Evaluating the impact of pre-diagnostics on an automotive workshop's operational efficiency

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ABSTRACT

Time-Driven Activity-Based Costing (TDABC) is an addition to traditional Activity-Based Costing (ABC). The process of ABC highlights and allocates costs to products providing a more accurate view. However, TDABC focuses on the time spent on processes and eliminates certain barriers in traditional ABC implementation. Due to the ever changing environment influenced by technology and globalisation, companies need to change the way they did things in the past to remain a noted role player in the market. Making use of accurate costing methods can provide management to make informed and real time decisions; active measurement opens the window of opportunity for improvements. TDABC allocates a cost to time; this is very important for the fast moving world businesses are operating in.

Value Stream Mapping (VSM) is a process involved in lean thinking. During this process the objective is to visually draft the current process followed within the business to identify waste. Waste, also known as non-value added, is a normality, a duplication of work or lead times that can be prevented. To visually depict the process being followed and to objectively evaluate the status quo can contribute to companies longing to reduce waste.

By integrating TDABC as time-driven costing method with the aim to reduce waste using VSM can be an exciting combination to evaluate your current business and the possible increase of profitability.

During the study the value of TDABC is highlighted and combined with an evaluation of the diagnostic process followed in an identified automotive workshop. The aim of this study is to identify whether there is any waste during the diagnostic procedure followed by means of VSM and to conduct a profitability analysis making use of the TDABC principle. This framework will assist management with tools to make better profit calculations and to challenge the status quo of operations.

Anonymous Motor Group is in the automotive industry selling and offering after-sales services to the public. They do not manufacture the products but represent certain brands as approved dealer. New vehicle sales have grown instable due to the strict competition involved amongst all the different brands. However, stability is provided

through the after-sales departments, because clients need to service their vehicles to retain the warrantees and normally these vehicles have active service plans. Consumers need to service their vehicles but due to the competition and national dealership footprint of the brands, customers can choose their preferred dealership. Automotive workshops sell their time against an allocated benchmark rate and a governed labour rate, thus profitability is correlated with the efficiency of technicians.

The main objective of this study was to establish if pre-diagnostics will have a significant influence on the efficiency rate of technicians. The efficiency rate was converted to a profitability analysis per minute making use of TDABC. The pre-diagnostics were integrated into the current process by making use of VSM and a conclusion was made accordingly.

TDABC is a helpful tool to calculate costs and revenues and VSM disintegrates the current process followed to identify any non-value added processes.

KEYWORDS

Activity-based Costing, Automotive workshop, Diagnostics, Time-driven Activity-based Costing, Value Stream Mapping.

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CHAPTER 1 - INTRODUCTION

1.1 Background

Globalisation has complicated competitive rivalry in the automotive market and is an aspect companies need to embrace to sustain competitiveness. Companies need continuous evaluation of their business model by focussing on waste reduction and cost optimisation. Accurate cost measurement tools need to be used, increasing overall profitability and customer satisfaction (Fei & Isa, 2010). Although numerous companies constitute to very successful business cases, they may still need to capitalise on every opportunity that enable sustainable growth and improved profitability. Chen and Jones (2007) reiterate innovative drivers by initiating approaches and tools to deliver more efficient products and services, not affecting quality whatsoever. In highly technological business environments, Williams (2015) highlights that a company's ability to attain and accurately distribute real time information has a major influence on its competitiveness against rivals. Fei and Isa (2010) and Walters and Lancaster, (2000) advise business management to focus energy on optimising their current business processes and to improve their value chains. When a company works more efficiently and reduce waste, it will directly have a positive influence on their bottom-line. Furniss and Spencer (2005), Fei and Isa (2010) and Poggenpoel (2004) highlight the importance of innovative operations improving the value chain by measuring key performance indicators (KPI's) and to provide management with understandable cost drivers relating to the end product. Similarly to other industries, profitability within an automotive workshop is highly correlated with efficient operational procedures and time-efficiency of technical employees.

Vehicle brands provide customers with extended after-sales service offerings. This enables them to sustain their competitive position to establish customer relationships. The aforementioned is highlighted by vehicle brands offering vehicle warranties up to 5 years or 150,000 kilometres. This forces customers to service and maintain their vehicles at approved workshops using originals parts; if this is not adhered to, the warranties are cancelled. The brands also offer customers national dealership footprints. New vehicle sales are very competitive and exceptional service needs to

be offered to customers. If the service is not up to standard, the workshop may lose customer support. Word of mouth can spread like a fire by means of social media connectivity. It is a highly competitive environment where the client's maintenance needs must be satisfied whilst business efficiency rates being at optimal standard with the possibility to increase profitability.

1.2 Activity-Based Costing and lean management

Amongst the ever changing business environment and highly competitive automotive industry, it could be argued that sustainable companies are those with the ability to adapt and continually improve their service offerings. In this globalised environment change is the only constant. This establishes the need to change conventional measurements to provide more in-depth cost analyses, improving management control and accuracy. Activity-Based Costing (ABC) and lean management are management principles that improve accurate costing measurement and reduce operational waste. This compliments an increase of profitability.

Tsai (1998) explains that ABC is a management instrument which comprehensively identifies the deficiencies in traditional costing methods, highlighting a more detailed costing allocation. This is achieved by magnifying operational processes in order to allocate overhead costs. Focussing on operational key cost drivers and activities in operations enables management with insightful information to which activities accumulate to total overheads. In general ABC will provide a comprehensive framework of operational processes and the contribution thereof to the bottom line of the company. Time-Driven Activity-Based Costing (TDABC), as explained by Szychta (2010), is an addition to traditional ABC with the aim to reduce the barriers during its implementation, through calculating the cost of time and applying the predetermined rate to each processes. Kaplan and Anderson (2013) explain that TDABC simplifies the measurement, it avoids the taxing data collection exercise and it caters for individual customer needs through allocating overheads to time spent on clients' orders and / or service offerings respectfully.

Lean management is the principle in operational management with the objective to enhance the operational process by avoiding waste at all cost, hopefully resulting into improved efficiency. One of the tools used in lean management is Value Stream

Mapping (VSM). During VSM the whole process is plotted onto a flow chart with time allocated to each step. This tool provides an opportunity to identify operational waste; improving the current flow of processes or alternatively avoiding some processes of which may be proven to have no positive contribution to the department or business. Lean management thus drives continuous optimisation of resources and avoiding waste. Readily available technology provides a very good opportunity to exploit possible opportunities to improve efficiencies. With time as the cost driver of ABC within the automotive workshop, technology enables the technician to obtain pre-diagnostics or even future remote diagnostics before they commence with repairs on vehicles, thus measurable cost optimisation will result because of the technicians' ability to increase their efficiency of accurate vehicle repairs by making use of comprehensive pre-diagnostics provided. Considering all of the above, since both ABC and VSM techniques are centred on the operational procedures, these complementary tools form the theoretical basis for this research project.

1.3 Field of study

Anonymous Motor Group is a multi-franchised dealership with a fully equipped automotive workshop. Workshops in general are considered as the backbone of the business, providing a stable financial contribution through the consumer vehicle requirements of repairing and servicing their vehicles by approved workshops in order to retain their warranties. Industry competition however, is very condensed due to the national dealership footprint available to the consumers. This entails that the entity needs to retain its (satisfied) client base, as the clients can opt for any other approved dealership. Vehicles repaired under warranty have no cost allocation to the consumer, thus, repair costs are paid directly to workshops from warranty underwriters.

In terms of vehicle repairs and maintenance, all repairs are benchmarked with job completion time allocations. The time-efficiency of a technician directly relates to profitability. Illinois Transportation (2007) explains that the time-efficiency calculation is done by dividing the hours sold into the hours worked. Within the automotive workshop, services and repairs are conducted daily; time limits for completion of work is benchmarked by original equipment manufacturers (OEM), for example, a 15,000 km service for a vehicle is benchmarked to take 45 minutes; if a technician takes 45 minutes to complete the work, they are 100% efficient (45/45 = 1(100%)), but if they

(technicians) are well trained and have accurate real time information, they can conduct the work quicker. This increases the time efficiency rate, for example, if they complete the same work in 30 minutes (45/30 = 1.5 (150%) they are 150% efficient. In an 8-hour working day 1 hour is allocated for lunch; leaving the technician with 7 physical hours to work. If the technicians work at an efficiency rate of 150%, they can sell 10.5 hours in a 7-hour day. Being more time efficient will increase profitability in the business.

Not all vehicles need to have an initial diagnostics conducted; thus, only vehicles with visible fault codes or lodged damage defects by consumers are initially diagnosed. Tahat *et al*. (2012) explains the partial implementation of On-Board Diagnostic Systems (OBD) dating back to the 1960's. In 1987 all vehicles sold in California were governed to have some basic OBD capability – these requirements refer to OBDI. In 1996 all vehicles sold in the US had OBDII requirements; the standard stipulates the type of connector and its communication with the protocols from the vehicle's OBD. The OBDII functions amongst one of five protocols: SAE-J1850 pulse width modulation; SAE-J1850 variable pulse width modulation; ISO-14230 keyword protocol 2000; ISO-15765 Controller Area Network (CAN) or ISO-9141-2 protocol. All vehicles use one of the aforementioned protocols; the protocol used during this study is ISO-9141-2. The 16-pin (2x8) J1962 female OBDII connector is located within two feet from the steering wheel of a vehicle. This function enables workshops to receive real time diagnostics of vehicles, reset fault codes whilst accurately guiding them to rectify and/or replace the faulty parts. Reiterated by Namburu *et al*. (2007) the use of the readily available technology within the vehicle provides technicians with accurate data collection. This enables the technicians to conduct efficient repairs to vehicles.

1.4 Research question and objectives

Historically new vehicle sales mainly contributed to the profitability of an automotive dealership, whilst nowadays the tendency is more towards the profitability contribution from the after-sales department (maybe a customer cannot afford a new vehicle purchase, however, they still need to service their current vehicle at approved workshops) – dealerships need efficient after-sales departments to remain financially viable.

Repairs and maintenance diagnostics are only conducted by the technician when the consumer's vehicle is pulled into the working bay. Namburu *et al*. (2007) explains that a real time fault is more accurate leading to increased efficiency. The readily available OBD system communicates through the OBDII. This provides technicians with accurate diagnostic capabilities. These diagnostic tools are currently used by technicians; however, the information process is not optimised to its full benefit.

As explained by Palumbo and Dyer (2008), accurate mobile technologies will help with streamlining processes and provide significant return on investments by achieving higher efficiency in completing tasks by decreasing operational costs, reducing data errors / loss and also by improving consumer retention through better customer service.

The focus of this study is to enhance the current status quo of the business process within the automotive workshop. The study will evaluate the current process followed by making use of the lean management principle of VSM to identify possible waste during the current diagnostic process versus pre-diagnostics being conducted.

The research then aims to calculate the cost of the technician with his time as the driver of ABC costing. Furthermore, the research aims to evaluate the current status quo and slightly re-engineers the current diagnostic process providing technicians with the relevant diagnostics and fault code information obtained from the OBDII port before the vehicle is being worked on. This provides the workshop the ability to verify any outstanding campaigns and to immediately address any problem area of the vehicle. Providing diagnostics before the vehicle is actually moved into the working bay can contribute to a possible increased time efficiency of the technician resulting into overall profitability increase.

Considering all the aforementioned, the primary research question of this study can be formulated as follows:

- Would management tools such as TDABC, which improves the accuracy of overhead allocation, and VSM, which depicts the value stream aiming to reduce waste, provide management with an accurate profitability analysis of technicians and possible waste identification?

Building further on this research question, the following supplementary research question can be formulated:

- Would vehicle pre-diagnostics increase the time efficiency of technicians within the workshop?

In answering the above defined research questions, the primary objective of this study is to evaluate the possible extend that TDABC and VSM might contribute to more accurate management information in an automotive workshop context, and then especially in the context of a vehicle pre-diagnostics process evaluation.

In the context of the stated primary objective, the specific objectives of the study include the following:

- Establish the impact of pre-diagnostics on the efficiency rate and relate it back to a monetary cost and potential revenue for the business by:
    - Establishing the actual cost per minute of the technician and determining the gain of revenue by making use of the principles of ABC;
    - Analyse the current diagnostic process by making use of the VSM method;

The study aims to evaluate and potentially improve the current step of diagnostics; empowering the technician to immediately commence with repairs with pre-diagnostics provided. After the process of technician profitability analysis by making use of TDABC and changing the current procedure followed by making use of VSM, the researcher will conclude findings elaborating on the significance thereof.

1.5 Research design

To attain the mentioned objectives, the proposed research method will be conducted in a case study format, finished by way of a literature review as well as an empirical analytical study.

1.6 Literature review

A comprehensive literature research study will be conducted by gathering theoretical data by making use of sources like supplier websites, academic journals and text

books and focused training journals. The fundamentals of this case study will be based on basic information and theory VSM, time efficiency and ABC integrated into practice by calculating cost and then constructing value contribution thereof in practice. The purpose hereof is to provide a foundation on which to base the empirical phase.

1.7 Empirical research

An empirical study will be conducted to compare current operational processes followed within the selected dealership; establishing a cost calculation resulting into conclusions made with the help of the Value Stream Mapping (VSM) process.

- The researcher will analyse and identify the current procedure followed by plotting down the initial flow chart, using VSM. The workshop's job cards will be evaluated by establishing the current time the technician spends on the initial diagnostic process. A total of 35 diagnostic job cards will be reviewed, establishing the mean time technicians spend on diagnosing the vehicles. This mean time will then be compared to the cost of the technician as per the TDABC principle, providing the reader with a comprehensive cost (loss of revenue) of diagnostics. The pre-diagnostic phase is then implemented; shifting the time allocation from the technician by removing this function from their responsibility whilst only providing them with the comprehensively conducted pre-diagnostics. Time efficiency will then be re-calculated providing the reader with the influence of VSM intervention on the efficiency rate of the technicians and by making use of TDABC to determine the possible profit analysis and improvement accordingly.

The study involves a designated business, the business name will remain anonymous during the course of this study with data used respected and sensitive information will remain confidential. It is also important not to provide personal information regarding the current work time efficiency rate of identified individuals. It will be of the utmost importance to educate the technicians about what the intention of the research is, and provide them with the confidence that personal performance is not measured, but rather the potential influence of process re-engineering of the current operational processes; informed consent, right to privacy, protection from harm and involvement of the researcher are noted (Welman *et al*., 2012:).

1.8 Definitions

OEM – Original equipment manufacturer:

This is a company that has the right to integrate outsourced manufactured parts into their own end product, rebrand it and making it available to the market (Beal, 2013).

ABC – Activity-Based Costing:

An accounting technique that recognises actions that a business executes to complete a product or service and then allocates overheads accordingly (Investopedia, 2008).

TDABC – Time-Driven Activity-Based Costing:

An addition to the initial ABC technique that recognises actions that a business execute to complete a product or service, however TDABC establishes the time consumed by the certain process and then allocates a cost accordingly (Szychta, 2010).

VSM – Value Stream Mapping:

VSM is a lean thinking principle that graphically depicts organisations' processes followed to deliver goods; with the aim to critically evaluate the process, identifying non-value added activities and then innovates to eliminate this accordingly (Isixsigma, 2015).

OBD – On-board Diagnostic system:

OBD refers to a vehicle's capability to communicate its self-diagnostics providing the potential repairer with the fault codes relating to the various vehicle components (Ctemissions, 2012).

OBDII – The connector type connecting to the OBD:

This is where the communication device and the vehicle communicates and translates the vehicle diagnostics into fault codes which can be interpreted by the repairer (Namburu *et al*., 2007).

CAN – Control Area Network:

CAN is a durable digital serial bus intended for industrial settings that provides in vehicle communications (Pcmag, 2015).

TPS – Toyota Production System:

TPS is the synonym introduced by Toyota for lean thinking that involves adding customer value and reducing operational waste (Vorne, 2015).

CIMA – The Chartered Institute of Management Accountants (CIMA, 2005).

1.9 Overview

Chapter 1: Introduction

This chapter enhances integral information about the introduction, problem statement and the description of key concepts. An explanation of the research objective, questions hypotheses and a description of the research method will also be included in this chapter.

Chapter 2: VSM and ABC as management framework

The research constructs of a literature review about ABC and VSM. The researcher introduces ABC with the barriers to implement the costing model. The researcher explains why TDABC will be a better analytical tool moving forward. VSM is explained, the value it could add to a business and the steps to follow.

Chapter 3: The case of diagnostics of Anonymous Motor Group

This chapter will include an explanation of the research method and the results before and after intervention. This chapter commences with an introduction of Anonymous Motor Group's workshop diagnostic process followed. The cost per technician is established making use of TDABC. The diagnostic process is evaluated by making use of VSM. Waste is identified and changes are made on how diagnostics are conducted during daily operations.

Chapter 4: Findings, conclusion and recommendations

The finding will indicate if there is profitable opportunities for the workshop by making small changes within the current diagnostic process followed. A conclusion is derived from the data gathered with the possible gains in profit. Recommendations are made to the workshop and the limitations of the study is explained.

1.10 Chapter Summary

The chapter started with the background of business and globalisation which currently increases competitive rivalry amongst competitors. It explained the current automotive industry and the need to attain customers due to the financial sustainability it offers. The chapter explained the time efficiency calculation and how it can reduce or increase profitability. ABC and TDABC are briefly explained as a cost measurement method and lean management is defined. The chapter explains the field of study and the research questions were stipulated with the objectives of the study highlighted. The finding will indicate if there are profitable opportunities for the workshop by making small changes within the current diagnostic process followed. A conclusion is derived from the data gathered with the possible gains in profit. Recommendations to the workshop are made and the limitations of this study are explained.

CHAPTER 2 - VSM AND ABC AS MANAGEMENT FRAMEWORK

2.1 Introduction

During the previous chapter an in-depth introduction about the research was provided to the reader. The automotive industry and key performance indicators were identified with globalisation increasing competitive rivalry. The purpose of the study was highlighted with the aim of combining ABC and the lean management principle and aiming to add value to an identified automotive workshops' diagnostic procedure followed. The purpose of this chapter is to review the theoretical research relating to ABC and lean management principles. ABC and lean management principles are defined and discussed. The implementation of ABC and lean management principles are addressed. Lean management principles will be discussed. The principle of Value Stream Mapping will be defined and discussed.

ABC is an overhead breakdown outset that provides management to assign costs to each activity. Activities are accumulated by different events contributing to total overhead costs (Brewer *et al*., 2009).

Toyota's Production System (TPS) is based on lean "principles". These lean principles enhance customer focus by continual improvement through the reduction of waste and closely monitoring upstream and downstream practises as part of a lean value chain. Manufacturing companies have implemented some type of lean innovation and the lean approach is directly influencing service industries (Liker & Morgan, 2006). VSM is a visual tool depicting process that provides clear operating procedures and identifies where waste can be reduced. The tool further illustrates information flows that results from processes (Jacobs & Chase, 2013).

Toyota, one of the leading vehicle manufacturers, underlines the following principles as the reason for their success. They are customer focussed, continually improving by decreasing waste and understanding their cost drivers. This enables them to achieve higher profits whilst not discounting quality and service excellence.

2.2 Activity Based Costing (ABC)

2.2.1 Introduction

Companies aiming to achieve sustainable business success have to provide quality service at lower prices to remain competitive as explained by Huang *et al*. (2013). To understand the meaning of ABC methodology, Turney (2005) defines the concept as a rate and performance measurement process of cost objects and activities. ABC is a costing method where activities are measured by means of resource absorption contributing to the final cost of the product or service (CIMA, 2005).

ABC offers solutions to serious costing inaccuracies within standard costing systems. Traditionally the major cost systems only included labour, materials and overheads. Manufacturing companies could easily trace direct labour and materials used; however, indirect costs were regarded as overheads and thus not actively included in the daily key performance indicators (Sajid, 2010).

Due to automation and engineering-driven proficiencies the direct labour dimension of products declined. The portion of total cost characterised by random allocations of overheads persistently inclined during the 20th century. Furthermore, businesses deviated from mass production, opting for a more customer focussed strategy that provides customers with more tailored product dimension, providing the opportunity to choose from different product options and derivatives. This strategy's objective was to interest more customers, leading to business growth. All these new customised innovative product offerings were attractive to the market, however, it came with financial implications that accumulated overheads by adding more focussed dimensions to business operations like; engineering, logistics, quality control, setup costs, marketing and selling costs (Kaplan & Anderson, 2013).

ABC has been the pinnacle of management accounting since the introduction during the 1980's. It provides strategic management based on the concept to offer integral data relating to longstanding operational management. The method is not only a technique providing more precise process cost calculations; it correspondingly is a co-ordination of measuring standard and actual costs (Kaplan & Anderson, 2013). This costing initiative provided the solution to the incorrect allocation of overheads. As

explained by Kapil (2010) it offered traceability to the activities performed that were generally allocated to overhead costs.

This costing method does not solely include manufacturing costs, but provides management with overhead cost rates that can be applied to end products (van der Linde, 2011). Service prices are charged in correlation with the capacity it actually consumes, with idle time not considered (Kapil, 2010).

2.2.2 ABC Empowering management

ABC empowers management with the concrete management of actions, processes and resources. B&M Consulting (2011) and Kaplan and Anderson (2013) further explain that management opted for ABC systems that provided them with profitability dashboards and enabled them to make informed decisions that led to justifiable improvements in products and profitability.

The method was originally initiated by manufacturing companies, but it was very soon adopted by companies offering services as well. Service companies consist of operating expenses being fixed once the work was completed successfully. In service entities it provides information relating to the costs of services and the profitability thereof respectfully. These systems lean towards intricate and time-consuming events and are expensive to establish. This is one of the underlined barriers to implement the costing methodology in companies, which directly influenced some companies in the past to deviate from this highly criticised costing framework (Szychta, 2010).

ABC is a skill that efforts to assign overhead costs more precisely to services. The fundamentals deviate from single cost allocations to activities that accumulate to total overhead costs. An activity is an event contributing to total costs by absorbing overhead resources (Brewer *et al*., 2009). Activities within an automotive workshop include:

- Booking in of vehicles.
- Moving the vehicles to perform work.
- Conducting diagnostics.
- Costing of job cards.
- Maintenance of equipment.

- Ordering parts and consumables.
- Stocking up of parts held on shelves.

This costing method will effectively focus on these main activities within a workshop. Referring to Figure 1, each activity constitutes from its own cost pools, its own measure, and its activity rate. This can be seen as a “cost bucket” where the cost within each activity mounts up (Brewer *et al*., 2009).

Figure 1: Activity-Based Costing diagram (Activity Based Costing, 2015)

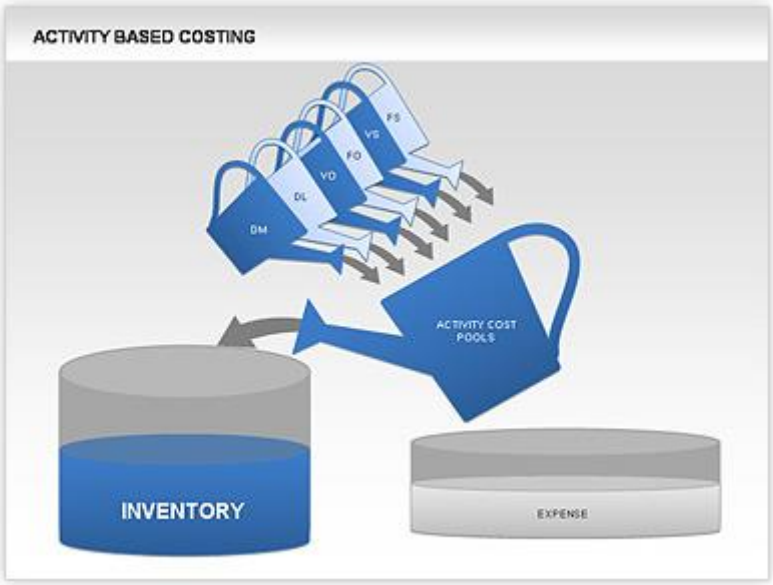
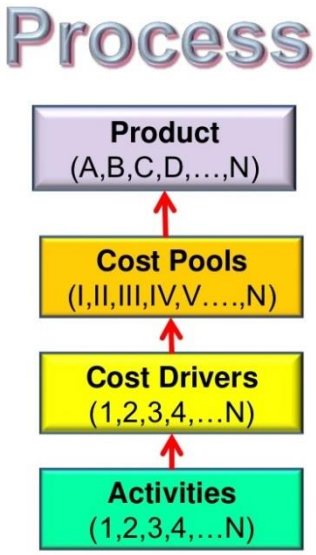


Figure 1 highlights the different cost pools driving the manufacturing overheads. ABC assists management to break down the different cost pools to smaller drivers and attach costs to the activity accordingly. This accumulates with the direct labour and materials to provide a final cost per product.

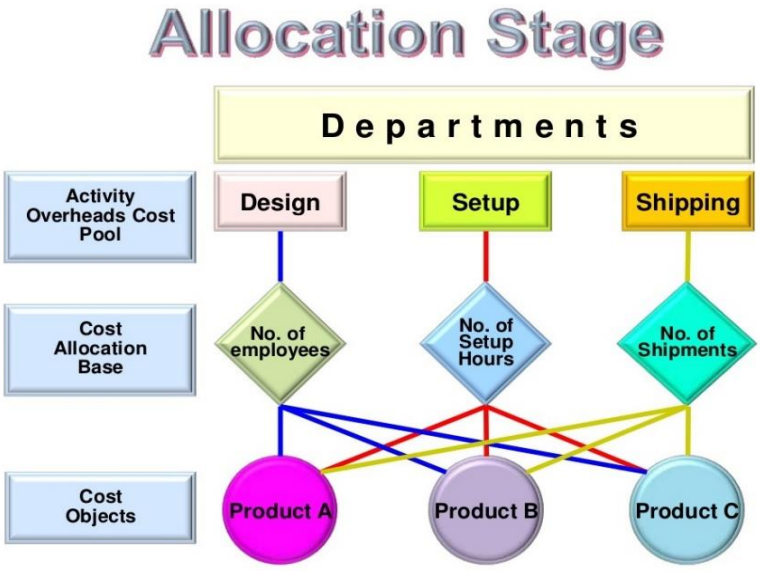
Referring to Figure 2 it visually explains the process of overhead costs allocated to end products. Different activities are driven by certain actions; these actions being called “cost drivers”. Cost drivers are the actuality of the overhead costs accumulating when a certain process needs to be completed. These cost drivers are allocated into identified cost pools, where the cost can be traced back to its origin. All of this accumulates overheads contributing to the final product cost.

Figure 2: ABC Process (Bhatti, 2012)



Referring to Figure 3, cost pools are broken down into design, setup and shipping. This differs from organisation to organisation. Figure 2 explains that different activities constitute to different cost pools; this can also be seen as the costs being sorted into its respected category of relevance. The design's cost allocation base is determined by the number of employees. The setup allocation base is determined by the number of setup hours. The shipping is determined by the number of shipments made to the client. The design, setup and shipping are then allocated to the cost objects which are required by the process to fulfil client needs. In this case it was Product A, B and C.

Figure 3: ABC allocation stage



Brewer *et al*. (2009) explains that ABC enhances accurateness of costs in three dimensions. Firstly, it divides the accumulative activity into cost pools determining the overhead costs. Secondly, the activity cost pools are more standardised than departmental cost pools. Lastly, ABC opts for diverse activity measures to assign overhead costs, some are aligned with volume and others are not. ABC places interest on activities that could value the most from Six Sigma (Define, Measure, Analyse, Improve and control) and other enhancement initiatives. ABC reviews current operations and it can be integrated to improve operational efficiencies.

With ABC seen as measurement tool adding value to organisations, one would believe that companies would implement this with immediate effect; however, it was generally not accepted, as explained by an annual survey conducted by Kaplan and Anderson (2013). The study indicated that ABC ranked below average with only 50% of companies choosing to integrate this system into management dashboards and operations. Kaplan and Anderson (2013) explain that the low acceptance was a strange occurrence due to the value that ABC brings to the tables of management.

The design and implementation can be explained by this simplified 7-steps approach as explained by Bhatti (2012):

1. Classify the cost objects i.e. product A, B and C.
2. Classify the direct costs of the cost objects.
3. Select how the costs are going to be allocated i.e. shipping.
4. Identify the overhead cost relevance to the bases.
5. Calculate the activity rate.
6. Allocate costs relating to the absorption requirement of overheads.
7. Calculate total costs of products.

2.3 ABC's difficulties to implement

Companies deviated from accepting ABC, as stressed by Kaplan and Anderson (2013), because communicative and administrative resistance come with any new idea. However, the general theme for not implementing this approach was justifiable and on merit as highlighted by Kaplan and Anderson (2013). ABC was very costly to establish, continuity difficult and modification complex. Individuals quizzed the correctness of cost allocations based on approximations of ratios of time

consumptions on several activities (Abusalama, 2008). ABC provided definite limitations during implementation. As explained by Brewer *et al*. (2009) the benefits of ABC can be outweighed by the cost implication to successfully implement the model. The cost of ABC includes that integral employees are taken away from their daily duties. The data collected must be verified and as a normality it requires information which was not previously collected. In hindsight, implementing and sustaining an ABC can pose challenging environments, leaving management to decide against it if the costs are too highly skewed versus the expected benefits (Brewer *et al*., 2009).

Managers noted an additional alarm; that the method wasn't true or gritty enough to record the density of genuine operations. This statement is supported (Kaplan & Anderson, 2013) providing an activity example of *ship order to customer* – In place generalising as shipping cost, companies may opt to identify cost variations between the different options available i.e. overnight express or commercial courier. To enable important options in resources, it will require added activities that will complex the method even more (Kaplan & Anderson, 2013).

As summary, provided by Kaplan and Anderson (2013), highlight the difficulties to successfully implement the method:

- Data collection was time consuming and expensive.
- The information for the ABC model were independent and had substantiation difficulties.
- The information was not cost effective to store, route and record.
- General ABC models were limited and didn't provide a combined spectrum of the organisations' profitability opportunities in whole.
- The model was not user friendly to absorb updates and adjusting to the environment was difficult.

2.4 Time-Driven Activity-Based Costing (TDABC)

The solution to the barriers within the original ABC was not indefinitely delayed as explained by Kaplan and Anderson (2013). Time-Driven Activity-Based Costing (TDABC) came to the rescue.

TDABC provides the solution to make things easier by avoiding the need for intensive data-collection efforts to tag certain resource costs to activities (B&M Consulting, 2011). It is agreed that TDABC directly allocates resource overheads to cost objects using an outline consisting of only two estimates, as firstly supported by (Kaplan & Anderson, 2013) the model: establish the cost of all resources consumed by a process and divide this into the time available to complete the work (refer to Table 1) – This provides management with the cost rate (CR). Secondly, it uses the CR as the driver to estimate the demand that each cost object / customer / product needs (B&M Consulting, 2011). This costing method accommodates unique customer orders because it allocates time spent on individual processes and individually allocates costs of the time spent on the process.

Table 1: Cost Rate Calculation (Adapted from Kaplan and Anderson, 2013)

$$\textbf{Capacity cost rate} = \frac{\text{Cost of capacity supplied}}{\text{Practical capacity of resources supplied}}$$

There are some barriers during ABC implementation. Kaplan and Anderson (2003) identified the innovative addition to ABC, TDABC, aiming to reduce pitfalls during the implementation phase through adapting the collection means of activity data and amends the traditional ABC activity cost calculation (Szychta, 2010).

TDABC is exactly what the methodology describes it to be i.e. it calculates the primary cost of time as the main driver. Time is the resource cost allocator directly linked to different objects during the process flow. In a workshop this will typically be the service scheduling, orders, picking of parts, booking in process of the vehicle, diagnostics and the physical service or repairs. This establishes the opportunity to overlook an intricate step during the conventional ABC approach; pre-assigning resource costs to activities before allotting them to cost objects. The writers of TDABC regard time as the main cost driver because the majority of resources have dimensions readily calculable to establish the time-availability to complete the work (Szychta, 2010).

When resources are distributed to each unique incidence of an activity such as customer requirements, it requires different time allocations. Then the mere counting of the number of times the activity was completed does not provide an accurate cost allocation.

To successfully implement ABC the company needs to manage their time effectively. Effective time management is achieved by observing access, flow and the level of information (Stout & Benedis, 2007). According to CIMA (2005:3) time-driven ABC is based on time requirements to complete activities. According to Kaplan and Anderson (2003) this approach takes unexploited capacity into consideration, underlining the importance of linking costs to activity consumptions.

The automotive workshop's time is directly correlated with profitability. Increasing the efficiency rates will result into increased profits. For the purpose of this research, the researcher will focus on Time-Driven Activity-Based Costing.

2.5 Lean management / Manufacturing

2.5.1 Background

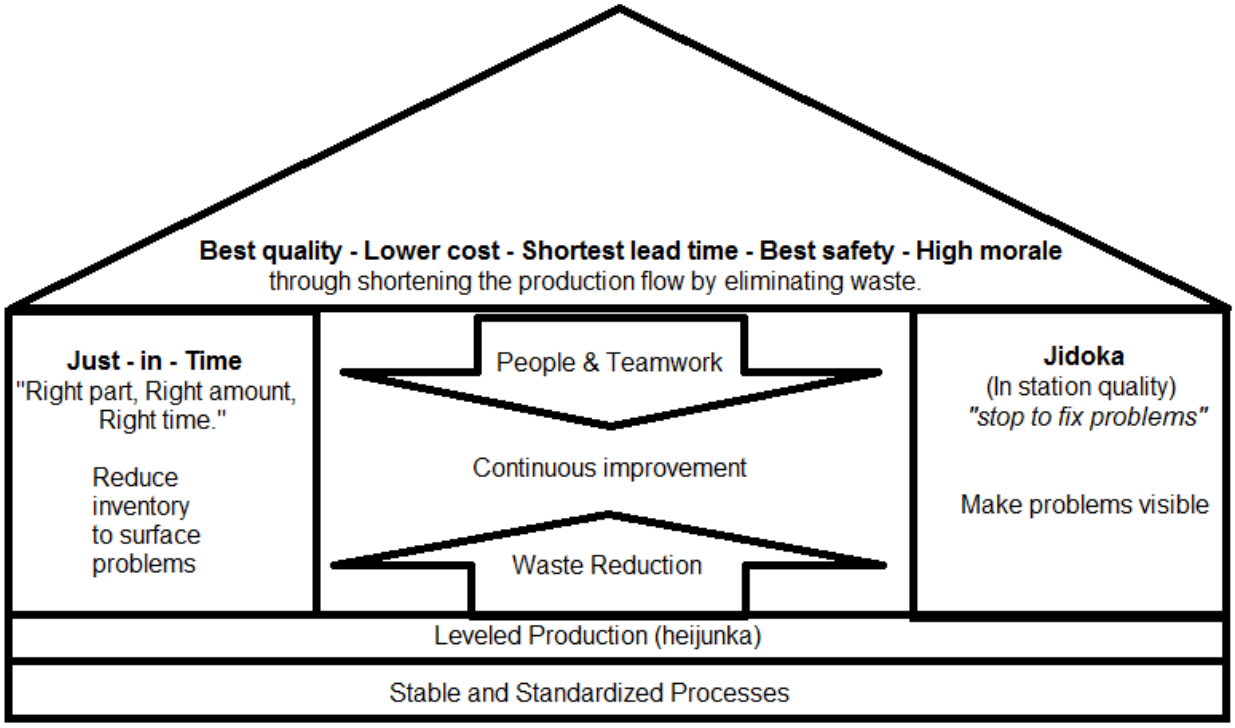
Apel *et al*. (2007) explain that in the 1900's Henri Ford "married consistently interchangeable parts with standard work and moved conveyance to create what he called flow production." Just post World War 1, the Toyota Production System (TPS), presented lean manufacturing principles into the manufacturing industries. These days it may be seen as incomplete if businesses do not evaluate the business model against operating as efficient as possible. Toyota is regarded as one of the top 50 companies internationally (Businesswire, 2015), with the general discussion touching their innovativeness (Fastcompany, 2015). The TPS model has laid the fundamentals of lean initiatives to business environments, not only touching base with manufacturing companies, but has been adopted by various businesses like financial institutions and medical centres (Liker & Morgan, 2006).

Lean thinking, as explained by Apel *et al*. (2007), are fundamentally supported by three general categories namely operations, administration and improving strategically. Operational benefits may include cycle time and quality improvements. Administration benefits may include decreased order processing and using less paper. Strategic

improvement is gained by the value proposition lean thinking offers to the business operations, the value offered to customers must be marketed and must be the backbone of the business (Apel *et al*., 2007).

TPS is well recognised as the lean thinking in reality. Liker and Morgan (2006) explain that the principle is that wisdom arises from action at the *gemba* – on the production floors. The model was depicted visually known as the TPS house (Figure 4). The reason they chose the representation of a house is because a house is built on different factors that support one another and it is only as strong as the weakest link. The factors work in synergy to be complete (Liker & Morgan, 2006).

Figure 4: The Toyota Production system house (Adapted from Liker and Morgan, 2006)



2.5.2 The Toyota Production System (TPS)

The house as explained by Liker and Morgan (2006) consists of “Just-in-time”, “Jidoka”, “Heijunka” and “Stable and Standardised Processes”:

2.5.2.1 Just-in-Time (JIT)

This well-known dimension communicates efficient resource flow where the right processes are followed to provide the resources needed on the exact time when it is needed. Consumer tuition named “kanban”, ignite renewal of the supply. This simplified concept can be traced back to the material suppliers (Liker & Morgan, 2006).

2.5.2.2 Jidoka

Jidoka is not that well known however it is far more intricate by demonstrating instruments with human smartness. The intelligence is to achieve quality control by identifying any product that deviates from the norm and stopping the production immediately to rectify it accordingly. After the process is stopped, whether automatically or manually, lights and signal sounds request assistance; this is known as “andon”. The problem is immediately attended to by the needed authorities and is resolved within seconds. This prevents any product leaving the department which is not up to the standard required. This ignites continuous improvement and customer satisfaction by means of providing products on the quality as expected (Liker & Morgan, 2006).

2.5.2.3 Heijunka and Stable, Standardised Processes

Heijunka is defined as pressing flat. This is the basis of the house that offers steadiness on which JIT methods can be supported and Jidoka can be signalled to rectify problems. The goal is to flatten workflows and when this is achieved, windows of opportunities open to standardised processes. Heijunka also provides insightful information to the work capacity required (Liker & Morgan, 2006).

2.5.3 People engaged in Kaizen

This well-known word is very seldom integrated within organisations. This concept is compulsory during lean thinking. JIT means “running on what is needed”, Jidoka entails that problems will be rectified immediately. This contributes to barriers that need to be overcome and will be valued if people are capable and driven to efficient problem-solving. If this is not the case, the outcome is merely a wearing down of working efficiencies and competitiveness (Liker & Morgan, 2006).

The majority of companies have adopted some dimension of lean initiatives in the meantime, as explained by Liker and Morgan (2006). Many companies have learned that lean thinking is a business culture and not a quick remedy to success as reiterated by Liker and Morgan (2006). Organisational culture divides short term business successes from articulated long term lean principles, thus lean thinking does not stop on the shop floors but must flow down from executive boards and top management to the grass roots of the business. Womack and Jones (1996) explain that business departments cannot work in silos, but should instead work together in synergy to achieve customer satisfaction through eliminating waste within the value stream and striving for optimal business operations.

Toyota's Production System (TPS) house referred to in Figure 4, has been the mentor for companies trying to achieve optimal lean business operations. The initiative commenced through organisations striving to achieve more with less within manufacturing plants i.e. reducing waste and working smarter and not harder. Liker and Morgan (2006) highlight that big batch manufacturing that enables economies of scale, has been replaced by lean principles integrated within the business operations; however, lean thinking has evolved from shop floors to service industries. Companies are operating on lean principles when they are targeting customer satisfaction, continually trying to eliminate waste and letting tightly integrated departments communicate well within the value stream (Liker & Morgan, 2006).

2.6 Value Stream Mapping (VSM)

2.6.1 Introduction

With globalisation on the increase, competitive companies are striving to improve value proposition through increasing time efficiency rates. The increase of labour costs and the cost of controlling operations are forcing companies to have their focus on where they can reduce waste and control effective cost allocation. For management to identify lead time, defects and material waste can be a taxing exercise, thus in order to have a better prospective of the process followed and the value stream, a Value Stream Map (VSM) is drawn. VSM's is opted for by organisations to visually depict the current process followed, whilst identifying the ideal future state of the value stream –

It is of utmost importance for companies to continually adapt and increase business efficiencies and strategies (Apel *et al*., 2007).

2.6.2 What is Value

Let's start at the core of the principle, namely value. Value is a resource offered to consumers at the required quality, timeously and at a fair price (Parida, 2010). McMahon (2011) explains the principle of value being directly linked to monetary value and the willingness of customers to trade their money for the product offered. In some cases value for customers is time, in other circumstances it might be price or even quality. Customers sometimes are willing to accept a lower quality burger if it can be quick. Other consumers will accept low quality products if it is cost effective and in other circumstances premiums will be paid by customers for quality. The value proposition to the customer must be the starting point while aligning the business model with the customer requirement accordingly (McMahon, 2011).

It is very important to note that not all processes and additions add value to end products. Only the activities that contribute usefulness to the object or service from the end user's point of view are Value Added (VA) processes or additions. Non-value added (NVA) processes need to be identified and avoided (Parida, 2010; McMahon, 2011)

2.6.3 VSM and lean thinking

VSM is a lean principle originated from the TPS model which is also known as "material and information flow mapping". The tool is primarily used by organisations to diagnose opportunities to decrease waste and to create more efficient process flows. VSM can be visually making use of a computer or even a pen and paper (Apel *et al*., 2007).

VSM as explained by Parida (2010) is the first step towards increasing lean thinking in companies. Lean thinking is very important in the modern day business environment. VSM is a management instrument that depicts the current state, identifies waste and makes suggestions to move towards an articulated vision of lean thinking through Kaizen events. Identifying the process map and after the process is visually drafted, one must critically evaluate the current process followed and initiate innovative thinking to improve the current process followed. McMahon (2011) explains

that it is of the utmost importance to involve people working in the current process to be involved in the brainstorming session. There must also be an authority like a manager identified of whom must champion the whole process moving forward. Figure 5 indicates that all processes have a minimum of three varieties.

Figure 5: Three Process Dimensions (Adapted from Parida, 2010)

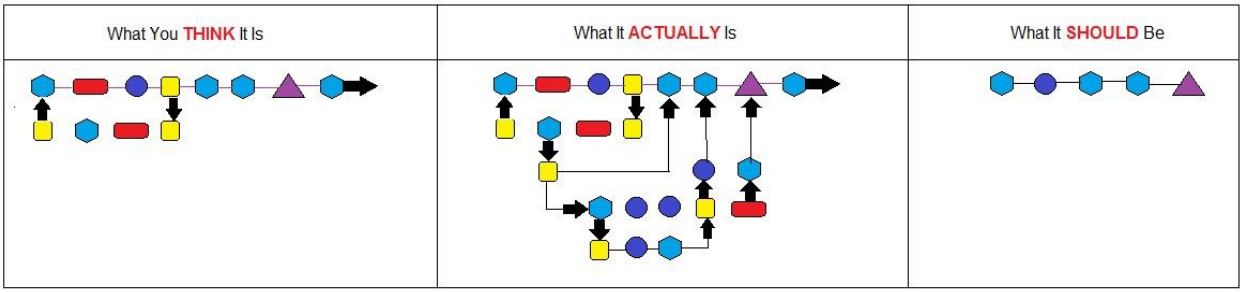


Figure 5 might be seen as hilarious, however, in reality this might be the case. It is of the utmost importance to continuously evaluate the process followed and ask the question if we are still doing the right things right. During the analysis it is very important as explained by McMahon (2011) to map the process objectively and as a true transparency of the reality, not as a past experience processes or the perceived way it ought to work.

The steps to follow to successfully draft a VSM as explained by Apel *et al*., 2007

1. Identify the product or service or step that the VSM will focus on,
2. Visually illustrate the current VSM of 1,
3. Critically evaluate 2 and identify possible barriers,
4. Articulate the desired future state,
5. Implement tactics to improve.

McMahon (2011) provides an in-depth summary of the objectives that need to be reached during the analysis; the value stream must be identified and depicted down being critically objective about the current process; the process must be led by a nominated leader who walks through the current process and ensures that all information flows are comprehensively identified and accurately integrated; the process involves taking baby steps and spending the necessary time to critically evaluate the steps by identifying hold-ups and the critical path to follow; the articulated

vision for the business operations must be depicted and it must be installed as quickly as possible to remain relevant.

2.7 Chapter summary

In Chapter 2 the research provides an in-depth literature review of the principles relating to the study. ABC is introduced providing a brief theoretical definition of the concept. ABC's background is explained and the need for the principle was established. The benefits of ABC as well as how it can empower management are identified by providing a method to management to allocate overheads to cost objects which can indicate the profitability thereof respectfully. The relevance of ABC is linked to an automotive workshop and a general prospective is provided about the process to follow and how to allocate the overheads to products. The design and implementation are briefly explained whilst the difficulties during implementation are highlighted. TDABC is introduced, the relevance for this addition is explained relating to an automotive workshop and the cost calculation is noted. The chapter then introduces lean management and provide a background of the principle as Toyota as the pioneer and initiator. TPS is graphically explained by the Toyota Production house. The house consists of JIT, Jidoka, Heijunka and Kaizen which are defined and explained during this chapter. VSM as a dimension of lean thinking is introduced. The principle is then disintegrated into what value is and what the benefits of the system may entail as well as the steps to follow. VSM is concluded by an in-depth summary of the objectives and the key points to remember during the analysis.

During Chapter 3 TDABC and VSM are linked to an identified workshop. Actual data is collected. The cost and the revenue opportunity per technician are calculated. The current efficiency of technicians is linked to a profitability analysis. Reducing waste by making use of VSM is conducted with only changing the diagnostic process and accordingly providing a post profitability analysis. The post efficiency difference is calculated and it is then linked to a post profitability analysis. Each calculation is interpreted and the chapter concludes with a summary.

CHAPTER 3 - THE CASE OF DIAGNOSTICS OF ANONYMOUS MOTOR GROUP

3.1 Introduction

During the previous chapter an in-depth literature review was conducted. The literature review included a background study and where the need arises for ABC. The benefits of ABC were highlighted followed by the steps to follow during the implementation phase. The barriers of ABC were noted with the implementation thereof being the biggest. TDABC as an addition to ABC was defined and the needed opportunity of this addition was linked to an automotive workshop. TDABC cost calculation equation is explained. Lean thinking was introduced and the focus was on the VSM dimension and the value it can contribute to continuously improving on the status quo. The process implementation of VSM was explained.

During this chapter TDABC and VSM are merged and integrated with the diagnostic process followed within Anonymous Motor Groups' workshop. TDABC will provide us with the cost per minute and the revenue per minute of the technician. VSM will be used to identify waste during the current diagnostic process. The researcher will then intervene by making a change during the diagnostic process followed. An in-depth post analysis is conducted, providing the result by making use of an empirical analysis. The chapter is then concluded with the summary of the finding.

3.2 Determining technician cost making use of TDABC

The workshop manager indicated that the mean salary of a service technician amounts up to R12,500 per month. This amount excludes overtime. Currently there are 6 technicians employed working at an average labour rate of R550 per hour.

3.2.1 Cost / Revenue per technician

Enabling the researcher to establish the current cost and revenue of the technician, the efficiency rate needs to be established. Please refer to Table 1.

Table 2: Technician efficiency calculation (own research)

Benchmark hours to complete jobs	83.08	
Hours consumed to complete jobs	73.62	
Benchmark / Consumed	1.13	**Efficiency Rate**

A benchmark is predetermined by the OEM. The benchmark for the completion of jobs is determined, providing standard measurement to where technicians are to be trained and must exhibit their skills. Depending on the technicians' skills it can increase or decrease their efficiency rate. Each individual job has got a certain time allocated to have the job completed. This time and hourly rate is fixed; if the technician utilises more than the allocated time, he or she is below the benchmark. When the technician is below the benchmark, it is costing the company money due to the loss of efficient revenue opportunity. However, if the technician is above the benchmark - if he or she is more efficient than the benchmark - they can sell more hours per day. The efficiency rate will determine how quick the technician completes the job versus the time allocation relating to the benchmark time allowed. The benchmark time is divided into the time consumed as per Table 2 to determine the efficiency rate (ER). Referring back to Table 1, the actual time allocated to complete the repairs / services was 83.08 hours, however, the technicians completed the jobs in 73.62 hours. By dividing the benchmark hours into the actual hours consumed, the efficiency rate is established at 1.13. Thus, for every 1 physical hour consumed, the technicians are selling 1.13 hours in revenue claims.

A technician's normal working hours amount up to 8 hours per day, including a lunch break of 1 hour. For calculation purposes we calculated the cost per technician on 7 hours. Please refer to Table 2 providing a cost analysis per technician.

Referring to Table 3, the average salary of the technician amounts to R12,500. Dividing the salary into the physical working days and hours, the technician is costing the company R89.29 per hour. Thus, on an efficiency rate of 1.13, the hourly rate decreases to R 79.01 per hour. This establishes a cost per minute of the technician at R 1.32.

Table 3: Cost per minute of technician (own research)

		Cost
Monthly salary	R12,500.00	Per month
20 Working days	R625.00	Per day
7 Working hours	R89.29	Per hour
Efficiency rate (ER)	1.13	
7 Working hours sold (ER)	R79.01	Per hour
Cost per minute on (ER)	R1.32	Per minute

Referring to Table 4: The hourly labour rate is the guaranteed revenue per hour. This revenue income is mainly paid by the warranty and after-sale plans underwriters. When a service plan has expired, this hourly rate will be absorbed by the consumer. Being a franchised dealership footprint, the costs are governed and need to be charged by the dealership. The labour rate per minute is calculated by converting the hourly labour rate into a minute labour rate by dividing the hourly rate into 60 minutes. Due to the efficiency rate being 0.13 above the benchmark, the technician will do more work within an hour. This means that the efficiency rate can increase or decrease the hourly rate. Calculating the actual rate per minute is done by multiplying the benchmark labour rate per minute with the actual efficiency rate. This can be calculated back to the actual hourly rate by multiplying the labour rate per hour (benchmark) with the efficiency rate. Using labour rate per hour multiplied by the available working hours provides the daily predetermined daily revenue per technician and by multiplying the predetermined daily revenue with the available working days in the month will provide the predetermined monthly revenue per technician. The technician salary is a fixed expense. The window of opportunity rests on the hourly labour rate versus the efficiency of the technician. Inversely, the opposite is also relevant to the calculation. The OEM provides a predetermined labour rate for the work to be conducted; it is currently averaged at R550 per hour. Calculating this, aligned with the current efficiency rate at 1.13, the technicians are providing the workshop with R621.50 per hour, R4,350.50 per day and R87,010.00 per month. Please refer to Table 4.

This leaves the current direct revenue per minute at R10.36. The technicians are indicating a time efficiency profit as per Table 5:

Table 4: Revenue per minute (own research)

		Revenue
Hourly labour rate (benchmark)	R550.00	Per hour
Labour rate per minute (benchmark)	R9.17	Per minute
Current efficiency rate (ER)	1.13	
Labour rate per minute	R10.36	Per minute
Labour rate per hour R 550 x 1.13 (ER)	R621.50	Per hour
R621.50 x 7 hours (ER)	R4,350.50	Per day
R 4,350.50 x 20 days (ER)	R87,010.00	Per month

Table 5: Profitability analysis (own research)

Labour cost per minute	R1.32
Labour rate per minute	R10.36
Labour profit analysis per minute	R9.04

Linking Table 5 to TDABC on the current efficiency rate;

- The technicians' predetermined cost per minute is R1.32,
- The technicians' predetermined revenue per minute is R10.36,
- Leaving a predetermined time efficiency profit at R9.04 per minute.

In conclusion, management can currently derive a predetermined time efficiency profit of R9.04 per minute on a time efficiency ratio of 1.13.

3.3 Reducing waste with Value Stream Mapping (VSM)

The focus of the VSM graph will be on a diagnostic process followed. The VSM will thus only consist of the time data of the diagnostic process and the VSM will then be re-engineered to the proposed procedure to follow. Refer to Table 6 for a basic outset of the value stream of Anonymous Motor Group's workshop. Note that all the lead and completion times are not filled in due to information being obsolete for the purpose of this research. The current process starts with the pre-picking of parts, the physical booking in of the vehicle, the technician retrieves the vehicle from the parking bay and diagnostics are conducted, if applicable additional parts are picked, repairs are conducted, vehicle is cleaned and lastly the vehicle is released to the customer. There is a lead time of 2 hours during diagnostics because vehicles remain in parking bays without any attention being paid to it.

Table 6: VSM with diagnostics as focal point (own research)

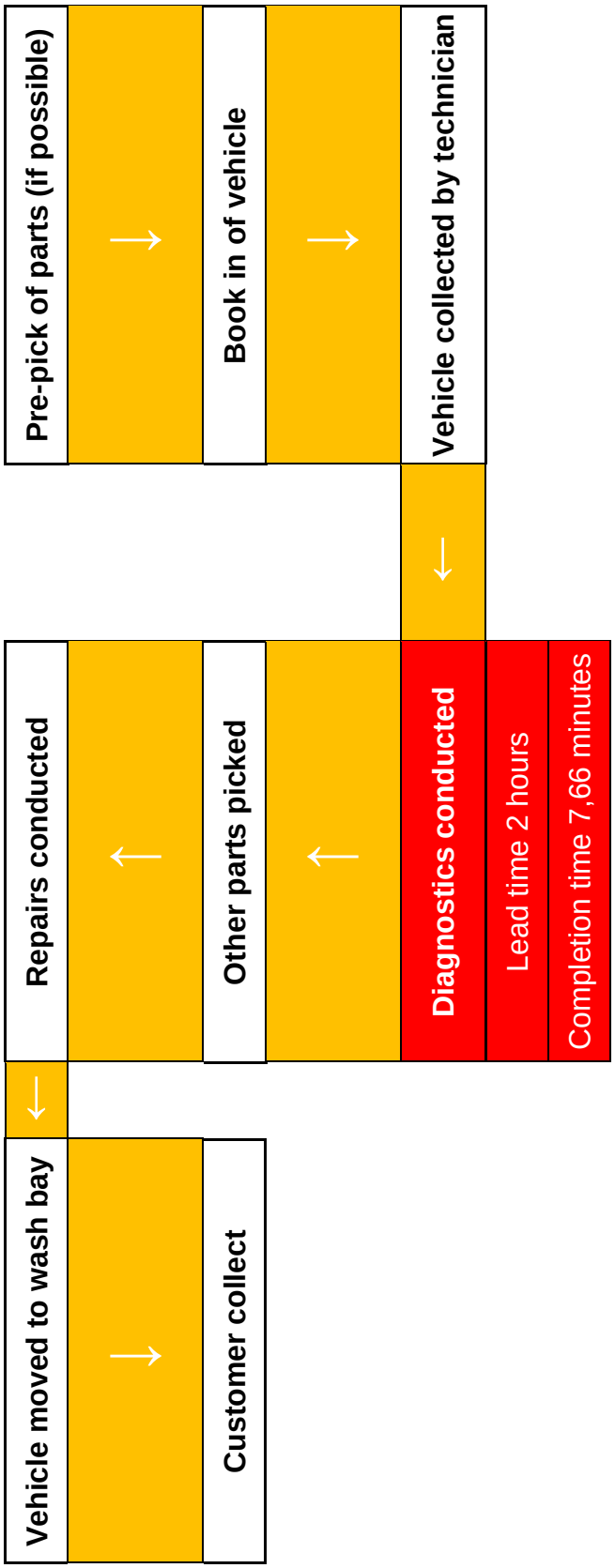
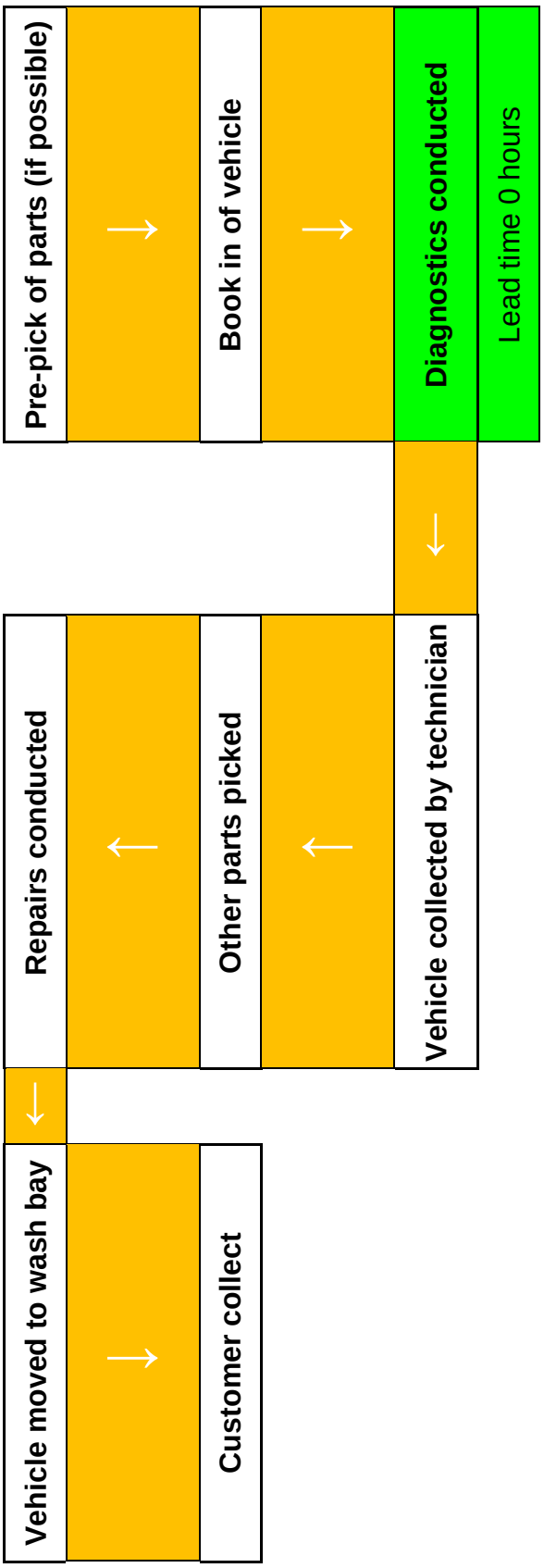


Table 7: Revised VSM with diagnostics as focal point (own research)



In Table 7 everything remains the same, however the diagnostic process is moved one step earlier. This eliminates the 2-hour lead time because the diagnostics can be conducted immediately even though the repairs on the other vehicles continue. This increases the technicians' time availability empowering them to complete jobs 7.75 minute quicker. Note that the OEM benchmarked time starts as soon as they clock in before collection of the vehicle in the parking bays. The lead time is mainly due to current work in progress that needs to be completed before an open working bay is available to lift the next vehicle; this can be compared to a waiting area of a medical doctors' practice.

The diagnostic process is calculated within the available benchmarked time; however, diagnostics are done by making use of the OBD (On-Board Diagnostic system) port and a diagnostic device detecting fault codes from the vehicle's on-board computer. This does not need to be done by the technician themselves, but can be completed by the service advisors or alternatively a specialised diagnostic employee.

3.4 TDABC applied to revised Value Stream Mapping

3.4.1 Revisited cost / Revenue calculation per technician

After the revised value stream mapping, the proposed time-efficiency calculation per technician as per table can be found.

Table 8: Revised time efficiency calculation (own research)

Benchmark hours to complete jobs	83.08	
Hours consumed to complete jobs	65.86	
Benchmark / Consumed	1.26	**Efficiency Rate**

Referring to Table 8, the post VSM intervention indicated that time-efficiency of the technician will improve to 1.26 from the current 1.13 efficiency rate. The revenue per hour and expenses remained fixed thus the technician will increase the revenue potential per hour resulting into increased profitability.

Table 9 calculates the cost per technician with the current efficiency rate noted. The table confirms that the monthly salary per technician and working days remained constant. The revenue per hour is 89.29 with the cost per technician calculated at

R70.86. The post efficiency rate of the technician results into the cost per technician per minute decreasing from R1.32 to R1.18 per minute.

Table 9: Revised cost per minute of technician (own research)

Monthly salary	R12,500.00	Per month
20 Working days	R625.00	Per day
7 Working hours	R89.29	Per hour
Efficiency rate (ER)	1.26	
7 Working hours sold (ER)	R70.86	Per hour
Cost per minute on (ER)	R1.18	Per minute

Table 10 calculates the potential revenue per minute after the intervention. The hourly labour rate and labour rate per minute (benchmark) remained constant. The post ER is calculated into the equation. The revised ER influences an increase of 11.4% leaving a revenue increase of R11.55 per minute, R693.00 per hour, R4,851.00 per day and the total revenue per month increased from R87,010.00 to R97,020.00 per month. This calculation is relevant to every technician.

Table 10: Revised revenue per minute (own research)

		Revenue
Hourly labour rate (Benchmark)	R550.00	Per hour
Labour rate per minute	R9.17	Per minute
Post efficiency rate (ER)	1.26	
Labour rate per minute	11.55	Per minute
R550 x 1,26 (ER)	R693.00	Per hour
R62150 x 7 hours (ER)	R4,851.00	Per day
R4,350.50 x 20 days (ER)	R97,020.00	Per month

Table 11 constitutes the revised profitability analysis of the post VSM intervention. The average efficiency rate is predetermined to increase by 11.50% from 1.13 to 1.26. The predetermined labour cost per technician decreased by 10.61% from R1.32 to R1.18. The predetermined labour rate per minute is influenced to increase by 11.49% from R10.36 to R11.55. This estimates the predetermined profit per minute (labour rate per minute minus labour cost per minute) to increase by 14.71% from R9.04 to R10.37 per revenue minute.

Table 11: Revised profitability analysis (own research)

Labour cost per minute	R1.18
Labour rate per minute	R11.55
Labour profit analysis per minute	R10.37

During the chapter an empirical study was conducted. The study evaluated the application of TDABC, calculating the cost per technician per minute and the labour rate per minute (revenue) accordingly. VSM was applied with the focus on the diagnostic process within the automotive workshop. The cost of the technician per minute and the revenue per minute are directly influenced by the change of the ER of the technician. During the study there was significant change in the ER of the technician when the diagnostic process followed changed. The ER increased by 14.71% increasing the predetermined profit per minute by 11.49%.

The workshop currently makes use of the labour of 6 technicians. The calculations were conducted from their historic averages using real world figures. After the VSM process with the diagnostics changed to one step earlier, it indicated a positive change on the ER by 14.71% per technician increasing the profitability of the technician per minute from R9.04 to R10.37 per minute. This change of process has the potential to increase the total profit of the workshop (R97,020.00 – R87,010.00 x 6 technicians) by R60,060.00 per month and R720,720.00 annually.

3.5 Chapter summary

During this chapter we have determined the average efficiency rate, the cost per technician and the revenue of technicians calculated at the current ER making use of TDABC. After this, information was calculated and a pre-profit analysis was conducted on the data received. The study intervened with the lean principle of VSM with the aim to identify waste by eliminating non-value added / optimised processes. The focus was on the diagnosing of the vehicle as for it had a significant lead time. The study indicated that by moving the current diagnostic process followed one step earlier effective improvements to the profitability of the workshop can be made.

During the following chapter the study aims to answer the research questions and evaluate whether the objective set was reached. A final conclusion is composed with

the help of the data of the empirical study. The limitations of the study are identified and future recommendations are made for future research.

CHAPTER 4 - FINDINGS, CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

The study followed the process of Anonymous Motor Group's operation process with the diagnostic procedure pivotal point. The following has been concluded and recommendations are made to Anonymous Motor Group for further contemplation.

With the integration of Time-Driven Activity-Based Costing, the forecasting, direction and judgements can be more effectively and consistently evaluated within the Group. Opting to integrate TDABC as a management tool may provide management with accurate predetermined cost and revenue calculations which will provide profit analysis (Chapter 3, Tables 5 and 11). The study mutually integrated VSM as a continuous evaluation framework that can enable the workshop to continually improve processes by eliminating non-value added processes being followed. During this study lead time was identified during the diagnostic process that was followed. Lead time that can be avoided or minimised is seen as waste and if this can be prevented it will lead to increased profits or a more attractive value proposition for consumers (Chapter 3, Tables 6 and 7). In the competitive automotive industry it is of utmost importance to have proper profitability calculation tools and to continually challenge the status quo of the business. This will keep management alerted, informed and critically trying to improve the business operations.

The primary research question of the study considers whether management tools such as TDABC and VSM may provide management with accurate profitability analysis of technicians and the possible identification of waste during processes. Building further on the question was whether pre-diagnostics would increase the average efficiency rate of the technicians. For this study the current diagnostic process was evaluated with the diagnostic procedure as focal point, trying to identify waste. The fixed cost to company of the technician was the basis for the cost per minute calculation and the chargeable labour rate was the driver for the revenue per minute calculation. Both the bases are fixed and directly influenced the efficiency rate of the technicians.

The research questions were answered and by referring back to Chapter 3, the integration of TDABC and VSM will indeed provide a management with tools to predetermine profitability of technicians and to identify waste within the workshop. Pre-diagnostics will indeed increase the average efficiency rate of technicians within the workshop.

4.2 Research objectives – Results

The current cost and revenue per minute were determined by making use of the data received from the workshop manager. The major influence on the efficiency rate was due to the lead time before diagnostics; the technician personally conducted the diagnostics once the vehicle is clocked, thus there is ample time to conduct the diagnostic before the technicians' time commence on the vehicle. This decreased the potential efficiency rate achievable. With the objective of VSM identifying waste, the study restructured the current diagnostic process followed and recalculated the efficiency rate which indicated a significant increase. This directly increased the profitability of the technician per minute.

- Primary objective: The primary objective of this research was to evaluate the impact on the efficiency rate if diagnostics were shifted prior to the technician actually start working on the vehicle and whether this will improve the efficiency rate of the technician and if so, what the impact on the profitability analysis will be. For the research to achieve its objective it was built on two management tools namely:
    - TDABC was used to determine the actual cost and revenue per technician by evaluating the current diagnostic process followed. The data retrieved from the workshop manager indicated that the OEM allocated 83.08 hours to complete the variety of work. The technician completed the work in 73.62 hours. By dividing the hours allocated by the actual hours consumed, an ER of 1.13 per technician was calculated (Chapter 3, Table 2, p.36). The average cost to company of the technician forms the basis of the cost per technician calculation. On the ER of 1.13 the cost per minute of the technician was calculated at a rate of R1.32 (Chapter 3, Table 3, p.37). The revenue per minute was calculated by the benchmark labour rate provided by the OEM's.

Integrating the ER provided, technician revenue per minute rate of R10.36 was calculated (Chapter 3, Table 4, p.38). The profitability analysis then calculated the profit per minute by deducting the cost from the revenue per minute, the current labour profit per minute was calculated at a rate of R9.04 per minute (Chapter 3, Table 5, p.38).

  - Two value stream maps were drawn with the focal point being diagnostics. The first map (Chapter 3, Table 6, p.39) indicated a lead time of 2 hours with the initial diagnostics consuming 7.75 minutes from the technician. As soon as the technician clocks on to the vehicle, the time starts. During the VSM process (Chapter 3, Table 7, p.40) the map merely suggest to move the diagnostic process one step earlier. The map eliminates waste by removing the lead time whilst the process still consumes 7.75 minutes to complete.
  - After the VSM a post ER calculation was conducted. The hours allocated by the OEM to complete the work remained the same however the diagnostic process is suggested to move prior to the collection of the vehicle with this being possible because of the lead time. This will reduce waste and concurrently prove to increase the ER rate of the technician to 1.26.

- As a result TDABC and VSM were integrated into the workshop process. With the focal point on diagnostics it is suggested to improve the following KPI's:
    - Efficiency rate by 11.5% from 1.13 to 1.26.
    - Reduce the technician cost per minute by 10.61% from R1.32 to R1.18.
    - Increasing the technician revenue per minute by 11.49% from R10.36 to R11.55.
- Building on the research objective the study indicates that pre-diagnostics can increase the technician profitability per minute by 14.72% - from R9.04 to R10.37.

TDABC can provide management with an effective management tool to manage daily key performance indicators and estimates by providing the predetermined cost and revenue averaged against the particular workshop's technician ER rate. Management can simply calculate the revenue vs. the cost to determine a direct gross profit per

technician per minute, day or month. This can be used as platform to set logical targets and objectives moving forward. The objective of calculating the profitability was achieved by making use of TDABC and VSM during the diagnostic process of the identified workshop.

In order to successfully complete the empirical study, data was requested from workshop management regarding the time allocation relating to work that needed to be completed during actual repair scenarios. The time used to conduct the diagnostics was recorded and the average was established. The results proved to make a positive difference.

4.3 Research Synopsis

The study highlight the importance of empowering management with tools to make informed decisions and to support lean thinking. The management tools suggested integration between TDABC and VSM. A brief background about the automotive industry was provided, stressing the importance of the after-sales departments' contribution to overall profitability throughout Chapter 1. The primary objective however was to establish if there is a way to eliminate waste during the diagnostic process by making use of time-driven activity and value stream analysis integrated frameworks. Supporting the primary objective, the study was to calculate the technician profitability by making use of TDABC and also determine if pre-diagnostics will make a positive difference to the efficiency rate of technicians. The approach of the research was established by conducting a comprehensive literature review followed by an empirical study.

The fundamentals of the empirical study were merged between the theory of ABC where the concept was explained and the advantages and disadvantages highlighted. ABC was founded by Robert Kaplan and Robin Copper during the 1980's to improve cost allocation of traditional costing methods. The study focused on the dimension of TDABC because of the advantages it proved by simplifying the calculation process. TDABC allocates costs to processes linked to the time it takes to complete. TDABC eliminates the constraints during the initial ABC approach by making it easier and cost effective to implement. Alongside with TDABC as the costing method it compliments VSM. VSM is a dimension of lean management which is synonym with the Toyota

production process. Toyota introduced lean thinking into its operational practices and was soon adopted by numerous companies. One dimension to ignite lean thinking is by means of a value map being drawn with the aim to eliminate waste and improve working procedures. VSM visually depicts the current process providing management and floor staff to critically evaluate the status quo with the aim to eliminate non-value added process. The VSM is easy to start up however objectivity is the key for it to really add value.

The study involved Anonymous Motor Group's workshop facilities. During the study the demand for time efficiency was stated due to the competiveness of the automotive industry. The focus of the empirical study was to determine the current efficiency rates of the technicians. The efficiency rates of the technicians directly influence the cost and revenue resulting into improved or declined profitability. The focus of the empirical study was on the current diagnostic process followed and whether the mere shift of the diagnostic process can increase the efficiency rate of the technicians. Pre-diagnostics were applied to the TDABC cost and revenue calculation. The pre-diagnostics positively influenced the efficiency rate of the technicians resulting to improved profitability.

Chapter 4, being the concluding chapter, highlights the key findings and recommendations were provided. The research question, approach of the study and the objectives were answered, explained and final recommendations were provided.

4.4 Recommendations

Considering the findings of this study it is evident that, if management is provided with tools, they will be able to improve and measure performance more accurately and by challenging the status quo of operations they can lever significant results by making small amendments.

The concept of ABC can add value to company costing methodologies, however due to the barrier of implementing the method, the study rather suggests considering TDABC. TDABC, the addition to ABC, should be integrated into the current ERP system, and these two structures should run mutually to provide management with improved key performance dashboards that provide reliable and current information. When costs can be accurately allocated it is very important to identify non-value added

processes and to reduce waste. VSM should therefore be a further practise performed on set dates. This will enable management with insight from brainstorming sessions, involving relevant individuals to improve the current processes. Improving current processes can add a value proposition gaining market share from competitors and also improve profit ratios.

The challenges that these management tools pose are firstly that accurate data has to be provided to calculate reliable figures. Further, during the process evaluation it is important to be unbiased, which really challenges the processes. If accurate data is received and objectivity to improve business is present, a merged TDABC and VSM structure can add value to business operations.

4.5 Limitations of this study

During the completion of this study, data was received from a workshop manager. This information is anticipated to be a true reflection of the relevant data needed. The data retrieved was not based on statistical information and the sample was too small to determine the extent to which the costing method VSM will contribute to the business. For the purpose of this study there were no future inflation, currency fluctuations or labour increases noted thus labour rates and salaries may differ in the future. During the study it was also assumed that all vehicles were booked in on exactly the right time and there was no delay from consumers' sides. Lastly, there might be circumstances when it will be needed to action an additional diagnostic procedure to verify if the faults were rectified accurately.

4.6 Recommendations for future research

This study opens the window of opportunity for future research:

- The impact of diagnostic mobile applications on the efficiency of an automotive workshop.
- The impact of comprehensive value stream mapping on the process of an automotive workshop improving efficiency rate.
- The integration of TDABC to allocate general admin costs to end service or product profitability.

APPENDIX

01/06/2015

To: The Workshop Manager

Data for MBA Mini-dissertation

Good day Sir,

As per our meeting held on 29th of May 2015, I will like to record our meeting and the contents thereof accordingly:

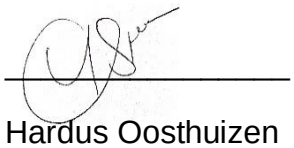
My name is Hardus Oosthuizen (student no: 22686967) I am a 3rd year MBA student at the North university. II require confidential data regarding your current operations and financial information to complete my mini dissertation due in November 2015. I hereby agree that the company will remain anonymous and no individual will be identified.

As per your confirmation meeting held today, we have agreed that you will supply with the following information on or before the 24 of July 2015.

- The average time for allocation diagnosis to each relevant case?
- The physical time taken by the technicians to complete the diagnosis process?
- The number of technicians taken into account?
- The average efficiency rate of the technicians?
- The average salary per technicians?
- The average labour rate as provided by the OEM's?

Once again thank you for your time and willingness to assist me. I truly believe that I will provide you with positive feedback,

Kind Regards



Hardus Oosthuizen

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