Time Reduction of Oxyhydrogen Carbon Clean Process at Automobile Workshop in Indonesia Using Business Process Reengineering

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Abstract

The car is now for some people a hobby item that is not only a means of transportation that can take its owner from point A to point B but also a life partner who makes users happy and most of the car hobbyists will take care of their car. with extras, both from the car exterior, car interior, and of course in terms of engine health because without a healthy engine the car cannot operate properly as it should. The study of an Automobile Workshop in Indonesia upon current business processes in order to advise the organizations in measuring the size of the gaps (gaps) that exist between current business processes. This is a descriptive qualitative study with a descriptive design. The findings of this study suggest that business process improvement is accomplished through the use of Business Process Management Notation (BPMN) tools and a Business Process Re-engineering approach, which leads to improvement strategies such as redesigning the overall process flow to make it more efficient (Parallelism). With the adoption of some devices, also the to-be model is simple to implement. As a result, this model is 30% more efficient than the as-is model.

Keywords
Business Process, Re-engineering, Analytical, Hierarchy Process, Automotive Industry.

1. Introduction

Along with the increasing number of car users in Indonesia, the car is now for some people a hobby item that is not only a means of transportation that can take its owner from point A to point B but also a life partner who makes users happy and most of the car hobbyists will take care of their car. with extras, both from the car exterior, car interior, and of course in terms of engine health because without a healthy engine the car cannot operate properly as it should.

One of the treatments carried out to maintain or restore engine performance is to do a carbon clean which aims to clean the carbon crust produced from the rest of the combustion of fuel in the engine room which can interfere with the combustion process that occurs so that it will directly reduce the performance of the car engine. carbon clean itself generally uses a special liquid that is inserted into the combustion chamber and in general, carbon clean maintenance is carried out periodically every 3000km to 5000km distance. Car engine maintenance in general can be done at the official workshop of the Sole Agent Brand Holder (ATPM) for the car brand you own, but due to the increasing number of car users, there are not a few third-party workshops that offer services that are the same or even more than those offered by official workshops. Like engines in general, engines in cars require regular maintenance aimed at maintaining engine performance so that it remains in optimal condition without any problems so that the car can operate properly as it should.

The process of carbon clean maintenance services offered by THE WORKSHOP uses the oxyhydrogen carbon clean method which is more effective and safe for car engines and is the only workshop that applies the oxyhydrogen carbon clean method. The oxyhydrogen carbon clean process carried out by THE WORKSHOP can still be optimized again to reduce the length of service time for oxyhydrogen carbon clean services by using the Business Process Reengineering (BPR) method. (Goksoy et al., 2012) explained that BPR is a strategic method for organizational change. This is very important considering that companies want to survive in today's competitive environment. Every company almost every year or every five years needs change. This change was made so that the company was able to adapt to the times. If this is not done, the company will not be able to survive and will then be rivaled by foreign companies. Meanwhile (Hussein et al., 2014) and (Essam, M.M., Mansar, 2012) state that BPR is a tool to make business processes more efficient in time and cost. In the book (Petrozzo and Stepper, 1997) explains that business process reengineering is useful for making a business more efficient and flexible, the key thing in the success of business process engineering is a new concept, simple but can change systems that are not useful in in it.

2. Literature Review

2.1 Business Process Reengineering

In the business world, the term Business Process Re-engineering (BPR) is often known. BPR has become the most popular process management method in the business sector and is attracting great attention from manufacturers, practitioners, and academics (Goksoy et al., 2012). Today most companies are still trying to find methods to better manage radical change (Grover and Malhotra, 1997).

With regard to this phenomenon, many basic questions remain unsolved. Academics and researchers are trying to study this but the published articles related to this phenomenon are still very few. According to (Nisar et al., 2014); (Habib and Shah, 2013) there are several basic questions related to this phenomenon, including: What does reengineering involve? Are there methods to achieve BPR effectively? Why is it so popular? Is there any logic behind reengineering? Organizations that do not change according to the environment will disappear from the market.

Along with technological developments, the existence of new management process methods in the business sector will certainly bring a change in the business order. Change is a continuous process and forces a company to adapt their activities both in terms of processes, services and others (Habib and Shah, 2013).

In line with this (Goksoy et al., 2012) explained that BPR is a strategic method for organizational change. This is very important considering that companies want to survive in today's competitive environment. Every company almost every year or every five years needs change. This change was made so that the company was able to adapt to the times. If this is not done, the company will not be able to survive and will then be rivaled by foreign companies. Meanwhile (Hussein et al., 2014) and (Essam, M.M., Mansar, 2012) state that BPR is a tool to make business processes more efficient in time and cost.

A process is a continuous and regular activity that is carried out with the goal of reaching a specific result (Bashein et al., 1994). While reengineering is a process for achieving radical improvements in terms of time, quality, awards, and, of course, costs by redesigning processes, organizations, and information systems at the same time, it is also a process for achieving radical improvements in terms of time, quality, awards, and, of course, costs. Firm process reengineering is effective for making a business more efficient and flexible, according to the book (Petrozzo and Stepper, 1997). The key to the success of business process engineering is a new concept, which is basic yet can modify systems that are not useful in it. The basic purpose of business process engineering is to build a process by simplifying work procedures that will satisfy customers and boost existing values, particularly customer value.

Business process reengineering or business process reengineering aims to significantly improve business processes, drastically revise structures, and change existing concepts so that a process can still be implemented and managed properly. The success of this reengineering process is heavily influenced by the members or people involved in it (Ostadi et al., 2011). Meanwhile, business process reengineering is described as a management technique that rethinks present company practices and processes, as well as their interrelationships, according to (Patwardhan and Patwardhan, 2008). In other words, business process engineering is an idea that is implemented to improve process efficiency by using a fundamental, radical, and dramatic approach, as well as processes by modifying or eliminating activities that do not add value, and rebuilding the processes, structures, and cultures that already exist.

2.1.1 Reengineering Concept

According to (Fandy, 2007), quality improvement or total quality management (TQM) is an approach to running a business that allows it to compete by maximizing organizational competitiveness by maintaining continuous improvements to quality programs while working within the framework of existing company processes and attempting to improve in order to continue to climb. Meanwhile, TQM is effective and has a positive impact on increasing employee satisfaction, motivating employees, improving managerial performance, reducing costs and increasing profits and company competitiveness, and, of course, improving the quality of human resources, according to (Wicaksono, 2006). Business process reengineering, on the other hand, is a method of enhancing

current processes that bring no value to the firm, rather than deleting them and replacing them with something new that does.
The major objective of restruturing or downsizing, often known as capacity reduction, is the decrease of human capacity. In the meanwhile, according to (Kamarudin et al., 2014) Corporate restructuring, or the strengthening of corporate governance, is a key aspect of the economic reform program. Corporate restructuring include the reorganization of a firm's assets and liabilities, as well as a comparison of debt and equity inside the corporation. Reengineering, on the other hand, concentrates on how a work process might be improved by eliminating ineffective procedures.

Reengineering differs from the automation system in that it involves simply replacing conventional equipment with more sophisticated equipment that is controlled by a computer system. This is in contrast to the concept offered by the automation system, which involves simply replacing conventional equipment with more sophisticated equipment that is controlled by a computer system. Automation is a technique that replaces traditional methods that were previously deemed incorrect or improper with new methods utilizing a more advanced IT system.

2.1.2 Information Systems Strategic Planning

Information system strategic planning is extremely beneficial in achieving a company's or agency's long-term objectives (Alamri et al., 2016). The Ward-Peppard technique is one of the most widely utilized methodologies in information system strategic planning (Table 1). This strategy combines internal and external study of company situations with present and future IS/IT conditions. Current business and IT circumstances, also known as an As-Is analysis, are required as inputs for the following step, which is to formulate plans that would eventually become a roadmap (Ward, 2002).

Table 1. overview of the advantages and disadvantages of as-is process modeling

Advantage	Disadvantage
1. the same understanding of the existing problems 2. project scope defined 3. the same terminology 4. support acceptance for the project (unfreezing) 5. the basis for the migration strategy against the redesigned process 6. Completeness for evaluating the to-be process 7. The results from the analysis of the as-is process can be used as a to-be, if there is no or only a slight change 8. it shows weakness and restriction	1. the as-is process will become obsolete after the to-be process has been designed or implemented 2. dangerous because of narrow focused process design (thinking in constraints) 3. time and cost consuming

Source: (Process Modeling As-Is Process Model in the Business Process Cycle, 2014)

2.2 Software (IGrafx)

In BPR projects, iGrafx software may be used for process mapping and simulation modeling. One of the most appealing features of this modeling method is its simplicity; even those who have never seen a business process model before will find it simple to grasp. In simulation, the iGrafx technique is quite effective. It may create a variety of data at the conclusion of the simulation, including the length of each transaction, expenses, resource use, and so on.

2.3 Oxyhydrogen Carbon Clean

Oxyhydrogen Carbon Cleaning is an H2E engine carbon cleaning technology that produces hydrogen and oxygen in a 2:1 volume ratio by electrolyzing alkaline water in the presence of potassium hydroxide (KOH). During the addition operation, the resulting gas mixture is delivered into the engine cylinders through the intake manifold, with the engine operating in a mode controlled by the H2E application. Carbon degradation happens in the cylinder and exhaust manifold under regulated combustion conditions. Increases in internal oxygen percentage promote combustion, but the catalytic characteristics of hydrogen allow carbon combustion to be broken down slowly to clean internal carbon. An oxy-hydrogen mixture is formed when a strong electric current breaks a water molecule into its component atoms. By combining the oxy-hydrogen with the gasoline, the mixture is supplied to the engine and consumed while it is operating. The hydrogen combines with the carbon dioxide as it goes through the induction system, combustion chamber, and other parts of the engine, converting it to hydrocarbons. This eliminates the carbon dioxide from the engine, and the resultant gas departs through the exhaust system. Carbon dioxide is eliminated from the interior of the engine using hydrogen technology, which is naturally created during the vehicle's lifetime. Further engine damage and breakdown can be avoided by releasing harmful carbon dioxide. The carbon cleaning effect is proportional to the engine's "dirtiness." This is related to a variety of factors, including driving style, distance, and fuel consumption. More carbon will likely build up if the engine is not running under a high load. Taxis and buses are the worst since they stay motionless and frequently stop-start short excursions when there are few passengers. (2018, Dragan et al.)

The oxy-hydrogen carbon cleaning system uses water electrolysis principles, feeding a single-phase 220V to the device, converting it to DC through a rectifier, and separating the water into hydrogen and oxygen. The gas combination in the engine combustion chamber creates high temperature steam, hydrogen ion, and oxygen ion when it is linked to the vacuum pipe of the automobile engine through the hose and sucked into the vehicle engine when it is idling. The high-temperature steam moistens and softens the engine compartment's stubborn carbon deposits. Hydrogen ions reestablish soft carbon deposition on the surface and produce combustible carbon-based compounds, which may later be burned utilizing oxygen ion support combustion. The thickness of the carbon deposit after combustion is nano-level in the method of the engine running all the time, so the carbon deposition is expelled as nanoparticles or carbon dioxide gas after combustion and does not clog the three-way catalytic converter and exhaust gas pipeline.

3. Methods

3.1 Tools

This research uses several tools to do data processing and to design a reengineering of the automobile maintenance workshop business process, which are as follows:
1. Microsoft Excel Software is used to process data. The formula used is the basic formula provided by this software.
2. iGrafx software is used to approach data or facts that occur in the real world by using blocks and processing time and show the actual event data approach.

3.2 Data Collection

In the process of collecting data in this study, the types and methods used are as follows:
1. Collecting primary data Data gathered through direct observation of the item to be investigated or analyzed is referred to as primary data. In this study, primary data was collected through direct observation and interviews with respondents, as well as Focus Group Discussions.

a. Observation

Observation is a data collection technique with systematic, direct observation of what actually happens on the ground. Data obtained from direct observation with the object and subject of research.

b. Interview

Interview is a data collection technique by asking questions directly to people who are experts in machining at The Workshop, so that researchers can get directly the information needed for research.

2. Secondary data collection Literature study was obtained from the results of research, journals, the internet, articles and text books that support research.

3.3 Data Collection and Processing

The goal of this study's data gathering and processing is to develop a business process improvement model for small and medium-sized firms. Using the Business Process Re-engineering (BPR) strategy, they participated in services. Initially, various specialists participated in a Focus Group Discussion to determine the flow and difficulties that arise in business processes. In addition, observations were performed to determine the amount of time required for each step. Fishbone is used to explain SMEs' business processes, and then the flow is mapped using the Flow Process Chart.

The initial stage of the BPR process is modeling the as-is process, which is done with iGrafx software. The as-is method is used after monitoring the present process before making adjustments; it depicts the traditional way of doing things. The Workshop business process application calculates the overall process time by entering time data for each process.

4. Data Collection

4.1 Business Process Identification

Before developing the as-is process model, a business process was identified at The Workshop by conducting a Focus Group Discussion (FGD) with relevant experts, and then an observation was made to match the results of the FGD with existing activities to get a more complete and detailed picture of the processing time. The data is subsequently organized into process groups, processes, and subprocesses that focus on the business process's fundamental tasks. Based on the findings of observations and focus groups, business processes are mapped out using the Flow Process Chart (FPC). The FPC is used to determine each activity carried out in the division, as shown in Figure 1 below.

Aktor	No.Proses	Proses	Operation	Movement	Inspection	Delay	Storage	Waktu (menit)
Service Advisor	1	Reviewing Service History Review Based on Customer Data	●					1
	2	Creating New Data	●					1
	3	Creating Working Vehicle License	●					***2***
	3.1	Creating Working Time Estimation	●					1
	3.2	Creating Fee Estimation	●					1
	4	Asking for Customer Verification	●					0.5
	5	Moving Vehicles to the Service Station	●					***3.5***
	5.1	Traveling to the Vehicle		●				0.5
	5.2	Moving the vehicle to the service station	●					3
	6	Finding Mechanic	●					***4.5***
	6.1	Traveling to Find Mechanics		●				3
	6.2	Explaining the Workdesk and Vehicle Condition	●					0.5
	6.3	Handing the Working Vehicle License	●					1
	7	Traveling to the Warehouse		●				1
Warehouse	8	Recieving the Working Vehicle License	●					0.5
	9	Apprroving the Working Vehicle License (Signatuire)	●					0.5
	10	Preparing Spareparts from the Warehouse	●					***5.5***
	10.1	Obtaining Required Spareparts	●					2
	10.2	Registering Spareparts	●					1
	10.3	Reviewing Spareparts cost	●					0.5
	10.4	Deliver Spareparts to the Service Station	●					1
Mechanic	11	Work Progress (Oxyhydrogen Carbon Clean Tune Up Package)	●					***86***
	11.1	Turning on HHO Machine	●					1
	11.2	Connecting the Hose to the Throttle Body	●					1
	11.3	Gathering 700ml Water	●					2
	11.4	Turning the Vehicle Engine On	●					0.5
	11.5	Waiting the HHO Machine to work				●		30
	11.6	Turning the Vehicle Engine Off	●					0.5
	11.7	Letting the Engine Cool Off	●					4
	11.8	Opening the Engine Cover	●					1
	11.9	Removing the Vehicle Coil	●					2
	11.10	Removing the Spark Plug	●					3
	11.11	Cleaning the Vehicle Spark Plug	●					4
	11.12	Installing the Vehicle Spark Plug	●					3
	11.13	Installing the Vehicle Coil	●					2
	11.14	Removing the Vehicle Air Filter	●					1
	11.15	Removing the Vehicle Intake	●					2
	11.16	Removing the Vehicle's Throttle Body	●					4
	11.17	Washing the Vehicle Air Filter	●					4
	11.18	Drying the Vehicle's Air Filter				●		14
	11.19	Cleanig the Vehicle's Intake Hose & Throttle Body	●					2
	11.20	Installing the Throttle Body	●					1
	11.21	Installing the Vehicle's Intake	●					2
	11.22	Installing the Vehicle's Air Filter	●					1
	12	Last Inspection Process			●			***4***
	12.1	Fastening the Bolts	●					3
	12.2	Ensuring the Bolts are Fastened into Specs	●					1
	13	Creating Service History and Recommendation for The Next Serivce Schedule (For Customer)	●					1
	14	Informing the Service Advisor that the Work is done	●					1
Service Advisor	15	Travel to Service Station		●				1
	16	Vehicle Testing	●					4
	17	Creating Total Cost Detail	●					2
	18	Handing Total Estimation Cost to the Cashier	●					1
Cashier	18	Creating Total Cost Detail	●					1
	19	Recieving Payment from Customer	●					3
	20	Moving Vechicle to the front of Waiting Room	●					4
	21	Handing the Vehicle	●					2
Warehouse	22	Registering Service History Files (For Workshop Requirements)	●					1
	23	Archiving Service History Files					●	1

Figure 1. Flow Process Chart and Identification Process in business process As-Is

4.2 In the making of As-Is Model

The current process is modeled using Business Process Modeling Notation (BPMN) and iGrafx software to create the as-is model. In the current circumstances, the process is based on what has been taught and discussed at the Workshop. As demonstrated in Figure 2, current business process modeling is done as a whole, from inventory verification through delivery to consumers' hands. BPMN separates the process into lanes, which are described as divisions participating in linked processes. There are four pools in this study: Service Advisor, Warehouse, Labor, and Cashier. The current model is structured into models that include the key business processes and their subprocesses.

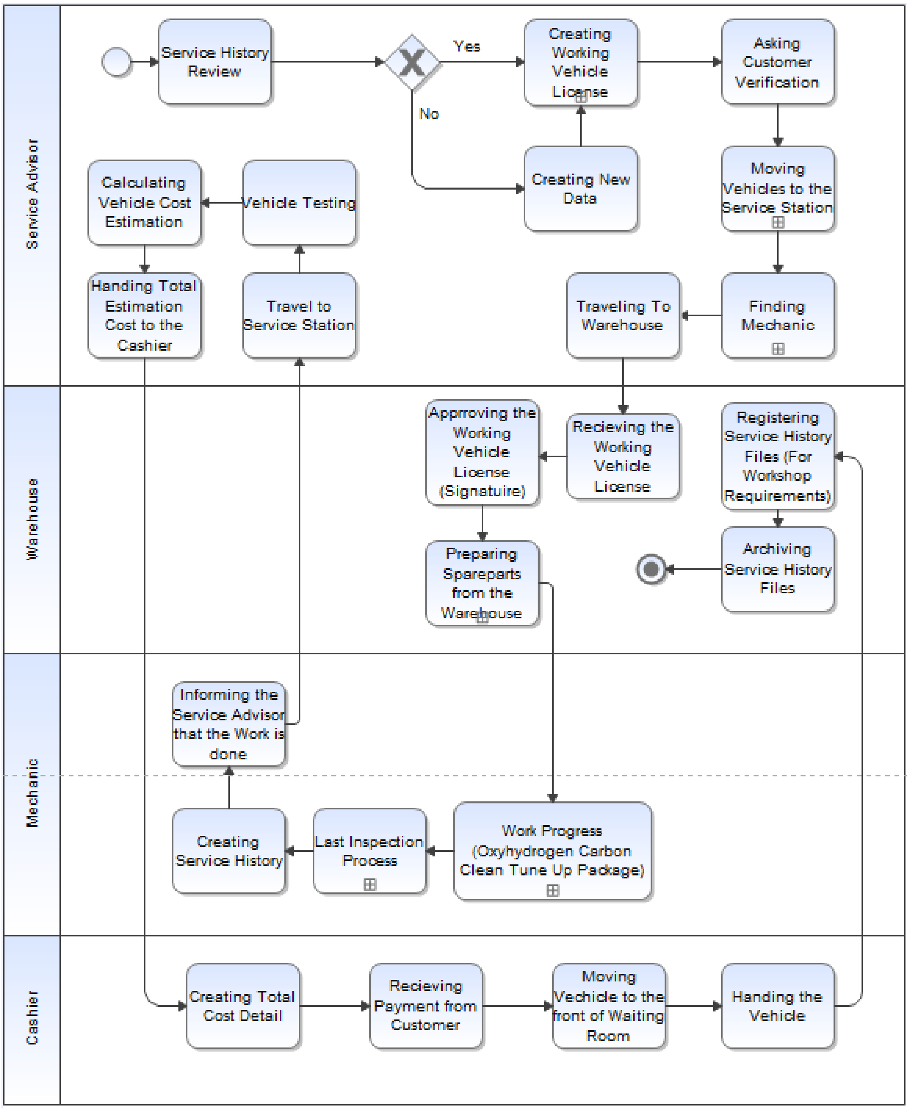

Figure 2. As-Is Business Process

4.3 As-Is Model Analysis

Figure 3 shows the results of the as-is model on BPMN iGrafx, which indicate the overall duration of the entire process (cycle time), which includes working time and waiting time for each process.

Elapsed Time (Hours)

2,15

Transaction Statistics (Hours)

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait	Avg Block	Avg Inact	Avg Serv
1	2,15	2,15	0,00	0,00	0,00	0,00	2,15

Transaction Statistics (Minutes)

	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait	Avg Block	Avg Inact	Avg Serv
Cashier	1	12,00	12,00	0,00	0,00	0,00	0,00	12,00
Mechanic	1	92,00	92,00	0,00	0,00	0,00	0,00	92,00
Service Advisor	1	25,00	25,00	0,00	0,00	0,00	0,00	25,00

Figure 3. The Result of As Is Model

4.4 Design Improvement

After assessing current difficulties from models and models that have been conducted, many techniques are offered to improve the The Workshop process. The method is then modeled and combined in iGrafx software to calculate how long it has been since the improvements were created (Table 2).

Table 2. Strategy Process Change To-Be Model

Model	Strategy		
	Implementation of Wireless Communicating using the help of Speaker, Bell, and Handy-Talkie	Adding 1 more mechanic for helping the existing mechanic and Redesign whole process flow with more efficient flow (Parallelism)	Implementation of the barcode integration process using the help of Handheld Mobile Computer in the Service Advisor division
To-Be	V	v	v

4.5 In the making of To-Be Model

The to-be model is based on the design of BPR strategies and best practices, and it allows business processes to run faster. Figure 4.4. addressed the to-be model of the main process with a combination of strategies, including adding one more mechanic to assist the existing mechanic and redesigning the entire process flow with a more efficient flow (Parallelism), implementing wireless communication with the help of a speaker, bell, and handy-talkie, and implementing barcode integration with the help of a handheld mobile computer in the warehouse division. Changes in the Workshop Business Process occur in this to-be model, beginning with the general process flow, warehouse management, and finance. Figure 4., and figure 5 depicts the outcomes of the to-be model.

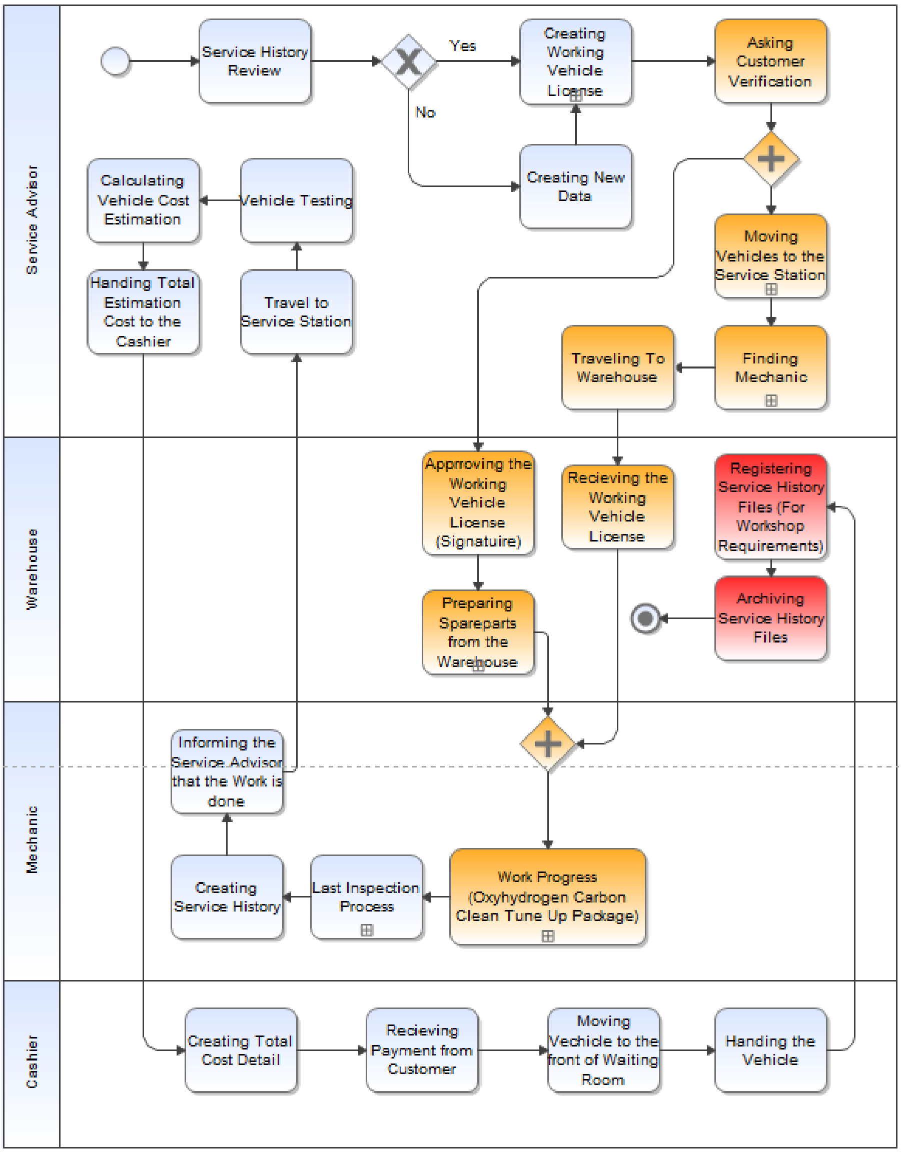

Figure 4. Process Model To-Be

Elapsed Time (Minutes)

90,00

Transaction Statistics (Minutes)

Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait	Avg Block	Avg Inact	Avg Serv
1	90,00	86,00	4,00	4,00	0,00	0,00	90,00

Transaction Statistics (Minutes)

	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wait	Avg Block	Avg Inact	Avg Serv
Cashier	1	10,00	10,00	0,00	0,00	0,00	0,00	10,00
Mechanic	1	57,50	57,50	0,00	0,00	0,00	0,00	57,50
Mechanic 2	1	33,50	33,50	0,00	0,00	0,00	0,00	33,50
Service Advisor	1	20,00	16,00	4,00	4,00	0,00	0,00	20,00
Warehouse	1	2,50	2,50	0,00	0,00	0,00	0,00	2,50

Figure 5. Result of Simulation To-Be Model

5. Results and Discussion

5.1 Scenario Analysis

Simulation of three improvement scenarios, including the use of BPR best practices such as task reduction and parallelism, as well as the polishing and integrating of the database system, to achieve a more efficient process flow. The design to improve the to-be model is also coupled with best practices from BPRs, allowing business processes to run faster.

Following are solutions that may be used using a mix of BPR best practices for a to-be process improvement model, as shown in Table 3 based on discussions and interviews with experts at the workshop.

Table 3. Changes in business process model based on BPR best practice

Best Practice	Lane	Model Changes	Device
Task elimination	Service Advisor	Traveling to find mechanic	Wireless Communicating Method
	Warehouse	Eliminating process "Registering service history file (for workshop)", "Archiving service History Files", and "Registering Sparepart"	Handheld Mobile Computer
Parallelism	Service Advisor - Warehouse	Making the process of moving the vehicle to Service Station and the Process of Preparing Spare Parts from the Warehouse to be done simultaneously (Parallelism)	
	Service Station	Adding second Mechanic	Human Resource
	Service Station	Making mechanic 1 and mechanic 2 work in parallel, mechanic 1 is focused on the upper part of the work (engine) while mechanic 2 is focused on the manifold (intake)	Car Special Electric Tools Set

5.2. Result of changes analysis

The first business process represented in the as-is model takes a lengthy time, with an average total time of 129 minutes per automobile, 129 minutes of work time, and no waiting time. Due to a sequence of processes, there is no waiting time in this first business process. The following formula is used to compute the percentage decrease in processing time:

$$\text{Percentage of decrease in processing time} = (\mathit{Time\ Process\ as\text{-}is} - \mathit{Time\ Process\ to\text{-}be}) \times 100\%\ \mathit{Time\ Process\ as\text{-}is}$$

The To-Be model produce the most optimal solution with a total average process time of 90 minutes, namely To-Be model with a combination of 3 solutions with Adding 1 more mechanic for helping the existing mechanic and Redesign whole process flow with more efficient flow (Parallelism), Implementation of Wireless Communicating using the help of Speaker, Bell, and Handy-Talkie, and Implementation of the barcode integration process using the help of Handheld Mobile Computer in the warehouse division as shown in Table 4

Tabel 4. Differences Between As-Is and To-Be models (Minutes)

Model	Transaction Statistic (minute)		
	Avg Cycle Time	Avg Work	Avg Wait

As-Is	129	129	-
To-Be	90	86	4

6. Conclusion

Based on the research conducted, there are several conclusions about the research as follows:

- By observing and reviewing business processes carried out by the workshop, several problems were deemed inefficient, at the analysis stage found some delays in the initial business process, namely in the Service Station, warehouse, and cashier divisions.
- Current business processes (As-Is) are modeled using iGrafx software, with an average total time of 129 minute per transaction.
- The improvement design produced 3 models, which Adding 1 more mechanic, Implementation of Wireless Communicating, and Implementation of the barcode integration process in the warehouse division.
- The combination of these strategies with the adoption of BPR best practices which saves 39 minutes or a 30.2% reduction in the initial process. So this strategy is the most optimal strategy for business process improvement.

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