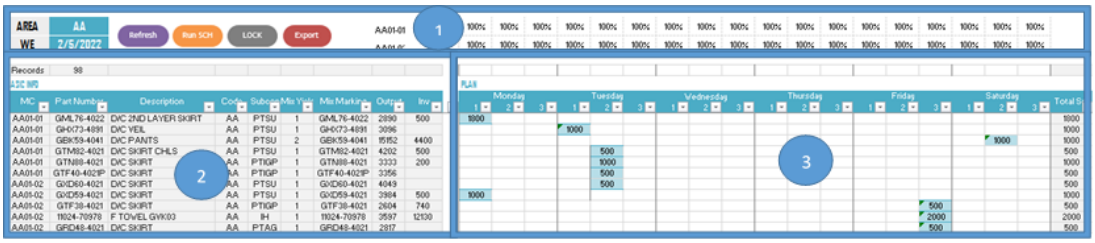

Figure 4. Interface Design Automation Planning Schedule

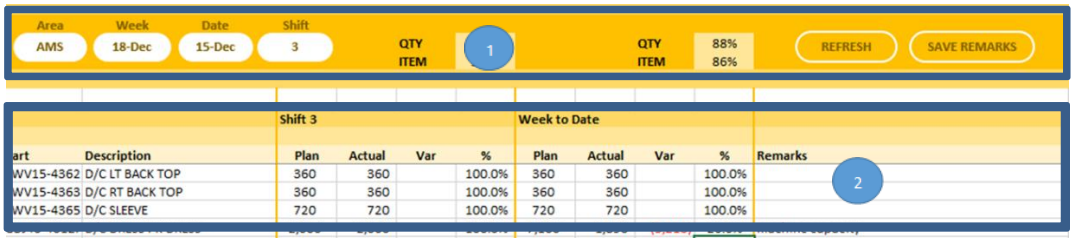

Figure 5. Interface Design Automation DSA

Figure 4. shows the interface design of automation planning schedule. There are three sections that divide the information of this interface. The first section contains of area, week ending, buttons, and machine utilization. The second section contains basic information of automation planning schedule such as machine name, part number, part number description, machine code, subcontract, mix yield, mix marking, output, and inventory. The third section contains planning schedule of automation planning schedule such as daily, shift, and total schedule.

Figure 5. shows the interface design of automation DSA. There are two sections that divide the information of this interface. The first section contains of area, week ending ,date, shift, quantity, and item percentage. The second section contains basic information of automation DSA such as part, description, shift plan, shift output, shift variance, shift percentage, weekly plan, weekly output, weekly variance, weekly percentage, and remarks.

The last phase is the cost calculation. The comparison between previous system and improved system will be calculated using cost calculation. The cost calculation is beneficial for a company, because the company can analyze the profit that can they get when implement the new system. The detail calculation of the new system can be seen in Table 3.

Table 3. Cost Calculation of New Integrated System

COST CALCULATION	
A. Time Reduction	
Total Time of previous system (minutes)	123.58
Total Time of improved system (minutes)	21.12
Time reduction (minutes)	102.46

Table 3. Cost Calculation of New Integrated System (Continued)

B. Total Unscheduled Part	
Amount unscheduled part of previous system per month (pcs)	15300
Amount unscheduled part of improved system per month (pcs)	0
Total reduction (pcs)	15300
C. Cost Allocation	
Worker Salary per month	Rp 4,816,921.00
Worker Salary per minute	Rp 10,035.25
Die cut part price	Rp 630.00
D. Cost Saving	
Improvement saving per month	Rp 10,667,211.93
Improvement saving per year	Rp 128,006,543.14

The cost calculation of the new system begin with measuring total time reduction when operate the system. Reducing manual activities and improved into automation system success reduce the total time from 123.58 minutes become 21.12 minutes or save 102.46 minutes. Moreover, there is no unscheduled part in the automation planning schedule. It is because the system generate the optimal solution and arrange the job order according to available hours and machine utilization. In the previous system there are 15300 pcs unscheduled parts happen in the production process every month.

According to Bekasi UMR, the worker salary every month can reach until Rp 4,816,921.00 or Rp 10,035.25 every minutes. The price of one die cut part also determined and the price is Rp 630.00 per pcs. Calculating the saving cost of the time reduction and unscheduled part. Company can save Rp 10,667,211.93 per month or equal to Rp 128,006,543.14 per year. The cost calculation is not included other supporting facilities cost like electricity cost, transportation cost, meal cost, assurance cost, etc.

4. Conclusion

After analyzing the data, there are two conclusions of this research based on research questions as follows:

1. The integrated system design using visual basic application (VBA) excel can improve the business process of the company. All of the phases lead into new integrated system which is automation planning schedule and DSA. Integrating two separated systems, the company become more efficient and effective when creating the production weekly schedule and tracking the production output using new integrated system.

2. The manual activities when creating production weekly schedule and DSA lead into human error issues and make almost 15.300 part numbers unscheduled. It also make the employee spend much time when creating, collecting, and revising the production weekly schedule and DSA. However, the new integrated system can reduce the manual activities and human error issues. By reducing manual activities, the new system can operate 102.46 minutes faster than previous system which is 123.58 minutes. It also can reduce 100% unscheduled part every month in the die cut area at PT. DEF

Overall, the integrated system can reduce manual activity and beneficial to be implemented at PT. DEF. The saving cost of new integrated system when calculated based on time reduction and unscheduled part number is Rp 10,667,211.93 per month or equal to Rp 128,006,543.14 per year.

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