

**IMPLEMENTATION OF INDUSTRIAL ENGINEERING PRINCIPLES TO IMPROVE A
MERCEDES BENZ VEHICLE SERVICE CENTRE**

By

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Submitted in Partial fulfilment for the requirements of the degree of

BACHELORS IN INDUSTRIAL ENGINEERING

In the

**FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND
INFORMATION TECHNOLOGY**

UNIVERSITY OF PRETORIA



23 OCTOBER 2008



EXECUTIVE SUMMARY

The author of this report has been appointed by De Wit Motors in Ermelo to assist them with a project to improve the efficiency and productivity of their service centre. This will be done by implementing different Engineering Principles as well as developing a simulation model of the service centre to evaluate improvements.

De Wit Motors is a Mercedes Benz dealership situated in Ermelo, Mpumalanga. The Managing Director is Mr. Johan Coetzer. De Wit Motors sells new vehicles and provide servicing to any Daimler-Chrysler vehicles.

All the processes in the service centre were evaluated with the use of certain tools obtained from the study of relevant literature. Workflow, the flow of tools and the flow of vehicles had been analyzed to observe where bottlenecks occur. Certain areas in the service centre were changed or moved to provide a more efficient working area.

The data that was obtained were analyzed. This provided information to the author where problems occurred in the system. The problems were addressed and the ideal method was developed.

The favourable ideas and solutions were then selected and if possible, it was implemented and analyzed to evaluate if improvements were successful.

During the implementation of certain solutions, the author experienced difficulty because of the resistance to change by the personnel at the service centre. This was overcome with many meetings and team work and the selected solutions were implemented.

At the end of this project the author provided De Wit Motors with suggestions to improve their service centre to become a more profitable part of the business. The service centre will be able to earn ±R89 000 of additional income per month.

This enhanced the customer satisfaction index score as well as the public image of De Wit Motors.



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GLOSSARY OF TERMS

CSI	–	Customer Satisfaction Index
MBSA	–	Mercedes Benz South Africa
N/A	–	Not Available
SOP	–	Standard Operating Procedure



I. BACKGROUND

While South Africa is currently experiencing a decline in vehicle sales but the number of vehicles sold is still very high. All these vehicles need to be serviced and this puts major pressure on dealerships that provide servicing services for automobiles.

The average dealership in South Africa has problems to handle the current capacity of vehicles that need to be serviced per day. Because of unscheduled entries into the service system as well as complicated problems, services may not even be completed on time and it results in a backlog that proves to be very costly and can be harmful to the company's public image.

De Wit Motors is a Mercedes Benz dealership that delivers a product as well as a service. De Wit Motors sells new cars and deliver after sale services like major and minor services to any Daimler-Chrysler vehicle, repair of damaged vehicles and installation of after sale optional extras to any vehicle.

The current service centre operates at full capacity but there is room for improvement. The ratio between the number of mechanics and technicians needs to be addressed as well as the operating procedures during the service. Some layout changes must also be implemented.

The flow of tools and special machinery needed for service is not working optimally and their performance must be improved. The flow of vehicles through the centre needs a vast improvement to ensure a free flowing service facility. There are a few minor problems that must be addressed, like the wheel nuts lying around, the placement of oil drums, parking of finished vehicles and vehicles in line to be serviced.

By eliminating the minor problems and bottlenecks in the service system the efficiency can be enhanced and optimized.



II. PROJECT AIM

The aim of this project is to:

- Applying industrial engineering principles to improve and optimize the service system of De Wit Motors
- Simulate the service system using Arena simulation software

III. APPROACH

The aim will be achieved by utilizing a systematic procedure that was adapted from Methods, Standards and Work Design by Niebel, Freivalds (2003:7). This will affect the optimization of the service centre.

1. Select the Project
2. Get and Present the data
3. Analyze the Data
4. Develop the ideal method
5. Present and install the method

The simulation part of the project will be done according to the simulation methodology adopted from Kelton, Sadowski and Sturrock. (2003:103).

1. Develop modelling approach
2. Building the model
3. Specify values of variables and parameters
4. Run the simulation
5. Evaluate the results



IV. PROBLEM STATEMENT

The management of De Wit Motors suspects that the service centre is not operating at full capacity. The current CSI of De Wit Motors does not meet the standards of Daimler Chrysler South Africa; which is damaging the company's public reputation. The author identified certain areas in desperate need of improvement.

The scope for this project will be the following:

- Service Centre
- Parts Area
- Wash Bay
- Parking Lot



1 SELECT THE PROJECT

While South Africa is currently experiencing a decline in vehicle sales, the number of vehicles sold is still very high. All these vehicles need to be serviced and this puts major pressure on dealerships that provide servicing services for automobiles.

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2 LITERATURE REVIEW

2.1 WHY A LITERATURE STUDY WAS DONE

Engineers need to do extensive research into a certain field before they start with a new project. Different fields of focus need to be understood and evaluated for different projects. Any kind of research in policy involves, at some level, a study of the relevant literature. The relevant literature should be analyzed and used in order to support the project. This is the process of critically assessing and evaluating the same material in order to develop an analytical approach and/or relate it to new aspects of inquiry.

There are good reasons for beginning a literature study before starting a project. These reasons include:

- To see what has and has not been investigated
- To develop general explanation for observed variations in a behaviour or phenomenon
- To identify potential relationships between concepts and to identify researchable hypotheses
- To learn how others have defined and measured key concepts
- To identify data sources that other researchers have used
- To develop alternative research projects
- To discover how a research project is related to the work of others

While conducting a literature study it is very important to stress that is a constantly interrelated process of:

- Gathering and assimilating
- Evaluating and analyzing
- Formulate arguments on the analysis that was gathered
- Structuring and writing of arguments

For this report the author needed to gather information and do research on methods and techniques to improve the efficiency of an automotive service centre.



In engineering, optimal projects are considered beautiful and rational, and the far-from-optimal ones are called ugly and meaningless. Obviously, every engineer tries to create the best project and he/she relies on optimization methods to achieve the goal (Andrej Cherkaev 2001).

The desire for optimality (perfection) is inherent for humans. The search for extremes inspires mountaineers, scientists, mathematicians, and the rest of the human race. This theory is vitally important for modern engineering and planning that incorporate optimization at every step of the complicated decision making process (Herbst, Junginger, and Kühn 1997).



2.2 METHODS OF GATHERING INFORMATION

There are different methods of gathering information that is needed to do a proper literature study. These methods consist of the following:

- The Library
- The Internet, books, articles, manuals and notes
- Interviews, discussion, news footage
- Observation

By evaluating previous and current work done by different people, the author of this report will be able to gather data and information about different methods and systems, to improve the efficiency of an automobile service centre.

The different methods will be inspected and evaluated and then the best methods will be chosen and implemented or applied to the service centre of De Wit Motors.

2.3 INFORMATION GAINED BY OBSERVING THE SERVICE CENTRE AT DE WIT MOTORS

The service centre at De Wit Motors was observed and the following findings were made.

The service centre at De Wit Motors does not operate at full capacity. Too much time is spent on unnecessary actions, like waiting at the parts counter or walking around looking for tools.

The company is also currently experiencing difficulty in deciding the correct number of technicians and apprentices that should be employed at their service centre. A mechanic can only perform a normal service, which mostly consists of; changing tires, checking brake pads and changing oil. A technician can perform a service as well as addressing and resolving problems of the vehicle.

There are 7 service stations at the service centre. Each station needs to be manned by either one mechanic or technician. There is also a wheel alignment station, which needs one technician.



The flow of tools and special machinery needed for service is not working optimally and their performance must be improved. Special tools are stored in a locked room, which result in time lost for looking for the key. The Air-Con recovery module is never stored in the same place and this makes it difficult to locate sometimes.

The flow of vehicles through the centre needs a vast improvement to ensure a free flowing service facility. The parking at the facility is also a problem. Finished vehicles and vehicles that need to be serviced are parked in the inside as well as outside the service centre.

There are a few minor problems that must be addressed, like the wheel nuts lying around, the placement of oil drums and organizing of keys of vehicles in the service centre. By eliminating the minor problems and bottlenecks in the service system the efficiency can be enhanced.

The last problem is that De Wit Motors does not currently confirm with the Customer Satisfaction Index, determined by Daimler Chrysler South Africa. This is because too many vehicles need to be reworked, because of poor work done by the service personnel. Some vehicles leave the service centre with problems after they were inspected. Because of this the inspection methods must be evaluated and improved.



2.4 GATHERED INFORMATION AND BENEFITS OF THE DIFFERENT METHODS, TOOLS AND TECHNIQUES

Any industrial process or operation can be optimized using a variety of available methods. Each method design has its advantages and disadvantages. The best overall method is chosen using selection criteria and concepts. The outcome of the selection process will then be presented to the company for implementation at the service centre.

The following different methods can be used to optimize and improve systems of the company. The methods will be described and commented on in the following paragraphs. The benefits of each method will also be explained.

2.4.1 GANTT CHART

A Gantt chart is a horizontal bar chart that is used as a production control. A Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific tasks in a project.

Gantt charts provide the project manager and everyone involved in the planning of the project, a clear illustration of project status, but one problem with them is that they don't indicate task dependencies. Because of this it is not possible to illustrate how one task falling behind schedule affects other tasks.

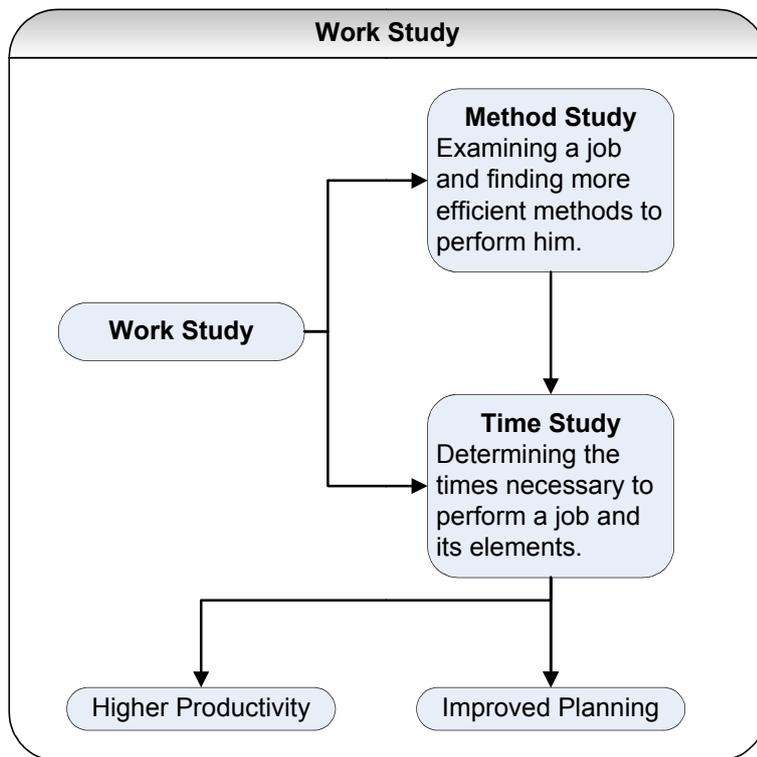
A very important feature of Gantt charts are that they offer the benefit of being easy to change. The charts may be adjusted frequently to reflect the actual status of project tasks if they diverge from the original project plan.

2.4.2 WORK STUDY

According to the (ILO 1978), Work Study is the technique, which is used in the examination of the human work in all its contexts, and which leads systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvement.



Figure 1 - Work Study Diagram



It is also valuable tool because:

- No capital expenditure is needed
- Work study is systematic, no factor affecting the efficiency is overlooked
- Most accurate means of setting standards of performance
- Savings resulting from the applied study, starts immediately
- Work study can be applied to any part of a business
- It is one of the most penetrating tools of investigation.

This has to do with Productivity Improvement, but also improvement of Quality and Safety.

2.4.2.1 Method Study

Method study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs.



2.4.2.2 Work Measurement

Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out a specific job at a defined level of performance.

2.4.3 CAUSE AND EFFECT DIAGRAM

When utilizing a problem solving approach, one way to capture different problem areas is the cause and effect diagram. This diagram will help to visually display the many potential causes for a specific problem or effect. It is particularly useful in situations in which little quantitative data is available for analysis.

The cause and effect diagram has an additional benefit as well; this can help bring out a more thorough exploration of the issues behind the problem - which will lead to a more robust solution.

2.4.4 PARETO ANALYSIS

Pareto analysis identifies and measures the items of interests, on a common scale, and then the items are ordered in descending order, as a cumulative distribution. Typically 20 percent of the ranked items account for 80 percent or more of the total problems.

Because only a few items (operations) accounts for the most problems, the greatest effort can be applied to the few operations and then, if successful, could result in an excellent improvement in productivity and customer satisfaction.

2.4.5 SIMULATION

Discrete-event process simulation originally proved its worth and power as a process improvement tool within the manufacturing sector of the economy (Miller, et al., 2000). Somewhat more recently, simulation has likewise become highly respected, and its use widespread, in various service industries (Boucher, et al., 2003).



Indeed, a variety of published results attest to the value of simulation within the service sector of the economy. (Merkuryev, Yuri, et al., 2008) described the use of simulation to improve the business processing of accounting transactions within supply chains in the timber industry.

Simulation is a technique for modelling dynamics that can augment static value-stream analysis. For example, simulation can be used to estimate the effectiveness of alternative configurations of a lean business process prior to actual implementation. Simulation can often clarify the exact nature of the trade-off between customer satisfaction and cost-effective delivery of service, and allow the service provider to choose the right level of resources (Lipovszki, et al., 2004).

Lean thinking is a systematic approach to developing business processes with the aim of doing more with less, while coming as close as possible to providing customers exactly what they want. It is already the dominant paradigm in manufacturing today. It provides a way to specify value, determine the best sequence for value-creating steps, perform these activities without interruption when customer requests them, and continually improves the process (Venkat, et al., 2006).

The key to lean service systems is to compress time by eliminating waste and let customers pull the product as needed. A number of standard lean service system tools exist, including value stream mapping. In the last several years, simulation has emerged as a complementary tool for design and improvement of service systems.

2.4.6 FLOW DIAGRAM

Flow charts are quality improvement tool that are used specifically for processes.

A flow chart is defined as a pictorial representation describing a process being studied or even used to plan stages of a project. Flow charts provide companies with a common language or reference point when dealing with a project or process.

Four particular types of flow charts have proven useful when dealing with a process analysis: top-down flow chart, detailed flow chart, work flow diagrams, and a deployment chart. Each of the different types of flow charts tends to provide a different aspect to a process or a task. Flow charts provide an excellent form of documentation for a process, and quite often are useful when examining how various steps in a process work together.



When dealing with a process flow chart, two separate stages of the process should be considered: the finished product and the making of the product. In order to analyze the finished product or how to operate the process, flow charts tend to use simple and easily recognizable symbols.

2.4.7 LINE BALANCING

Line balancing can be used to determine the number of workers needed for a certain workstation. When line balancing is done, it must be determined if the job is necessary, if it is performed in the right place, if it is performed at the right time and if it is done by the right operator.

The 3 main areas of waste which should be minimized in a line balance:

- Idle Time
- Ineffective Working Arrangement
- The Job Itself

2.4.8 INFORMATION FLOW MANAGEMENT

Information Flow Management is a management consulting process that specializes in an integrated approach to service centre productivity.

It facilitates the improvement of the complete business cycle from order entry to delivery. Information Flow Management assists a company in assuring that both the service processes and information processes are synchronized to attain their lean service centre expectations.

This also ensures that there is good communication between all the parts and departments of the service centre.



2.4.9 GEMBA TECHNIQUE

A Gemba visit is often simply called a customer visit. The trademarks that make it uniquely useful are:

- The first purpose is to observe, occasionally to question, rarely to guide or direct
- The visit occurs where the service is used, which allows direct observation of problems, workarounds that are applied and capabilities or services that are never used

Common cases for a customer visit include:

- Enhancing the features or usability of products
- The improvement of processes or tools

2.4.10 KAIZEN TECHNIQUE

The Kaizen technique is a daily activity used to improve productivity. It is also a process that improves the workplace, eliminates overly hard work, teach people to evaluate their work and learn how to spot and eliminate unneeded procedures in a business process.

To be most effective Kaizen must operate with three principles in place:

- It must consider the process and the results
- Systemic thinking of the whole process and not just that immediately in view
- An approach that will allow the re-examination of the assumptions that resulted in the current process

Kaizen methodology includes making changes and monitoring results and then adjusting the current processes. The Kaizen technique replaces large-scale pre-planning and extensive project scheduling with smaller experiments, which can be rapidly adapted as new improvements are suggested.



2.4.11 THE 5S METHOD

5S is a method for organizing a workplace, especially a shared workplace (like a shop floor or an office space), and keeping it organized. It's sometimes referred to as a housekeeping methodology; however this characterization can be misleading because organizing a workplace goes beyond housekeeping (Whitten, et al., 1995).

The 5S method focuses on workplace morale and efficiency. The 5S method works by assigning everything to a location and by doing this time is not wasted by looking for things. 5S methodology comes from deciding:

- What should be kept
- Where it should be kept
- How it should be stored

The 5S's of the 5S methodology are:

- **Sorting:** Sorting of tools and only keeping essential items
- **Set in Order:** Arranging of all tools, equipment and parts
- **Sweeping:** Systematic cleaning of the workplace
- **Standardizing:** Standardized work practices and operations
- **Sustaining:** Maintaining and reviewing standards

2.4.12 ANDON PROCESS

Andon is a term referring to a system to notify management, maintenance, and other workers of a process problem. The centrepiece of the process is a signboard incorporating signal lights, to indicate which workstation in the service centre has the problem. The alert must be activated manually by a worker. Modern alert systems can incorporate audio alarms and text or other displays.



2.4.13 TOTAL PRODUCTIVE MAINTENANCE (TPM)

TPM is the philosophy and practice of preventing the loss of productive machine time due to:

- Breakdowns
- Minor stoppage
- Idling
- Operating at less than planned for cycle times
- Changeovers / setups
- Unacceptable quality

TPM involves everyone in identifying, monitoring, and correcting the root causes of each of these losses.

2.4.14 VISUAL MANAGEMENT SYSTEMS

Visual management systems enable anyone to immediately assess the current status of an operation or process at a glance, regardless of their knowledge of the process.

- Visual displays relate information and data to employees in the area
 - Charts
 - Metrics
 - Procedures
 - Process documentation
- Visual controls are intended to control the actions of group members
 - Production status boards
 - Quality controls
- Visual process indicators
 - Painted floor areas for good stock, scrap
 - Direction of flow indicators
- Visual documentation of processes

2.4.15 CRITICAL ANALYSES

The Seven Steps of Critical Analyses are a set of questions to help in the improvement of any system or process. The questions that must be asked are: Who? Why? When? Where? What For? What? How?



- **WHO:** This names participants, resource people, facilitators, teachers, in short, all who are involved in the system.
- **WHY:** This names the situation that calls for improvement. The more information that can be acquired here, the more likely the design will fit the current situation.
- **WHEN:** This is the time frame. How long do the operations take? How long will the project last? How long do you have for the training? What season is it?
- **WHERE:** This describes the site.
- **WHAT FOR:** These are the behavioural objectives of the service centre. Behavioural objectives mean those that can be demonstrated, that affect the behaviour of the processes at the service centre.
- **WHAT:** This is the content of the improvement of the service centre. This is named as nouns. These are the skills, knowledge, processes and attitudes at the centre.
- **HOW:** This is the design itself. These are the tasks that implemented to improve the current system. The design is dependent on the responses to the other six questions.



2.5 EVALUATION OF LITERATURE

2.5.1 BENEFITS OF METHODS/TOOLS

2.5.1.1 Gemba Technique

- Practical evaluation of the system
- Evaluation from customer's perspective

2.5.1.2 Fishbone Diagrams

- Graphically presents causes of problems
- Very easy to use and very useful in identifying problems

2.5.1.3 The 5S Method

- Remove unwanted procedures from system
- Provide a enhanced working environment
- Improve productivity of worker

2.5.1.4 Information Flow Analysis

- Shows information flow through system
- Communication problems can be identified

2.5.1.5 Workflow Diagram

- Systematically shows procedures in system
- Graphically presents service system
- Can be used to determine bottlenecks in system

2.5.1.6 Work Study

- No capital expenditure is needed
- It is one of the most penetrating tools of investigation.
- Most accurate means of setting standards of performance



2.5.1.7 Simulation

- Change processes in system without changing the system
- No capital investment to improve system
- Changes can be made and evaluated on a computer
- No work or time is lost by employees while system is changed

2.5.1.8 Andon Process

- Efficiently communicate problems through service centre
- Problems can be fixed earlier because of early warning

2.5.1.9 Visual Management Systems

- Anyone can immediately assess the current status of an operation or process
- No knowledge of the process is needed.
- Visually communicates the movement of the vehicle through the system

2.5.1.10 Critical Analyses

- All personnel can participate
- Very easy to use
- Provide valuable information about the system by answering questions



2.6 CHOOSE APPROPRIATE METHODS AND TOOLS

The different methods, tools and techniques that were chosen must be implemented. In the next section, the author will describe what techniques have, and must still be implemented, and if there were any findings or improvements after implementation.

2.6.1 THE CHOSEN TOOLS, METHODS AND TECHNIQUES

2.6.1.1 Critical Analysis

Critical analysis was done to determine which processes are needed, which are performed in the right place, if the time constraint is correct, why does the certain process need to be done and if it is done in the proper manner.

This helped to remove unwanted and time-consuming processes from the system and optimally improve the efficiency of the system.

2.6.1.2 Work Study

A work study was done in the July vacation period. The whole system was evaluated, from the parts counter to the wash bay. This provided the author with detailed information about servicing times, efficiency of procedures and the quality and efficiency of personnel.

2.6.1.3 Simulation

The simulation model is built on the work flow diagram. It is now under construction and will be finalized at the end of the project. The model will then be used to determine the results if certain changes in the procedures in the system are made, and what effect it will ultimately have on the efficiency and productivity of the centre.

2.6.2 ADDITIONAL TOOLS, METHODS AND TECHNIQUES ALREADY IMPLEMENTED

2.6.2.1 The Gemba Technique

The Gemba technique was applied to evaluate the system and to identify the problems from a customer's point of view. The author visited the service centre and will schedule visits again



during the final phase of the project. This was done to gather raw data about the processes in the service system and to gain first-hand experience in the operations at the centre.

2.6.2.2 Fishbone Diagrams

Fishbone diagrams were developed to identify direct causes of the problems after the visit to the service centre. These problems were identified as low productivity and low customer satisfaction.

2.6.3 ADDITIONAL TOOLS AND METHODS THAT STILL MAY BE IMPLEMENTED

The following tools and methods may also be implemented in the next semester, in BPJ 420, if time allows it to be done.

2.6.3.1 The 5S Method

After defining the problems that resulted in the low productivity and the low customer satisfaction, the 5S Methods needs to be implemented to organize the workplace and keeping it organized. The 5S method works by assigning everything to a location and by doing this time is not wasted by looking for things.

By implementing the 5S method, unneeded tools and procedures can be identified. This will result in a workplace that is more efficient and organized, which will ultimately result in a more productive service centre.

2.6.3.2 Andon Process

The Andon process can be implemented, if there is enough time. This will ensure that, if a problem occurs, management and maintenance will be notified as soon as possible. This will improve the service time of vehicles, which will result in improved productivity.

2.6.3.3 Visual Management Systems

By implementing a visual management systems, personnel and customers, will be able to immediately assess the current status of an operation or process currently performed on the



vehicle. This will ensure better customer satisfaction as well as an improved working environment for the mechanics and technicians.



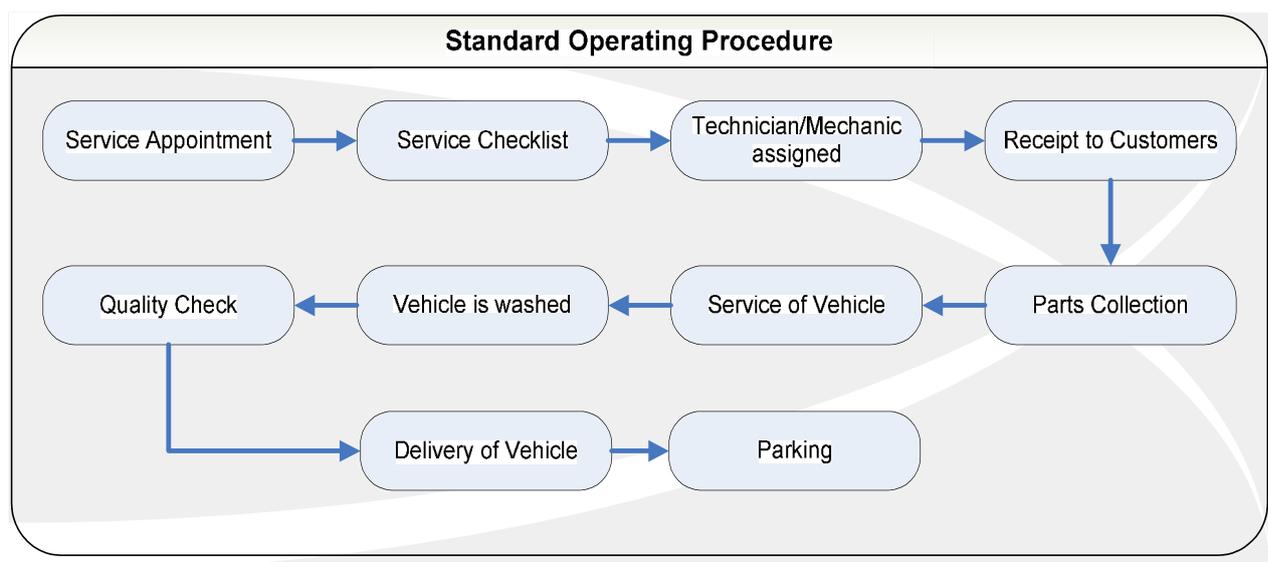
3 GET AND PRESENT DATA

The data was obtained from the service department of the De Wit Motors. The standard operating procedure (SOP) was analysed and the different data needed, was obtained. The operating procedure is the vital part of the whole service system.

If the whole procedure can be optimized, the efficiency and productivity of the service department can be improved. Technicians will then be able to service and repair more automobiles per day.

The current SOP consists of the following procedures:

Figure 2 - The SOP



3.1 SERVICE APPOINTMENT

De Wit Motors can service approximately 14 automobiles per day. Customers phone in advance to book a service. Services are booked on a computer system. There are currently two employees working in the booking and reception department. Both of the receptionists as well as the service centre foreman handle the booking of vehicles. They are linked with a computer system to ensure that no double-bookings are made.

When the customer phones to book a service for his vehicle, he is instructed to deliver his vehicle at a specific time during the day, mostly early in the morning between 7am and 9am. It



is not possible to provide the customer with a certain time, at which he can receive his vehicle. This is because the duration of a service differs from vehicle to vehicle.

If a customer delivers his vehicle later during the day, the vehicle will be placed at the end of the queue. If all the vehicles that were booked for a service are completed, the vehicle next in line would be serviced.

There are customers that do not book a service for their vehicle. They are called walk-ins. This cause some problems at the service centre because most of the time all the bookings are full and there is not enough time to service all the vehicles. But most of the walk-in customers are very important customers as well as fleet vehicles. Because of this it is very important to service these vehicles to ensure a good CSI score.

De Wit Motors have one courtesy vehicle available for customers that need a vehicle while his car is serviced. There is also a vehicle available for transporting people to the workplaces or homes. It is usually the driver of the parts-collection that transports the people.

3.2 SERVICE CHECKLIST

On arrival of the customer a service checklist is completed to provide the service centre with the work that needs to be carried out on the vehicle. The service centre manager is responsible for completing the service checklist.

The customer is asked if there are any problems with the vehicle, what service needs to be carried out and if there is additional problems that must be inspected. The vehicle is also inspected for scratches or damaged parts to ensure that the customer knows about it. This needs to be done so that a customer can not accuse the service centre of damaging his car if he finds scratches that was not there, when he delivered his vehicle.

The customer is then asked if he wants to fix the chips in the windscreen, if there are any. This is done by a third party company who specialises in fixing chipped windscreens. This is normally done after the vehicle is washed and ready for delivery to the customer.

After the customer is satisfied with the service checklist and all the problems were addressed, the key of the vehicle is taken and placed into the key box.



3.3 TECHNICIAN/APPRENTICE ASSIGNED

The service centre manager manages the assignment of technicians and apprentices. A list of all the customers for the day is compiled by the reception personnel and delivered to the manager in the morning. The workshop manager is fully aware of all the work that needs to be carried out on all the vehicles. He then allocates the different job cards to the most suited technician/apprentices.

The skill level of the technicians/apprentices plays a major role in the assignments of different tasks. Technicians are more qualified than apprentices and therefore they are capable of addressing serious problems and not only basic service procedures like apprentices. Apprentices can do service procedures like changing tyres, brake-pads, oil and sparkplugs. Technicians can address problems and repair any damage on a vehicle.

A display board is available to show which vehicles need to be serviced per day and what is the basic work that needs to be carried out. The board is not currently in use and needs to be written by hand every day.

3.4 RECEIPT OF CUSTOMERS

When the customer delivers his vehicle for service, the vehicle is parked outside the service centre in any one of the available parking bays. The customer is greeted by the service centre manager and shown to the reception desk. The job card is printed in advance, and the receptionist confirms that all the details on the job card are correct.

The work that needs to be done is also verified and any additional work is written on the job card. A key tag is then fixed to the key of the customer's vehicle. The tag provides information about the vehicle like the registration number and the name of the owner as well as the model of the vehicle.

The payment method is then discussed with the customer. The total amount of the service cannot be provided but an average amount is given to the customer. The customer is also asked if he would like to have the replaced parts of the service. The vehicle is then inspected, to make sure all the valuables in the vehicle are removed.

After all the administrative work is done, the customer is asked if he would like to be transported to a specific place or if he has organised transport for himself.



When the customer leaves the service centre, the workshop manager removes the service booklet from the car. He then fills in the appropriate information and stamps it with the dealer stamp. The job card is then placed inside the booklet and the booklet is placed on the passenger seat of the vehicle.

The driver's seat of the vehicle is then covered with plastic to ensure that it isn't damaged and to prevent the seat from getting dirty.

The vehicle is then allocated to a specific technician or apprentice.

3.5 PARTS COLLECTION

The parts department is situated inside the service centre. Every part needed for a service needs to be obtained from the parts department. The service department is informed in the morning, of all the vehicles that needs to be serviced. The parts for all the services are pre-picked and place in a bundle. Each vehicle has its own bundle.

The parts are not invoiced, because it will have major implications if the vehicle does not arrive on the pre-booked day.

The parts department will have to order parts that are not in stock. This causes some delays in the service procedure.

Mercedes Benz SA implemented a new way of handling inventory. Each dealership is linked with all the other dealerships in South Africa. All the dealerships have access to all the others' inventory. If De Wit Motors does not have a certain part in stock, the part can be looked up on the system and the part can be ordered from the nearest dealership which has the part in stock. A transport service from Mercedes Benz SA will collect the part and transport it to the dealership that is in need of the part. This usually happens the same day the part is ordered.

For more difficult to find parts, it has to be ordered from the Head Office Parts Department. This usually takes longer for the part to arrive and this has a major effect on the service time of the vehicle.

The parts need to be collected by the technician/apprentice themselves. The technician submits his job card, with the needed parts written on the job card, to the parts department. He



then waits for the parts department personnel to invoice the parts and the technician is then informed about the costs of the part.

The invoiced parts are then printed onto a new job card, which is stored on the computer system.

If there are any major parts that need replacement the customer is informed about the replacement needed as well as the cost of the replacement. The customer must then confirm that the parts may be replaced.

After the customer confirms the replacement the technician takes all the parts to his workbench with the job card.

3.6 SERVICE OF VEHICLE

The service centre at De Wit Motors opens at 07:00 in the morning. Most of the technicians and apprentices arrive early. It is the service centre manager's responsibility to open the service centre. The technicians must then remove the cars that were stored in the service centre during the previous night and park them in the allocated parking bays.

Each technician and apprentice is provided a job card by the service centre manager. The technician and apprentice keep the job card with them until the end of the service of the appointed vehicle. The job card is placed on the workbench and after it is finished it is handed in at the reception.

There are 4 service stations in the main building of the service centre and 3 more stations in the upper part of the service centre. The stations can be occupied by a technician or mechanic. There is also a wheel alignment station, which needs one technician.

De Wit Motors currently employs five technicians and three apprentices. There are also two cleaners. They ensure that all the stations are tidy and clean.

Each technician needs to provide his own tools and is responsible for his own work bench. This causes problems because the technicians sometimes do not have the appropriate tools for the specific work that needs to be done. Technicians waste valuable time looking for tools, which then prolongs the service time for the vehicle.



Carry-over vehicles, that were not finished the previous day, will first be finished by the assigned technician before he will start with a new vehicle. If a customer asked to receive a vehicle at an early time, the technicians available will start with the vehicle. The service centre manager will allocate the vehicles that still need to be serviced to the technicians and apprentices. After a service is completed the technician/apprentice will receive another vehicle.

When a technician or apprentice cannot complete the work that needs to be done because of unavailability of parts, the vehicle will be removed from the lift (if possible) and the next vehicle in line for service will be moved to the lift. When the part arrives, the technician will stop working on the current vehicle and go back to the unfinished vehicle.

When a service on the vehicle is completed, all the work done will be recorded, in writing, on the job card. The time the vehicle was finished will also be recorded onto the job card. This will be verified by the reception personnel.

If special tools (tools that are used for specialized work) are needed, the technician must retrieve the key for the special tools room and book out the tool that is needed. Valuable time is wasted looking for the key of the store room. After the tools are used it must be returned to the store room and the technician must sign the register to confirm that the tool is returned.

There are currently two air-con refill machines in the service centre, they are situated in the upper and lower part of the service centre. The machines are movable and they are moved to the vehicle that is in need of the machine.

After the service is completed the technician/apprentices inform the service centre manager. The job card is inspected and all the work done is verified. The technician hands the key to the manager. The service centre manager will then ensure that the vehicle is test-driven by the service centre foreman or by himself. All the vehicles that were serviced must be test-driven.

After the vehicle returns from the test drive, the vehicle is parked in the wash bay queue. The key is left inside the car.

All the service operations were evaluated and data was generated by using work sampling. This was done over a period of one week and all the operations were evaluated separately. This was done to determine where bottlenecks were in the system, where time was wasted and



where can improvements be made in the service procedures.

3.7 WASH BAY (WASH OF VEHICLE)

The wash bay is situated next to the main part of the service centre. It is part of the service centre but has its own manager. The wash bay manager ensures that every vehicle is clean and in excellent condition when it leaves the wash bay.

Vehicles wait in the queue to be washed. The queue works on a first come first serve basis. The wash bay is not only used for the vehicles in the service centre but the sales department also uses it to wash the new vehicles that need to be delivered to customers. This causes the queue to back up and this also prolongs the service time of vehicles.

The wash bay can accommodate a maximum of 2 vehicles. There is only one high pressure hose that is used to remove excess dirt from the vehicles. This means that both vehicles must be washed at the same time to prevent dirt from splashing onto an almost clean vehicle.

There are currently three employees working in the wash bay area. Only one employee can use the high pressure hose and while the hose is in use the other 2 employees must be outside to prevent them from getting wet.

Before the vehicle is parked, the wash bay manager will inspect the vehicle to ensure that it was properly cleaned and in a mint condition. After the vehicle is finished, it will be parked on an open parking place. The vehicles are parked anywhere in the service centre area, this sometimes results in a much crowded parking area. If the parking area is full some of the vehicles will be parked inside the service centre. The wash bay manager will ensure that the key is then placed into the key holder box in the reception area.

3.8 QUALITY CHECK

The service centre manager is responsible for the final quality check. He ensures that all the worked that needed to be done was carried out on the vehicle and will confirm that all the problems and errors on the vehicle were addressed.

The service centre manager is also responsible for periodic checks on all the technicians and apprentices to ensure that they are working and that they are on time with the service of the



vehicle. It is the service centre manager's responsibility to inform the customer if a technician/apprentice will not be able to complete the service in the allocated time.

Every vehicle is tested after the servicing is completed. After the vehicle is serviced the keys will be placed in the key box. The technician/apprentice will inform the service centre manager that the vehicle is finished and ready to be tested.

The service centre manager will then remove the key from the key box and will take the vehicle for a test drive. Normally the test drive will take several minutes. Usually the vehicle is driven just out of town and back to the dealership. But if the vehicle needs special attention, for example if there were rattles on a dirt road, the vehicle will then also be driven on a dirt road to ensure that the problem was fixed.

After the vehicle returns to the service centre and the service centre manager is satisfied with the work carried out, the vehicle is parked in the wash bay area. The key is left inside the vehicle.

If the service centre manager finds any problem before, during or after the test drive, the technician that was responsible for the vehicle will be informed about the problem. He will then carry out the needed procedures to fix the problem. After the problem is fixed, the technician will park the car and place the key into the key box. The vehicle will not be washed again, only if the repair of the problem caused the vehicle to get dirty again.

When the vehicle is completely finished, the service centre manager will sign the job card of the vehicle and forward the job card to the reception personnel.

3.9 DELIVERY OF VEHICLE

The delivery procedure is as follows:

When the job card is received by the reception personnel, the costing of the service is done. After the costing is done and all other information about the service is obtained, the customer is contacted. The customer is informed about the costs of the service and if queried, a detailed expenses list is gone through with the customer. The customer is also informed about the time he can collect his vehicle from the service centre,



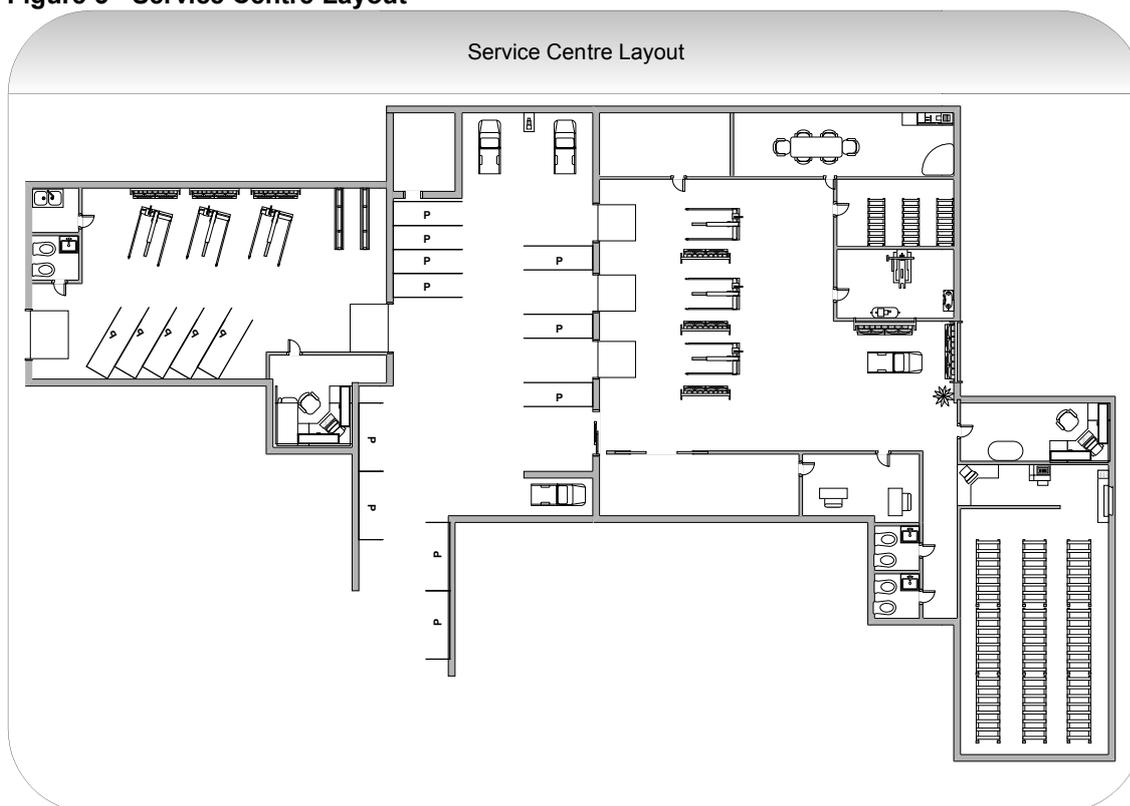
When the customer arrives at the dealership, he is shown the way to the reception area of the service centre. The reception personnel handle the payment of the service, by the customer. After the payment is made, the customer receives his key from the reception personnel. They will collect the key from the key box.

The customer is shown where his car is parked, by the service centre manager. The customer has time to inspect the vehicle and if there are any problems, the manager is informed. The vehicle is then handed over to the customer and the customer leaves the dealership.

3.10 PARKING

The following diagram shows the parking areas for the service centre:

Figure 3 - Service Centre Layout





The areas marked with a “P” shows the available parking places at the service centre. Over the night carry over vehicles are parked inside the service centre, in the top and bottom parts. These vehicles must be removed every morning before the work day starts.

Parking is one of the biggest problems at the service centre. There are 16 parking bays available. These bays must provide parking for the following vehicles:

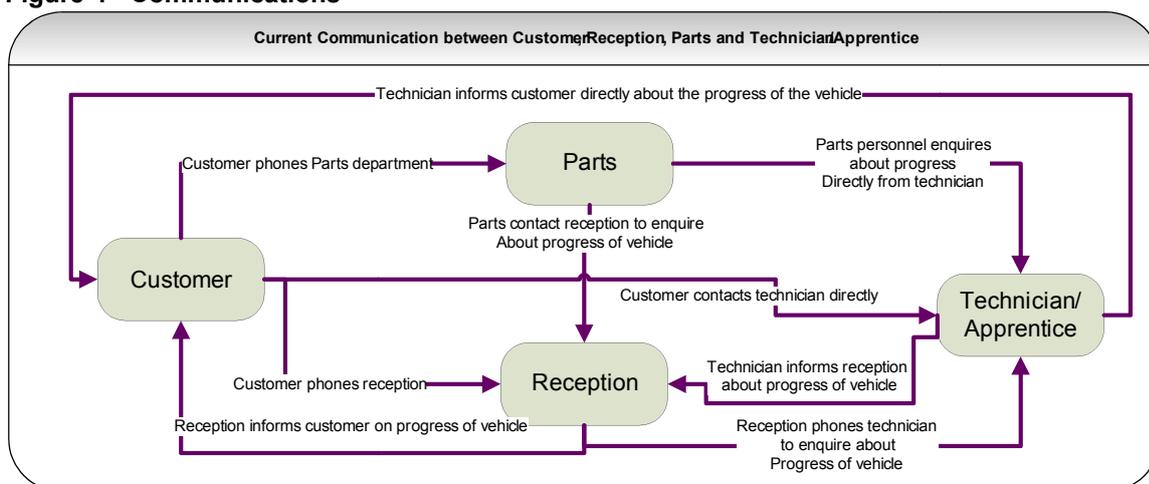
- Vehicles that need to be serviced
- Serviced vehicles
- Vehicles that were not completed (Carry-over vehicles)
- Wash bay vehicles

3.11 RECEPTION DEPARTMENT

The reception department has communication problems. If a customer phones to enquire about the progress of his vehicle, the reception personnel must first look if the key is in the key box, otherwise they must ask the service centre manager or they must call the technician/apprentice directly.

Another problem is that customers don't phone the reception, they phone the parts department because they know that the parts department would be able to help them more effectively. This causes major communication problems between customer, reception, parts and the technicians and mechanics. The figure below shows the current communication between the parties.

Figure 4 - Communications



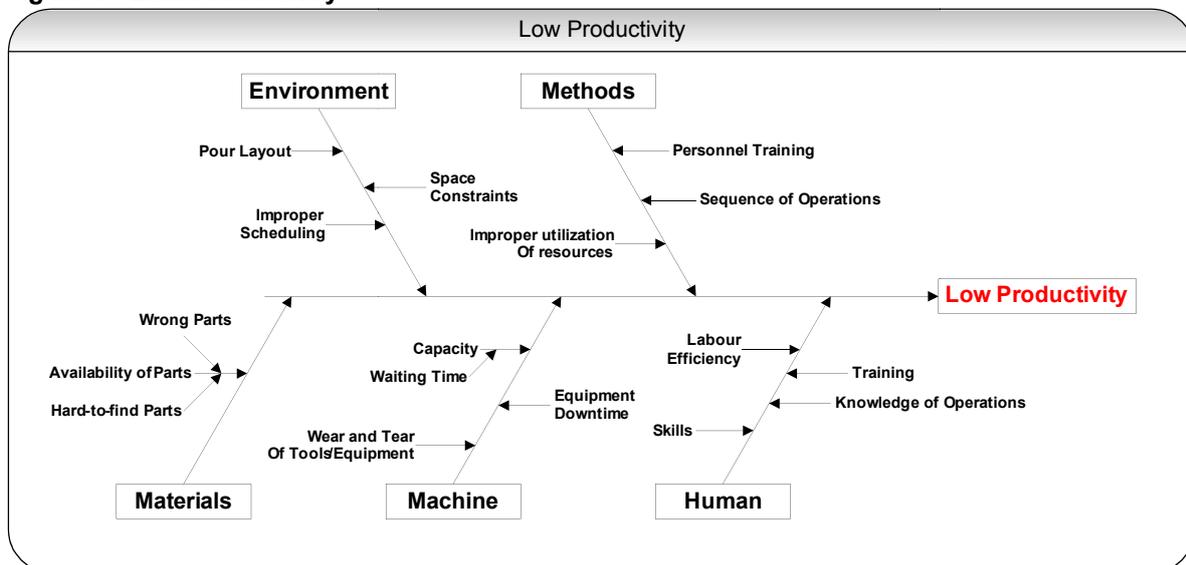


4 ANALYZE DATA

The information and data that were obtained in the previous chapter must be analysed and evaluated to identify if improvements can be made and where the problem areas are in the service centre.

In the following diagram, problems at the service centre were identified by using a cause and effect diagram. This showed where major problem are in the service centre and why the productivity is not according to standards.

Figure 5 - Low Productivity



From the information above, the author of this report decide to focus on the areas in the service centre that needs the most improvements and which can have the greatest effect on the productivity of the service centre.



The following areas in the service centre were identified to be analyzed:

- Service appointment procedure
- Assignment procedure
- Parts area
- The service procedure
- The Wash bay
- The Quality inspection procedure
- Parking



4.1 SERVICE APPOINTMENT

A major problem in the service appointment procedure is that the reception personnel books the number of vehicles according to the number of open slots left per day and not by the average time a service takes and the number of available working hours per day.

This causes that some days too many vehicles are booked for a service, which results in carry-overs and other days there are a shortage of vehicles to be serviced, which means that valuable working hours are lost.

MBSA provides guidelines on the amount of time it should take to complete different services. These times must then be used to determine how many vehicles can be booked per day within the available working hours per day. If the bookings are done with this method it would minimize the total carry-overs per day as well as to minimize the loss of working hours.

4.2 TECHNICIAN/APPRENTICE ASSIGNED

Technicians can perform a service as well as repair problems on a vehicle, where apprentices can only perform normal service procedures.

A technician would normally fix problems on the vehicle as well as repair damaged parts. This requires certain skills that the technician has and an apprentice does not. An apprentice can only perform normal service procedures.

This may cause some difficulty in the assignment of vehicles to be serviced. If the ratio is insufficient, technicians end up wasting time on service operations instead of using their skill and knowledge to address problems. While if there are too many technicians employed at a time and there is insufficient work to be done, it will cost De Wit Motors a large amount of extra expenses.

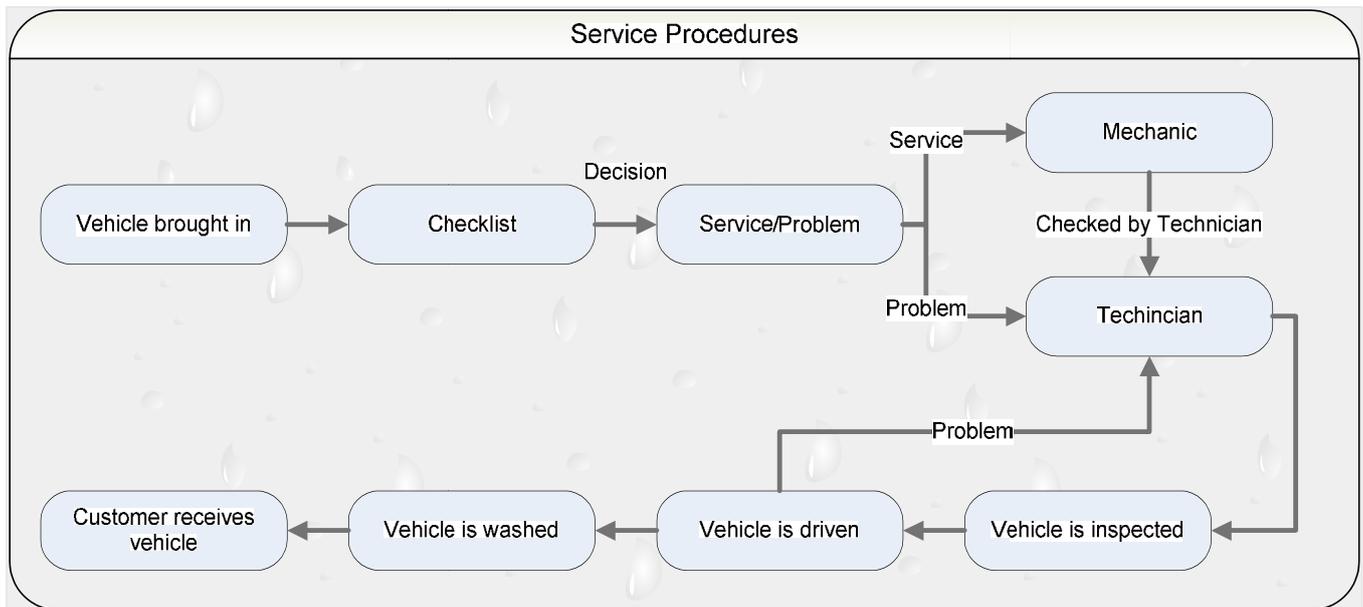
This problem will be analyzed by using an Arena simulation model. The model would be built on the SOP of the service centre. The ratio between the technicians and apprentices will then be constantly changed and the output of the number of vehicles during the total work hours will then be analyzed. This will show what the most efficient ratio between technicians and apprentices are.



This model would assign vehicles that needs to be serviced to apprentices, vehicles that need to be fixed, will be assigned to technicians and vehicles that need to be serviced and have problems fixed, will first be assigned to an apprentice and after the normal service procedures are completed the technician will take over.

The simulation model was built on the flow diagram in Figure 6.

Figure 6 - The Service Procedure



The data needed for the project was received from the Service Centre of De Wit Motors. The data available was of the past six months, from January to June 2008.

The data provided the author with the number of different types of vehicles serviced per month, the number of days per month, the average number of vehicles that needs to be serviced per day, the average number of vehicles that needed to be repaired during the day and the average number of vehicles that needs to be repaired and serviced.

- The probabilities for different types of operations:
 - Type 1 – Service – 0.2
 - Type 2 – Service with Problems – 0.5
 - Type 3 – Problems – 0.3

- The different times (Average times) for operations by:



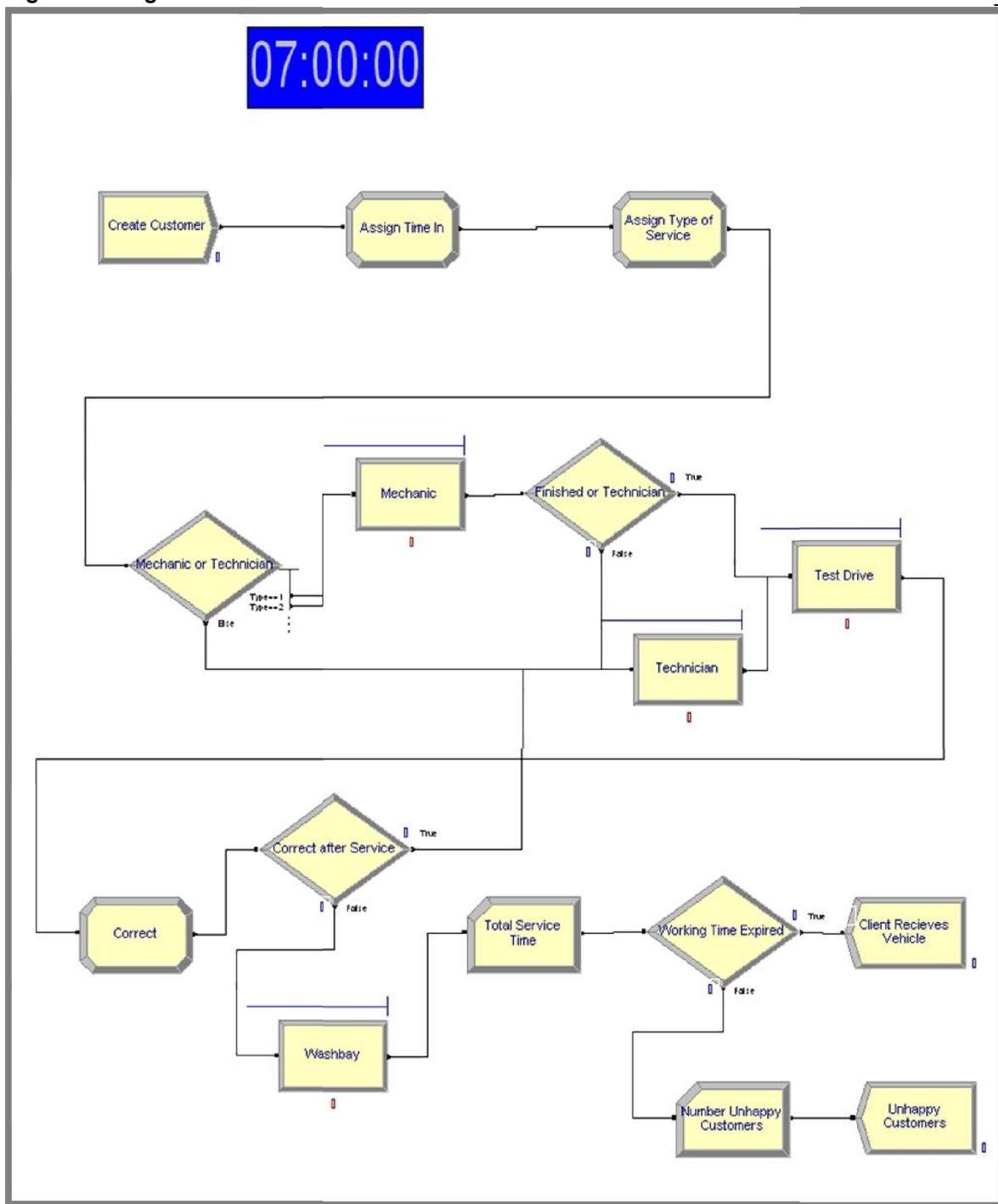
- Apprentices:
 - Triangular Distribution with a min of 1H, a most likely value of 1.5H and a max of 2h
 - Technicians:
 - Triangular Distribution with a min of 1H, a most likely value of 2H and a max of 5h
 - Test Drive:
 - Triangular Distribution with a min of 10 min, a most likely value of 15 min and a max of 60 min
 - Wash Bay:
 - Normal Distribution with a mean of 31.54 min, and a std deviation of 8.5 min
- 8% of the vehicles driven after service, still has problems
 - The average number of cars per day is 14 with a std. deviation of 2
 - There are 10 working hours per day and work starts at 7 in the morning
 - There are 7 service centres
 - There are 2 wash bays

The model was run with different numbers of technicians and apprentices employed at the different service stations. Each time the model was simulated with 120 repetitions. The ratio for technicians to employees was change from 1:1 to 8:0 and to 0:8.

By doing this the model will provide us with the number of vehicles not serviced in time. From this data we will see which combination will provide us with the smallest number of customers that are unhappy.



Figure 7 - Original Arena Model





4.3 PARTS COLLECTION

The parts department is currently functioning at a very efficient level. The whole department is working on a system that was installed by MBSA. The department must adhere to all the specifications listed by MBSA. Therefore not many alterations to the system can be made.

The only area that can be improved is where a technician or apprentice waits for the parts he needs for the service of the vehicle he is assigned to. A technician/apprentice spends valuable time at the parts counter waiting for parts.

A time study was done to evaluate how much time is spent waiting at the counter of the parts department. This was done over a period of 4 days and all the technicians and apprentices were studied.

The Excel Data Analyses toolbox was used to analyse the data obtained from the time study that was done. The Data Analyses shows that a technician or apprentices normally waits 3.9 minutes at the parts department counter as shown in Table 1.

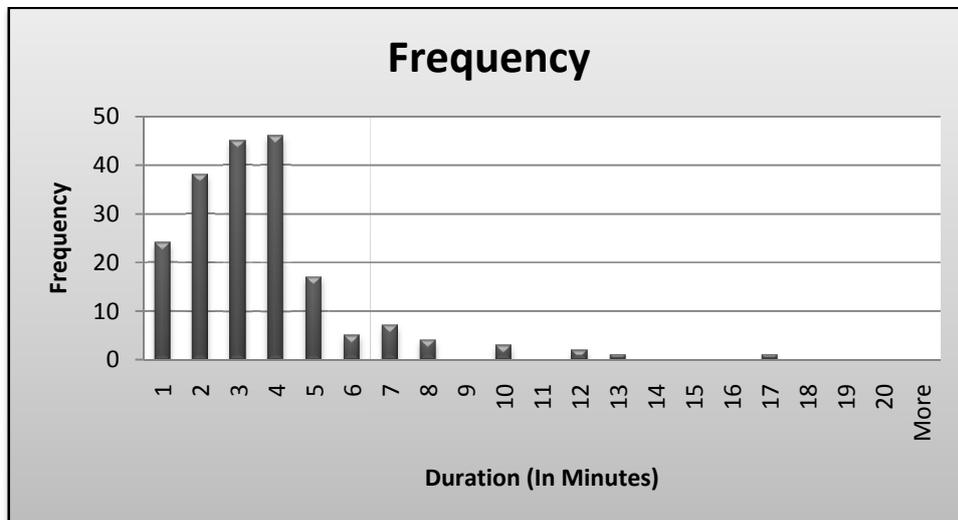
A histogram was also constructed to show the distribution of the different times that were obtained.

Table 1 - Waiting Time: Parts

<i>Waiting Time for Parts Summary</i>	
Mean	3.907
Standard Error	0.082627
Median	3.128
Mode	4.078
Standard Deviation	2.612887
Sample Variance	6.827178
Kurtosis	5.53753
Skewness	2.091557
Range	16
Minimum	1.952
Maximum	17.302
Confidence Level (95.0%)	1.0



Graph 1 - Waiting Time: Parts



The reception department provides the parts department of all the information of the vehicles, which will be serviced during the day, early in the morning. The parts department then pre-pick the parts needed for each vehicle. Although this is done the technicians and employees still waits for parts.

The parts department must still invoice the parts that were pre-picked and this takes time. The parts department must invoice the parts before the technician needs to collect the parts. But this may cause problems; if the customer does not want the part to be replaced the part will already be invoiced and this will cause unnecessary administrative work.

Here there must be very good communication between the customer, the parts department and the reception department. The reception department must confirm that the parts may be replaced with the customer. If the customer verifies that the replacement is acceptable, the reception department must inform the parts department. When the parts department receives confirmation for the reception department the pre-picking must take place. The parts department must then pre-pick all the parts that were confirmed by the reception department and invoice the parts on the job card.

By doing this the technician will not have to wait for the parts that need to be invoiced and will not waste valuable working time on non-productive work.



4.4 SERVICE OF VEHICLE

4.4.1 SERVICE PROCEDURE

The service procedures were analysed by applying a Work Study technique. This consists of a Method study as well as a Time study.

Work Study was done in a form of critical analysis that was done on the service centre operations. The author also applied the Gemba technique and evaluated the system as if he was a customer. It was found that too much time is spent on walking around and doing unproductive work.

One of the major problems causing unproductive work is the smoking breaks taken by technicians. A technician spends an average time of 7.5 min per cigarette. The technicians were watched and the average number of cigarettes smoked per work shift was 10 cigarettes.

This means that a technician wastes up to 75 min per day being unproductive while smoking. There are currently 3 technicians that smoke at the service centre. This means that an average of 3.75 hours is wasted on smoking. This is a really major problem and has a major impact on the productivity of the service centre.

The author also realised that, if it is possible, if the same technician can be assigned to the same vehicle every time the certain vehicle will be serviced, it can help with the efficiency of the service procedure. Technicians and apprentices get used to vehicles if the service is carried out by the same person every time.

After the procedures were evaluated from an outside perspective the critical analysis of the procedures were done. The Seven Steps of Critical Analyses are a set of questions to help in the improvement of any system or process. The questions that were asked were: Who? Why? When? Where? What For? What? How? The following were found on each of the questions:



Table 2 - Critical Analysis

CRITICAL ANALYSIS TECHNIQUE			
PRESENT METHOD		ALTERNATIVES	SELECTED ALTERNATIVE
Purpose: What is achieved	Is it necessary? (Y/N) If yes - Why?	What else could be done?	What is the purpose?
At the service centre, the service of a vehicle is achieved. This is done according to service procedures determined by MBSA but it must be noted that not on service is exactly the same.	Yes, this is necessary because this is the main function of the service centre. This is also done according to prescribed procedures to ensure that procedures are efficient as possible.	The standard procedures can be placed at each work station, to ensure that all the technicians and apprentices know exactly what to do and when to do it.	The author suggested that the SOP of a service must be placed at each work station.



Means: How is it done?	Why that way?	How else could it be done?	How should it be done?
As can be seen from the service procedure diagram, the service procedure follows a certain flow. Each technician/apprentice has the needed tools to complete the desired procedures.	This way was studied by MBSA and it was decided that this flow of procedures would be the most efficient. Some of the technicians/apprentices follow their own flow but it is basically the same.	These procedures are fixed and a change to the flow of the current procedures would not be advised.	The current service procedure is acceptable and must not be changed.
Place: Where is it done?	Why there?	Where else can it be done?	Where should it be done?
Each technician/apprentice has his own work bench at the lift where he is working. There working bays are spaced through the service centre as well as one wheel alignment bay.	The service procedures that are followed need a lift to be carried out. This is why the services are carried out on work lifts.	There is one lift that is not currently in used because it is difficult to access. This lift can be moved to the upper part of the service centre and this would provide an extra service bay.	The author suggested that the extra lift must be removed and placed in the upper part or in the express service bay.



Sequence: When is it done?	Why then?	When else could it be done?	When should it be done?
<p>The services on vehicles are carried out throughout the day. Most of the vehicles are booked-in in the mornings but throughout the day additional vehicles may arrive. The service is done after a complete inspection of the vehicle to determine if there are any problems.</p>	<p>After the vehicle is inspected, it can be determined what must be done and what procedures must be carried out. If a vehicle is serviced before inspection, some of the problems or faults can be overlooked.</p>	<p>Walk-in customers must be sent to the express service bay. This will help to reduce the current bottleneck experienced at the service centre.</p>	<p>The normal services during the day are acceptable, but the walk-in customers will be directed to the express service bay, after the express lane is in working condition.</p>



Person: Who does it?	Why that person?	Who else could do it?	Who should do it?
Currently technicians or apprentices work on vehicles in the service centre. Technicians will service vehicles with major problems while apprentices will carry out standard service procedures.	Technicians have the skill to address difficult problems, but apprentices only have basic knowledge. But currently technicians may be able to use their skill to a better advantage.	All the vehicles that need standard services must be serviced by apprentices, and if there are any additional problems the vehicle must be sent to a technician.	Technicians should carry out procedures that suit their skill level and apprentices should do all the normal service procedures that waste technician's skill and time.



After the method study was completed a Time study was done to analyse where the most time is spent and if time is spent doing productive work. The Time study was done on the work carried out. The work carried out can be divided into 3 categories namely:

Productive work

- Service
- Quality Check
- Car operation
- Operating equipment

Semi-productive work

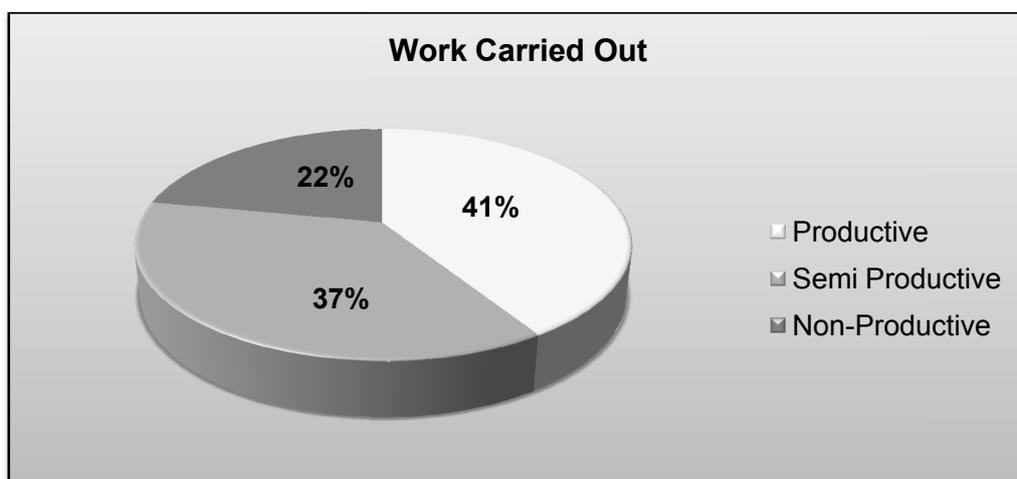
- Moving vehicle
- Acquiring Tools
- Parts Collection
- Paper work
- Assisting others
- Walking

Non-Productive Work

- Waiting for job allocation
- Toilet
- Idle talk/break

The following pie chart shows the time spent on productive work, semi-productive work and non-productive work.

Graph 2 - Work Carried Out





It is quite interesting to note that only 41% of the work carried out is classified as productive work. Most of the semi-productive work consists of walking, to look for and return tools and waiting for parts.

The author suggested that technicians and apprentices must be controlled better and that their productivity must be analysed on a weekly basis. This will ensure that less time is wasted on unproductive work.

A reward program must also be implemented to motivate personnel to work more productive and efficient. By rewarding the top apprentice/technician of the month, the personnel will be more focused on the work that needs to be done.

4.4.2 WHEEL ALIGNMENT PROCEDURE

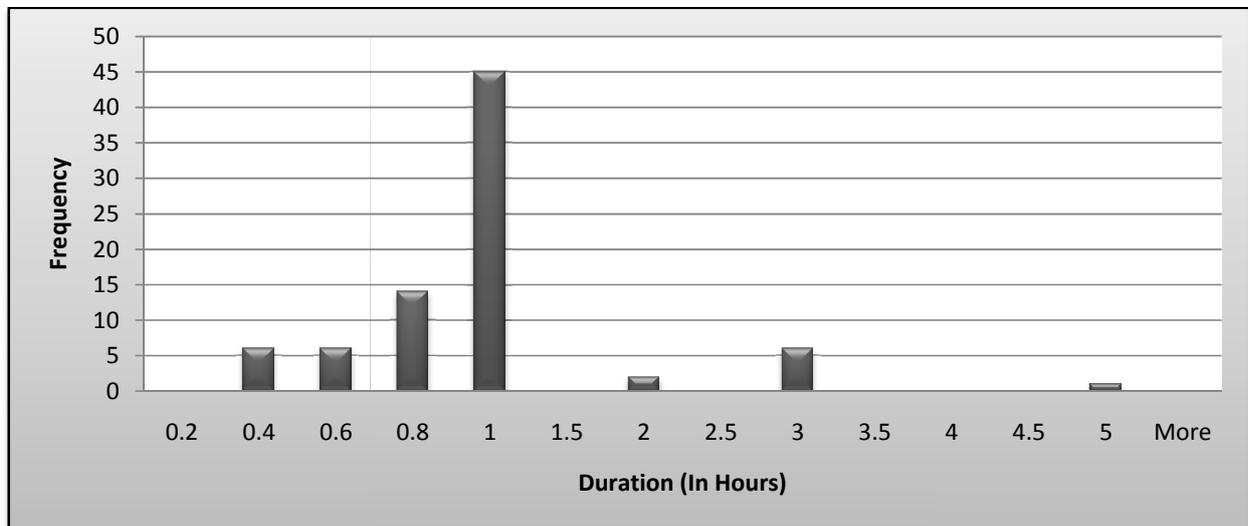
In the service process, one of the major bottlenecks is the wheel alignment procedure. The following histogram and summary statistics will explain the findings that were obtained from the data that was analysed.

Table 3 - Waiting Time: Wheel Alignment

<i>Wheel alignment Summary Statistics</i>	
Mean	1.0935
Standard Error	0.085656
Median	1
Mode	1
Standard Deviation	0.766126
Sample Variance	0.58695
Kurtosis	9.429091
Skewness	2.83386
Range	4.67
Minimum	0.32
Maximum	5.1
Sum	87.48
Count	80
Confidence Level (95.0%)	0.170493



Graph 3 - Waiting Time: Wheel Alignment



The major problem with the wheel alignment procedure is that when a vehicle is serviced and then sent to the wheel alignment bay, some of the bolts are fastened wrong and this causes that the wheel alignment technician must redo the work done previously by the technicians and apprentices.

Sometimes non-standard bolts are used which causes even more problems. The author suggested that any procedure that has to do with the alignment of the wheels must be done by the wheel alignment technician. The wheel alignment bay would have to have all the standard bolts needed for the alignment procedure.

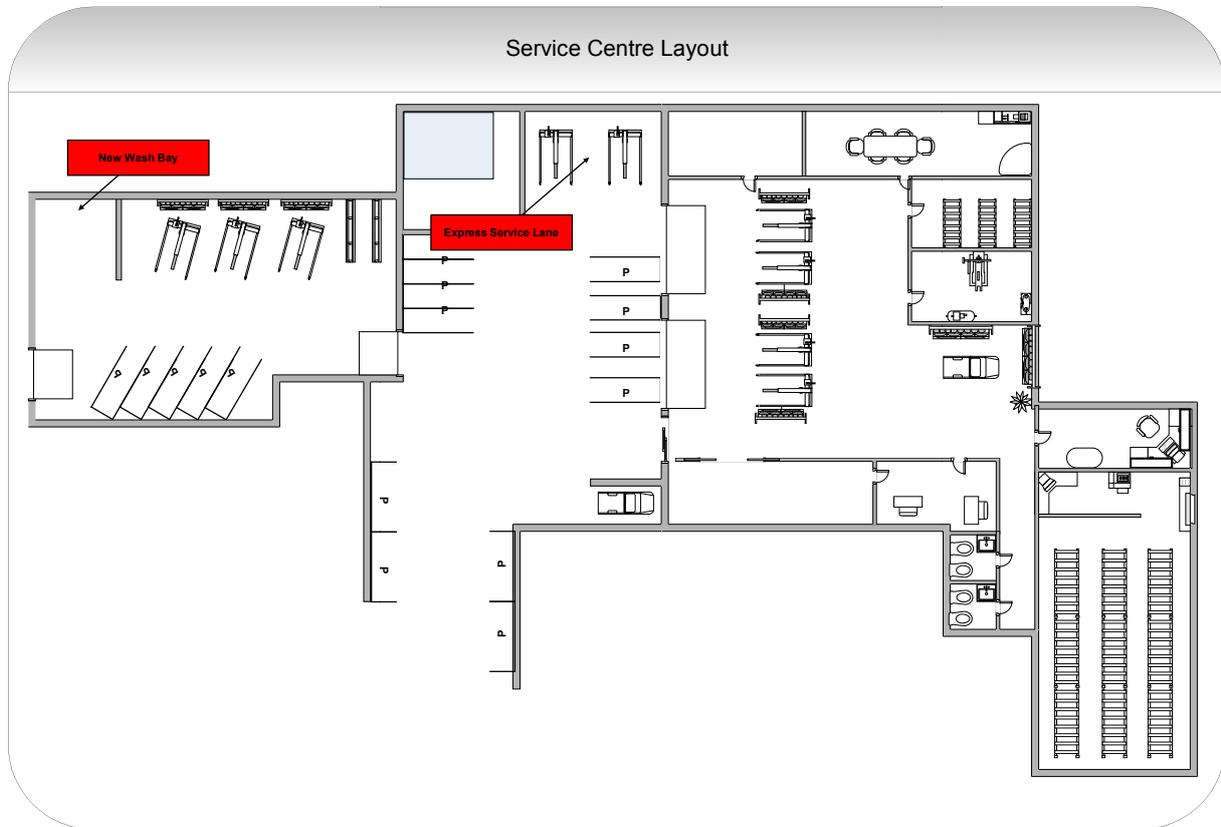
This will ensure that the procedure is more efficient and that there is no double work done by either the service centre or the wheel alignment procedure.

4.4.3 EXPRESS SERVICE LINE

Because there is a percentage of almost 20% of walk-in customers, the author suggested an express service lane. This must be implemented to quickly service and repair vehicles with minor problems, so that customers that are in a hurry can be helped immediately. This will help with the bottlenecks that occur when walk-in customers demand that their vehicle needs to be serviced immediately. This lane must only be used for minor services and repairs and not as an additional service bay.



Figure 8 - Proposed Centre Layout



4.4.4 DIAGNOSTIC EQUIPMENT

The number of vehicles that were waiting in line to be diagnosed with the STAR Equipment was analysed using the statistical analysis tool pack from MS Excel. The following table shows the summary statistics for the waiting line.

Table 4 - Waiting Time: Equipment

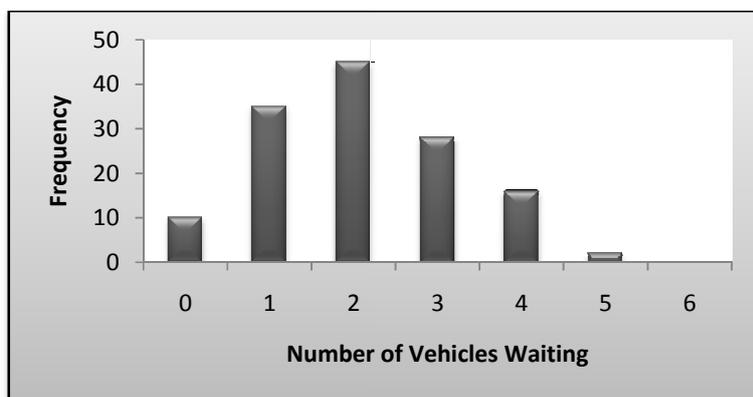
<i>Waiting time for Equipment</i>	
Mean	1.925
Standard Error	0.088237
Median	2
Mode	2
Standard Deviation	1.247862
Sample Variance	1.557161
Kurtosis	-0.82451



Skewness	0.0648
Range	5
Minimum	0
Maximum	5
Sum	385
Count	136
Confidence Level (95.0%)	0.174

A Histogram was constructed from the data. It shows that an average of 2 vehicles is waiting for the equipment.

Graph 4 - Waiting Time: Equipment



4.5 WASH BAY (WASH OF VEHICLE)

A time study was carried out on the wash bay operations. The wash bay forms part of the service procedure and therefore plays part in the total efficiency of the service centre. The wash bay was analysed over a period of one week. The times were compiled into an Excel workbook and the data was analysed with the Data Analyses toolbox.

The wash bay statistics can be seen in Table 2:

Table 5 - Waiting Time: Wash Bay

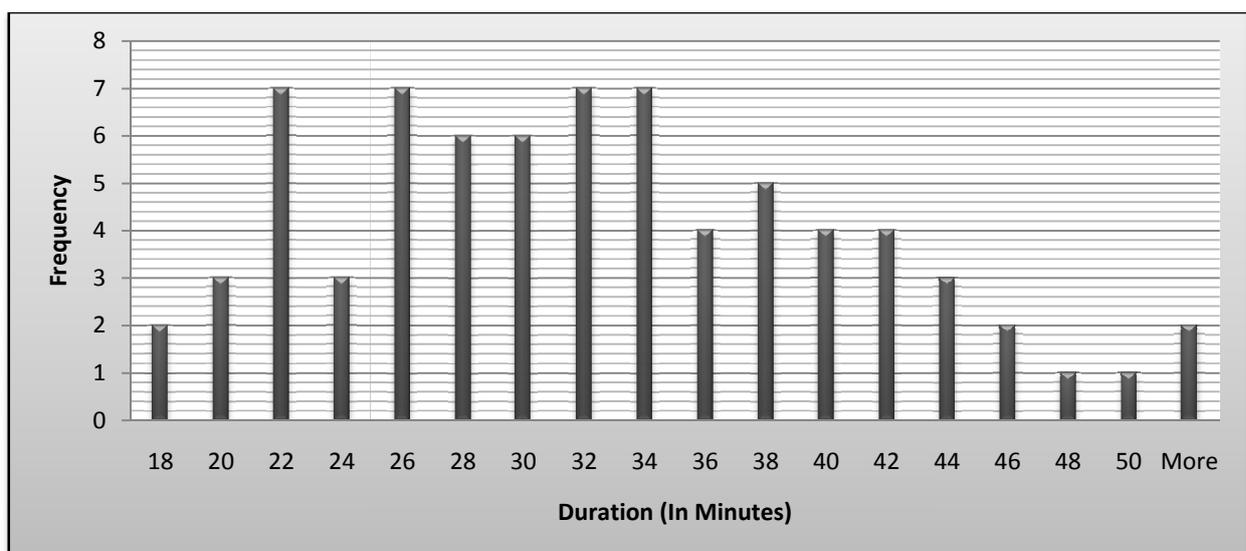
<i>Wash Bay Time Summary</i>	
Mean	31.537
Standard Error	0.988
Median	31.076



Mode	N/A
Standard Deviation	8.497
Sample Variance	72.202
Kurtosis	-0.486
Skewness	0.409
Range	35.698
Minimum	17.282
Maximum	52.980
Sum	2333.750
Count	74.000
Confidence Level (95.0%)	1.969

A Histogram of the data was constructed to show the distribution between times for vehicles at the wash bay. The Figure 5 shows the histogram.

Graph 5 - Waiting Time: Wash Bay



The wash bay currently has an average efficiency. There is room for improvement. Currently 2 vehicles cannot be washed at the same time although there are place for 2 vehicles. This is because there is no dividing wall between the two vehicles and only on high pressure hose. The dividing wall would prevent the one vehicle from getting dirty when the other vehicle is



rinsed. If a dividing wall is installed in the wash bay, vehicles do not have to be washed at the same time.

The parking for vehicles at the wash bay is also a problem. The vehicles must be collected where they have been parked after they had been serviced. This takes time unnecessary time.

The final area that needs improvement is that there is no emergency lane for vehicles that need to be washed urgently, for instance if a customer needs his vehicle immediately after service. An emergency lane will be suggested to the manager and a study will be done to prove that it will be acceptable as well as profitable.

4.6 PARKING

4.6.1 PARKING LAYOUT

Figure 9 - Previous Parking Layout

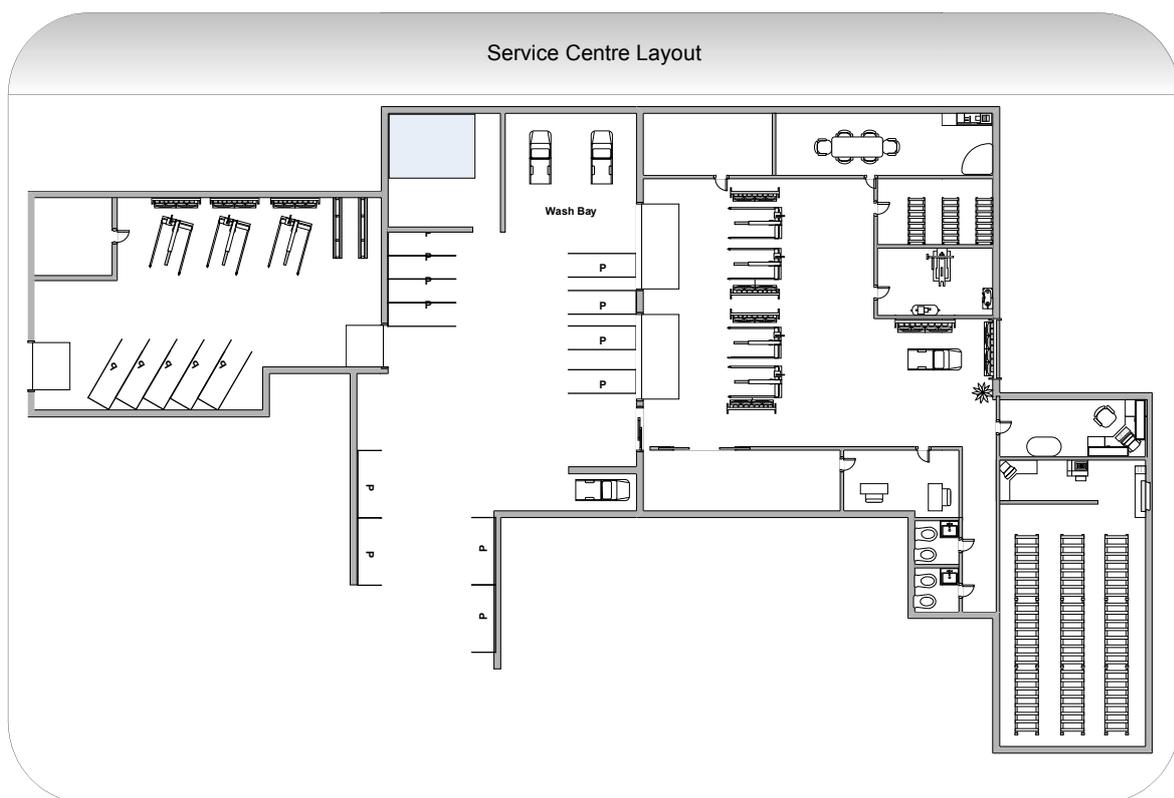




Figure 5 shows that there are only 18 available parking spaces available for vehicles at the service centre. This causes a major problem because there are on average 17 vehicles per day that need to be serviced. This leaves only one extra parking available. Some of the customers are dropped off by another person, which will then allocate an available parking.

There is a desperate need for more parking. But space is a constraint. The building map needs to be analyzed to see if more parking can be created with the available space.

4.6.2 KEY BOX

One more problem is that nobody at the service centre knows which key in the key holder box belongs to which vehicle. A suggestion was made to the service centre manager that the parking bays must be numbered and the key holder box must be improved so that the personnel knows exactly which key belongs to which vehicle.

The figure below shows the layout of the current key box. As can be seen, there is now organization of the keys and it is always a problem to find the correct key for the appropriate vehicle.

Figure 10 - Key Box





5 DEVELOP THE IDEAL METHOD

It will be the assignment of the author to develop the ideal method for the previously described areas of the service centre.

The new methods must have the following characteristics:

- The author must be able to implement the method
- It must be cost effective
- It must have a positive effect on the service centre
- The methods must be accepted by the employees
- Management must confirm that methods may be implemented
- The implementation must be done without affecting the per day SOP

5.1 SERVICE APPOINTMENT

5.1.1 BOOKING PROCEDURE

To improve the service appointment procedure, the reception personnel must book the vehicles on the hours available and not on a certain number of vehicles per day.

MBSA specifies the times it takes to complete certain services. These times must be used to book the vehicles. The times provided by MBSA must then be multiplied with the efficiency ratio of both the technicians and apprentices, depending on what type of service the vehicle requires. The reception personnel must also ensure that there is enough time left for walk-in customers that book a service for emergency breakdowns during the day. It was estimated that 20% of the services per day are walk-ins. Because of this, reception personnel must only book 80% of the available time per day.

The service centre manager provided the author with the idea that the service centre must try to book vehicles at different time periods during the day. This means that when a customer phones, the reception personnel must look for an available time slot. For example if there is a vehicle booked for 07:00, and the service will take approximately 2 hours to complete, the next vehicle can be booked for 08:30. This will ensure that there is enough time to spend with each customer and to ensure that all the problems and errors are properly documented. This will also



help with the current parking problem. By applying this method of booking, the parking area will be less congested and there will be fewer vehicles at the service centre.

To improve the whole booking procedure, the idea was taken from M Venter's project to design an Appointment Control Board. The Appointment Control Board must be utilized to perform the above mentioned tasks.

The Purpose of the Appointment Control Board is to:

- Provide a visual status of appointments
- Offer scheduled appointments to customers
- Reduce morning and evening congestion
- Load the service shop according to available hours
- Control the availability of the Courtesy vehicles

5.1.2 RECEPTION PERSONNEL

The two personnel at the reception are currently working well together and double bookings are kept to a minimum. But if the bookings of vehicles can be done by one person, it will be more efficient and can be controlled better.

The author suggested that the two personnel working in the reception department must be assigned specific job descriptions. One must handle all the booking of vehicles and the other must only handle the communication between the service centre and the customers as well as all the procedures that has to do with the CSI.

The author also suggested that an additional service advisor must be appointed. This will help with the efficiency of the costing of job cards. This will also help with the service centre manager to properly do his work.

The reception department must also try to do some research on the customers so that they can communicate on a personal level when the customer arrives at the service centre. This could be done by using the CRM computer program to retrieve personal details of the customer. By knowing where the customer lives, the reception personnel can welcome the customer and ask how the weather is at home, this will let the customer feel important.



There is currently a board that that welcomes each customer in the morning when he/she delivers their vehicle to the service centre. This allows the customers to see all the vehicles that need to be serviced. It is currently written with a marker on a white board, which sometimes looks unprofessional. It was suggested to the service centre manager to print the names of the day's customers on a large paper and attach it to the white board. This will look more professional.

5.1.3 COURTESY VEHICLES

The current courtesy vehicle is not able to service the number of customer it needs to. There are more customers that need transportation while their vehicles are serviced. This problem can be solved by using demo vehicles, provided by MBSA, to provide as transportation to customers. This must be organized with the Sales Department. This will also provide marketing for De Wit Motors and have a positive on the CSI score.

5.1.4 CSI IMPROVEMENT PROCEDURES

The reception personnel must also try to remember the customer one or two days prior to the service, that his vehicle is book for a service on the specific day. This can also be used to confirm the booking with the customer. This will also have a positive influence on the CSI. An after service call must also be made to the customer, to inquire if they were happy with the service and how they experienced the whole procedure. This plays a vital role in the CSI score, which is currently very low in the specific area.

5.1.5 OIL CHARTS AT RECEPTION DEPARTMENT

The reception department currently has the problem that the personnel must ask each technician/apprentice what the volume of oil that is needed per service is. This causes that the reception personnel are not always at the counter and this wastes unnecessary time.

This could all be dealt with if an oil chart with the different volumes for different vehicles is placed close to the reception personnel. This will ease their job and is easy to implement.

The knowledge of the reception personnel must also be improved. The personnel must know what oil is needed for which vehicle and how much is needed as well. The knowledge level of the personnel is not on the average level and this is because both of the employees are newly appointed.



5.2 TECHNICIAN/APPRENTICE ASSIGNED

The first example of the simulation model was completed and some changes were suggested by the employees and management, but it has already proven that it is in working condition and it has provided a realistic solution.

The model showed that the optimal solution for the model will be to assign 2 apprentices and 5 technicians to the different work stations. This will result in an average of 15.6 vehicles that are serviced per day.

This model for De Wit Motors can now aid the service centre in future decision making regarding the need of employing apprentices and technicians.

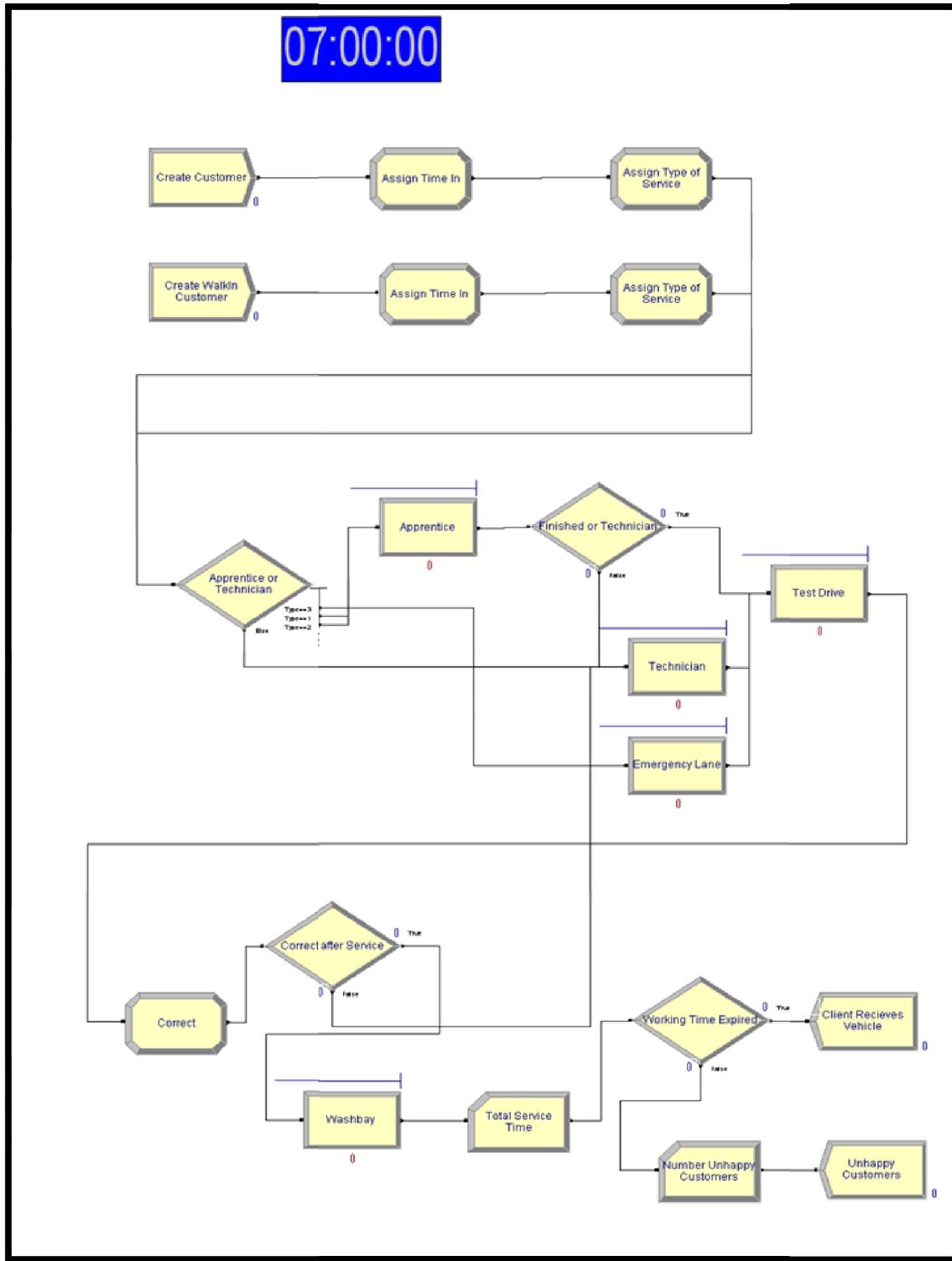
It can then be used to find the optimal solution if a different ratio of apprentices and technicians are employed or if new work stations are built in the future.

The suggestions made by management were:

- Incorporate a emergency lane for services and an additional lane at the was bay
- Insert a parts collection task into the model
- The model must be able to handle carry-overs
- The model must be able to handle walk-in customers



Figure 11 - Improved Arena Model





5.3 PARTS COLLECTION

The current parts system works well, but the waiting time at the parts counter is not acceptable. The reception department must provide the parts department with all the necessary information on all the vehicles that will be serviced during the day. Good communication here is vitally important.

The author has made the suggestion that the pre-picked orders of parts for each vehicle are placed into a plastic container. Each container must be fitted with a name tag, which will be used to write the vehicle's registration number on, that needs to be serviced. This must be done first thing in the morning.

The following figure shows the plastic containers that were suggested.

Figure 12 - Part Containers



When the technician/apprentice arrives at the parts counter he only provides the parts department with the registration number of the vehicle, and the container containing the parts are handed to the technician/apprentice. This will reduce waiting time and improve the productivity of the service procedure.

A runner may also be hired. He will take the sole responsibility to deliver parts from the parts department to the different technicians and apprentices. This will ensure that no time is wasted walking around and waiting for parts.

These procedures are currently under investigation to see if they are feasible to implement.



5.4 SERVICE OF VEHICLE

5.4.1 STANDARD WORKFLOW PROCEDURE

A standard workflow is currently implemented in the service system, but the author suggested that the Workflow boards (supplied by MBSA) must be installed at the work bays. This is according to (Venter, 2006).

Technicians and apprentices must adhere to these workflow boards. This will eliminate any unnecessary movements and the unnecessary use of tools.

5.4.2 KAIZEN BOARD

A Kaizen board must be implemented at both the service areas. This will help the technicians to remember important things to do, to write down any new ideas and to keep track of the day's work and what is left to be done. These boards can also be used to help with the continuous improvement of the service centre and its operations.

5.4.3 CLOCKING OF JOB CARDS

Technicians and apprentices need to clock their job card every time they start and finish with a vehicle and also if delays occur in the system. This will provide the reception personnel and the service centre manager with much more accurate data to work with.

The service centre manager must also ensure that employees work the specified time. He must enforce effective control over all the employees and minimize the time wasted by employees, in unproductive work.

Job cards must also be signed out by whoever is using the job card. A list must be made available that will provide information on who signed out the job card, when he signed it out and if it was returned. The reception personnel must be responsible for the execution of the sign-out procedure.

This will ensure that job cards aren't lost and that everyone at the service centre will know exactly who and where the job card is. This will reduce time that was spent looking for job cards by the technician/apprentices, the reception personnel and the service centre manager.



5.4.4 SERVICING OF FLEET VEHICLES

In order to service fleet vehicles, the service centre must contact the fleet companies and try to specify certain dates for servicing these vehicles. This will ensure that fleet vehicles are serviced on time and that there is no back log of services, when a vehicle is brought in during the day.

5.4.5 EXPRESS SERVICE LANE

The author suggested an emergency lane for vehicles that needs to be serviced urgently, without a booking. This is currently under investigation and will be implemented if it is feasible.

Two apprentices must be employed at the express lane. Only if there is a major problem a technician's guidance may be acquired. Here problems like blown fuses, headlamp problems, oil problems and any other small problems can be addressed

The author suggested that the express service lane must be place in the current wash bay area. This will ensure that vehicles have easy access to the express service lane. There is one unoccupied lift that can be placed in the express service lane, so only one extra lift will be needed.

5.4.6 FOLLOW-UP ON CUSTOMERS

After the service is completed, the reception department must try to implement the 3C method. This is Complaint, Cause and Correction. This will help to explain to the customer what the problem was, what caused the problem and what measures were taken to fix the problem. This will have a major effect on the CSI, because customers will understand what was wrong and what was done to repair the problem. If a customer understands what was done on his vehicle it will have a positive impact on the CSI score.

5.4.7 SERVICE PROGRESS BOARD

One problem that was observed while the author was conducting his studies was that when a customer phoned to enquire about the progress of his vehicle, the reception personnel had to contact the technician/apprentice assigned to the specific vehicle.



This wasted valuable working time of the technician/apprentices and caused the customers to feel as if the service centre does not know what is going on and it is unprofessional to keep a customer holding on for such a long time.

In front of the reception department there is a progress board but it is not currently in use. The author made it a deliverable of the project to provide the service centre with a new and improved progress board.

5.4.8 MAGNETIC TRAYS

Magnetic trays were proposed. This was according to (Venter, 2006). Magnetic trays will ensure that wheel nuts do not lie around after they were removed. A magnetic tray must be placed on each arm of the vehicle lift at each work bench.

This will ensure that technicians and mechanics do not waste time looking for wheel nuts that were kicked around or stumbled upon.

Figure 13 - Magnetic Trays



Image from: (Venter, 2006). p70



5.4.9 VENTILATION IN THE SERVICE CENTRE

Ventilation in the service centre is a major problem. Although there are large doors and many windows, exhaust gases still fills the whole centre if a vehicle's engine is running inside the centre.

Extractor fans must be installed to ensure that exhaust gases are removed from the centre. These gases are very toxic and may cause a health risk to the employees working at the service centre.

These fans need to be placed close to the inspection bay of the service centre. Most of the vehicles that are serviced at the bay engine's need to be running for a while to analyse what the problem is. This can only be done if the engine is at the desired temperature. The vehicle must be run inside the centre because most of the time the vehicle can't be driven and must be inspected where the vehicle is stored, which in this case would be the inspection bay.

5.4.10 SERVICE CENTRE DRIVER

There is a desperate needed for a designated driver at the service centre. If a driver can be employed his job would be to deliver and retrieve parts from other outlets or engineering firms.

This will ensure that technicians do not waste working time to retrieve or to move parts from the service centre to the different shops. He will also be responsible to move vehicles around the service centre and park the vehicles after they have been washed.

The driver may also transport customers after they booked-in their vehicles at the service centre. If this is done, none of the technicians or managers would have to leave the service centre and because of this no working time would be lost.

5.4.11 DIAGNOSTIC EQUIPMENT

The technicians/apprentices are currently experiencing a problem with the diagnostic equipment. There is one STAR Compact³ and one STAR Basic. The STAR computer can be used to trace problems and to give a diagnosis of the vehicle and explain what must be done to fix the problem. The STAR Compact can only trace a problem but can't provide the user with a diagnosis or a solution.



This causes a bottleneck of vehicles that need to be diagnosed. On an average 3 vehicles are waiting to be diagnosed during the peak hours of the day. This causes an increase in service time of a vehicle. If one extra STAR can be acquired this problem would be solved.

5.4.12 OIL RECORDINGS

A system must be installed to measure the number of litres of oil that is used in each vehicle electronically. The current system does not have the sufficient control and must be manually written on the job card.

If a system can be implemented that measures the number of litres and electronically inserts the number of litres of oil used into the job card, the service centre would have much more control over the use of oil. This will also save time and would make the whole procedure more efficient.

5.4.13 SMOKING TIMES

An average of 3.75 hours per day is wasted on smoking. This means that the service centre loses 75 hours per month and a total of 900 hours per year, just by smoking personnel. The loss in monetary terms if the labour rate is ±R290/h, is an appalling R261 000 per year. If this can be improved by reducing smoking times, it will have a major effect on the productivity of the service centre.

5.5 WASH BAY (WASH OF VEHICLE)

A suggestion was made by the author to the wash bay manager to place a divider between the two vehicles in the wash bay and also acquire an extra high pressure washer.

This will help the wash bay to wash both the vehicles at the same time and this will have a positive effect on the total washing time per vehicle, which will then ensure more productive service procedures.

The sales department must also inform the wash bay manager if they need to wash any new vehicles during the day that must be delivered to a customer. This will ensure that there is no bottleneck if a new vehicle arrives from the sales department.

Additional lighting at the wash bay is necessary. The lighting causes the wash bay personnel to wash some of the vehicles very poorly and this has a major influence on the CSI score. If additional lighting is installed the wash bay procedures would be more efficient and precise.



5.6 PARKING

5.6.1 PARKING CHANGES

A new parking layout was developed. This was an attempt to provide the service centre with more parking spaces. Small changes were made to the current layout and the author was able to provide 5 additional parking spaces.

An underground parking garage will also be used as parking for vehicles of the service centre. The parking garage was currently used by the employees, but because parking is such a major problem, the parking will no longer be available for employees. This will provide the service centre with 10 additional parking spaces.

It was suggested that the unused space next to the wash bay must be filled up and levelled and this space may provide some additional parking spaces. This would be a very expensive operation, but the space can be utilized much better. Currently it is used to store scrap metal and empty oil drums.

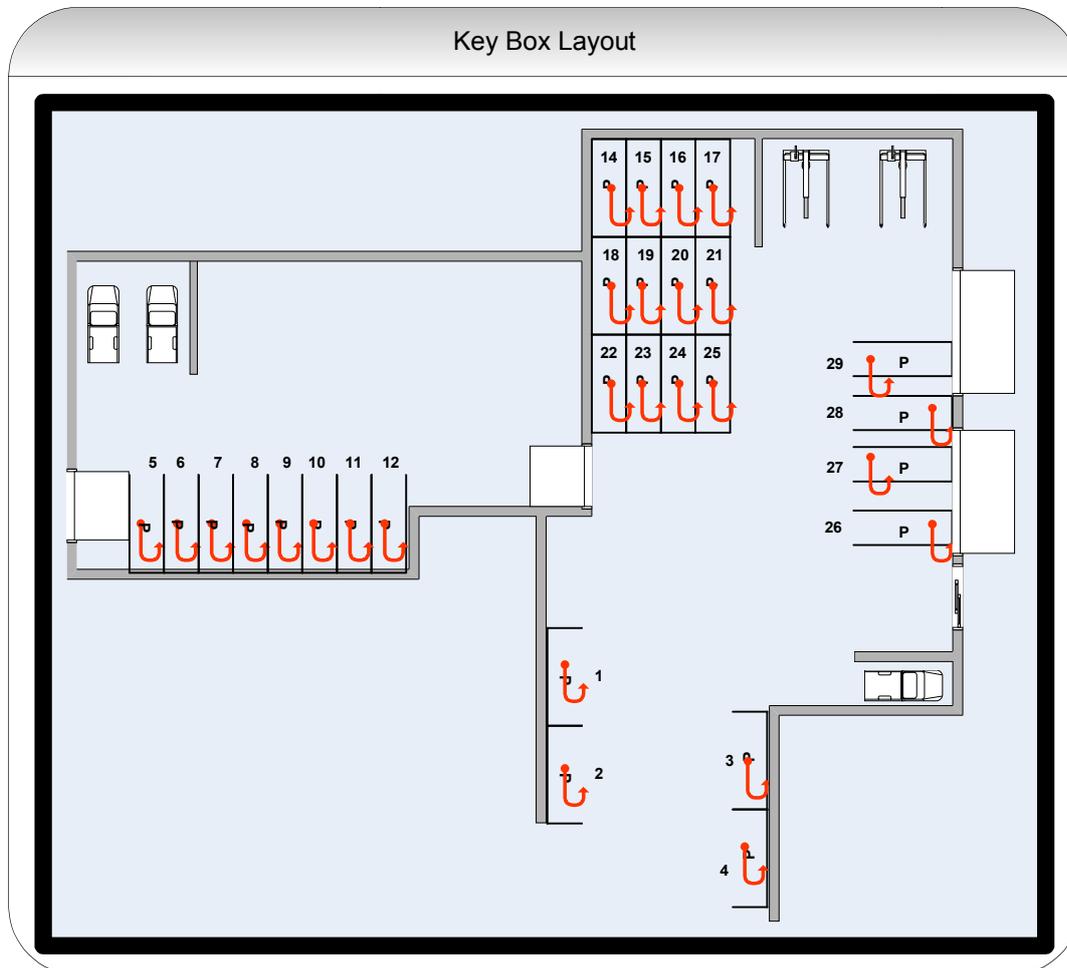
5.6.2 KEY BOX CHANGES

A new key box design was developed on the new parking layout. All the bays are being numbered and the parking layout picture would be placed inside the key box. Each bay would then have a key holder attached to it.

This will ensure that every vehicle parked at the service centre has its key placed in the according parking place in the key box. This will remove time wasted looking for keys and accompanying vehicles.



Figure 14 - New Key Box Layout



5.6.3 LAYOUT CHANGE

The extra lift that is not used at the service centre must be installed at the new express service line. The lift currently waste precious working space and is unproductive. It is also inaccessible because there is no opening in front of the lift and because there are vehicle parked inside the service centre, it is inaccessible from the inside as well.

Oil drums that stand around all over the service centre are also a most major problem. Every previously open space is now filled with empty 210l oil drums. This makes moving through the service centre and into certain rooms very difficult. Most of the used spaces can be used for much more productive procedures.

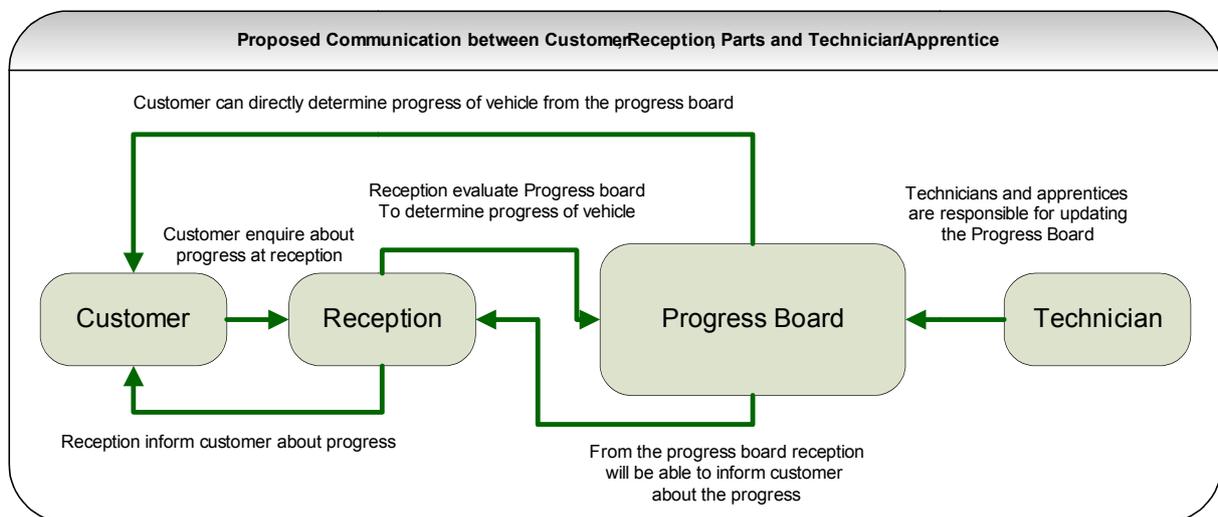


A procedure must be installed that can move and discard empty oil drums. Empty oil drums have no value to the service centre, and because of this it is a waste to keep it. An employee must be assigned to be responsible for the movement and the discard of the drums.

5.7 RECEPTION

The current communication problems would be overcome by the progress board described in earlier paragraphs. This would ensure that everyone in the service centre knows exactly where a vehicle is in the system and the progress of the vehicle.

Figure 15 - Proposed Communication Flow



5.8 SCRAP METAL

Scrap metal in the form of replaced parts is a major issue at the service centre. There is no procedure to remove scrap metal from the service centre. A weekly procedure must be installed and the assigned person must ensure that the scrap metal is removed and taken to a scrap metal retailer.

Scrap metal causes the service centre to look unprofessional and it may be hazardous to the employees working at the service centre. Scrap metal may also be a valuable extra income out of waste material.



6 PRESENT AND INSTALL METHOD

6.1 SIMULATION MODEL RECOMMENDATIONS

The new simulation model was run for a period of 2 weeks and the following results were obtained.

The model showed that the optimal solution for the model was now to assign 4 apprentices and 5 technicians to the different work stations. This will result in an average of 18.6 vehicles that are serviced per day.

This new and improved model for De Wit Motors can now aid the service centre in better decision making regarding the need of employing apprentices and technicians.

In real life, the times for services and repairs varies a lot and these results in inaccurate outputs from the model. Because of this the results from the model would not be 100% correct, but does provide De Wit motors with a relatively good guideline for future decision making.

The suggestions made by management that was incorporated in the model were:

- Incorporate a emergency lane for services
- Insert a parts collection task into the model (Formed part of the whole service procedure)
- The model must be able to handle carry-overs
- The model must be able to handle walk-in customers

6.2 VEHICLE PROGRESS BOARD

The new progress board was designed. An example was shown to the service centre manager and to the CEO of De Wit Motors and the design was approved. The board is now currently being manufactured at a sign manufacturing company.

Each technician and apprentice will receive different coloured magnets. He will place his magnet next to the vehicle he will service on the progress board. By doing this all the personnel will know which technician/apprentice is currently working on the vehicle.

The customer information must be completed by the reception department. If a courtesy vehicle is assigned to the customer it must be indicated on the board in the designated space.



The technician is responsible to move the magnet through the service procedure on the board. If there is a problem the magnet must be moved to the “problem” block. After the service is completed the technician must move the magnet to the “test drive” block. When the test drive is completed the responsible person must move the magnet to the “wash bay” block and then when the vehicle is finished at the wash bay the wash bay manager must move the magnet to the “finished block”.

It is then the responsibility of the service centre manager to ensure that the parking bay at which the vehicle is parked is recorded onto the progress board.

The progress board will ensure that all the personnel at the service centre are up to date with the progress of the vehicles at the service centre. This will also help the reception staff to inform the customers about the status of their vehicles.

The figure below shows the new Progress Board design.

Figure 16 - New Progress Board

Mercedes-Benz DE WIT MOTORS Mercedes-Benz												
	CUSTOMER INFORMATION					VEHICLE PROGRESS						
	Name of Customer	Veh. Reg. No.	Make	Courtesy Vehicle	Problem	Parked	Service	Test Drive	Wash Bay	Problem	Finished	Parking Bay Number
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
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14												
15												
16												
17												
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19												
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6.3 NEW PARKING LAYOUT

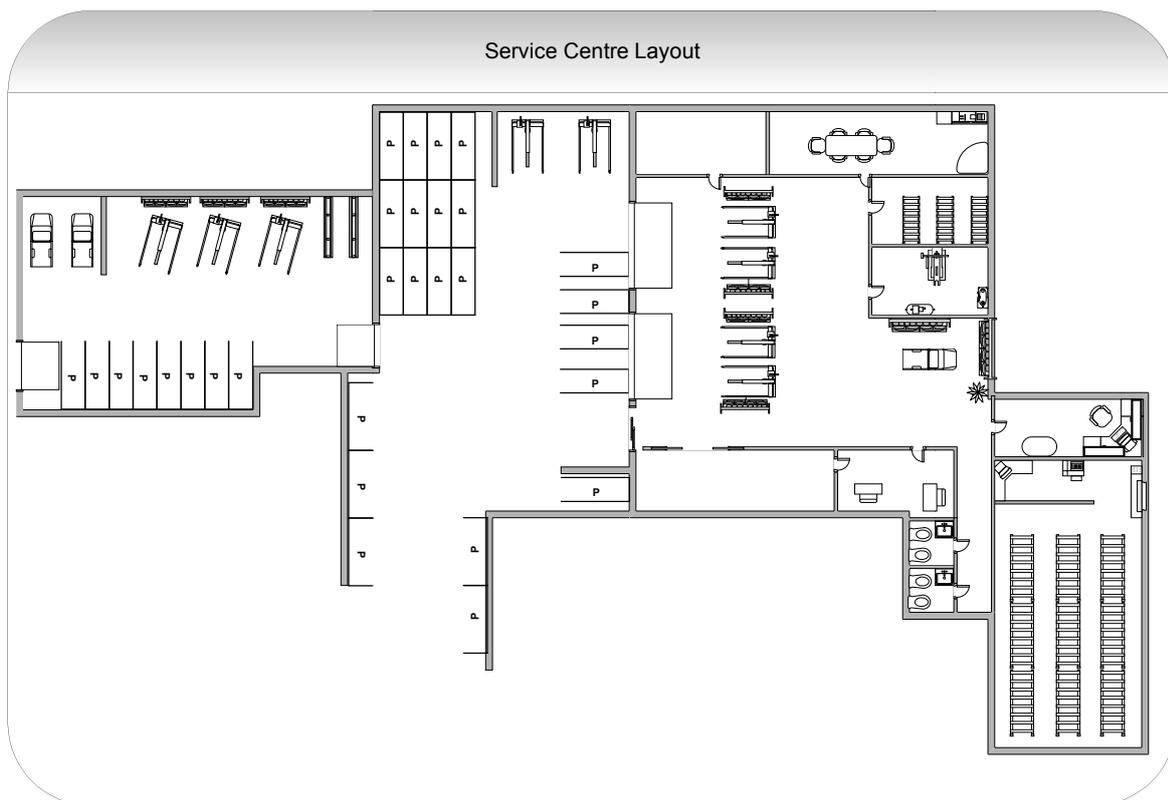
The space next to the wash bay was filled up and levelled and this space provided 8 additional parking spaces. This played a major role in the parking problem and the parking problem was reduced.

The 10 additional parking spaces in the underground parking area were also made available for use by the service centre. This almost solved the parking problem and the service centre is now less crowded.

The only problem with the new space is that there are no lines that show the current parking spaces. The new lines were painted and this solved the problem.

The new layout made it easier to find parked vehicles around the service centre.

Figure 17 - New Parking Layout





A suggestion was also made to remove the keys from the vehicles while they are waiting in the queue for the different procedures like the wash bay and wheel alignment. It is dangerous to leave the keys in the vehicles because it makes it easier to steal vehicles from the service centre and this would do permanent damage to the image of De Wit Motors if a vehicle is stolen on the property.

6.4 EQUIPMENT

An extra STAR Compact³ was bought. This was done on the author proposed that an additional star must be bought. The waiting line for the equipment was analysed again and it reduced dramatically from an average of 2 vehicles in line to a mere 0.7 vehicle in line.

Figure 18 - STAR Compact³



6.5 THE KAIZEN BOARD

Kaizen boards were placed at 3 different areas throughout the service centre. By using these boards, technicians and apprentices will have better control over their work and they will remember important things they must do.



Figure 19 - Kaizen Board



6.6 ADDITIONAL CHANGES

6.6.1 WASH BAY

The new wash bay was being built at the end of this project. It will be completed at the end of November 2008. The new wash bay will have a dividing wall that will ensure that two vehicles can be washed at the same time without getting dirt from one vehicle onto the next.

6.6.2 SMOKING TIMES

The author suggested that smoking times must be allocated. This will ensure that personnel do not waste valuable productive working time on smoking. Personnel are also encouraged to smoke during lunch- and tea time. The time wasted on smoking was reduced by 35% which meant that 315 productive hours were added per year. Because of this improvement the service centre saved R101 500 per year of available labour hours.

6.6.3 UNIFORMS

The author suggested that all the personnel at the service centre must wear the same uniforms during their shifts. It looked very unprofessional when a customer visited the service centre and all the personnel looked different.

New uniforms were made and all the employees at the service centre had to wear the same uniforms. This made the personnel look more professional and more capable. This helped with the image of De Wit Motors and resulted in an improved CSI score.



6.6.4 WEEKLY MEETINGS

Because there was such a problem with communications between the employees at the service centre, the author suggested that weekly meetings must be held between the parts-, sales- and service department. These meetings must be used to clear up any misunderstandings and problems.

6.6.5 RECEPTION PROCEDURE

A standard greeting must be used to greet customers at the service centre. If all the customers are greeted in the same way and all the employees greet the customer in the same way, it will ensure that the customer feels that he is being helped by capable and professional people.

The reception personnel must also stand up when greeting a customer. This will let the customer feel that he is important and respected. This will have a positive impact on the CSI score as well.

Technicians and mechanics must also put the plastic seat and steering wheel covers on while the customer is still at the vehicle. This will let the customer feel that great care is taken with his/her vehicle.

6.6.6 CUSTOMER DATABASE

It is very important for the service centre to keep their customer database up to date. From the database, the reception staff can have a more personal conversation with the customer. If the customer feels that the service centre is making an effort to let them feel important, it will have a positive impact on the CSI score.

6.6.7 KEEP EMPLOYEES UP TO DATE WITH TECHNOLOGY

It is very important to keep employees up to date with new technology and to ensure that they are trained and are regularly attending courses. This will help to resolve the current problem at the service centre.

The service centre must also try to retain their employees. There are currently too few employees with expert knowledge. This must be addressed immediately and employees must be trained and sent on courses on a regular basis.



6.6.8 OIL MEASURING SYSTEM

A system was implemented to electronically measure the number of litres of oil used per vehicle and automatically updated it on the job card. This provided the service centre with improved control and a more efficient procedure.

6.6.9 CUSTOMER WAITING AREA

The author suggested that the current television in the waiting area must not be showing channels from the DSTV bouquet, but instead Mercedes Benz videos must be shown. This will be more professional and more informative to the customer.

A show case must also be installed. This will be used to showcase different Mercedes Benz memorabilia as well as Mercedes Benz clothing and scale models of different vehicles. This will provide the customer with something to keep him busy while he/she waits for their vehicle.

6.6.10 REWARDS SYSTEM

A rewards system was implemented and there was the allocation of a “Technician of the Month” title for selling the most hours. This helped to motivate the personnel and keep the morale of each individual high.



7 CONCLUSION

A meeting with the CEO and Service Centre Manager was held to discuss the findings and the possible solutions. During this meeting it was decided to implement some of the solutions like the scheduled weekly meetings, the new wash bay, the parking layout changes and the improved reception procedure.

The phasing in of the new methods was difficult to implement and some of the changes, like the new progress board, will be implemented after the December vacation period.

The full implementation phase will not be described in this project, because of time constraints. This is because it was impossible and infeasible to implement all the changes and solutions at once.

The CSI score was improved by 8% from 84% to 92%, with only minor changes that were made. The productivity of the service centre was also increased. Productive billable working hours were increased with 19%. Because of this improvement **R5 800** worth of labour hours could be sold extra per month per technician. The service time, per vehicle, was decreased by 15%. 2 more vehicles on average could now be serviced, per day. This means that the service centre would increase their income by R3600 per day and a total of **R72 000** per month.

In total, if all the changes would be implemented as suggested by the author, the extra income would be ±R89 000 per month and this results in an extra income of over **R1 Million** per year.

This was accomplished by:

- Introduction of new processes
- Elimination of unnecessary actions
- Improvement of existing working methods

This project will help De Wit Motors to improve their image and this will result in better retention of new customers. This will also increase the sales of new vehicles and will benefit the company in a whole.

It is important to note that the increase in efficiency was not achieved by working harder or investing large amounts of capital, but simply by working smarter!



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