# Evaluating the success of Total Productive Maintenance at Faurecia Interior Systems

By

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## Declaration

"I, John Cornelius Jacobus Faber, hereby declare that:

- This work has not been previously accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.
- This dissertation is being submitted in partial fulfilment of the requirements for the degree of Masters in Business Administration.
- This dissertation is the result of my independent work/investigation, except where otherwise stated. Other sources are acknowledged by complete referencing. A reference list is attached.
- I hereby give consent for my dissertation, if accepted, to be available for photocopying and for interlibrary loan, and for the title and summary to be made available to outside organisations."

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Date: 20th November 2009

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## Abstract

Manufacturing processes should operate at optimal levels in order to remain competitive in current economic environment. The optimal manufacturing performance can be achieved by overall equipment efficiency which is also a measurement for Total Productive Maintenance (TPM). The successful implementation of TPM has been evaluated at Faurecia Interior Systems. The research consisted out of a literature review into the elements and benefits of TPM. A questionnaire was sent to all operator level personnel at Faurecia Interior Systems to establish their views on the implementation level of TPM at the East London site. In conclusion, this research paper has also led to the development of recommendations which should improve TPM at the site.



*Keywords:*

Total Productive Maintenance, Total Quality Management, Continuous Improvement.

## Table of contents

**Chapter 2: The history and elements of TPM**

**Chapter 3: Research design and methodology**

**Chapter 4: Research findings**

**Chapter 5: Conclusion and recommendations**

## List of figures

**List of tables**

# CHAPTER 1

# INTRODUCTION AND PROBLEM STATEMENT

## 1. Introduction

Manufacturing systems have become increasingly complex with the introduction of new technologies and are more costly to operate and support. The manufacturing system is often operated at less than full capacity, resulting in low productivity and high operating costs. The cost of operating and maintaining equipment has become a significant factor in the production of goods in an increasing competitive international environment. Researchers (Blanchard, 1997:69; Campbell & Reyes-Picknell, 2006:xviii) reported that the direct maintenance cost in a manufacturing enterprise could vary between five and 15 percent of the total operating cost, depending on the capital intensiveness of the business.

This article, written by Blanchard et al (1997) estimates that typical factories overall equipment effectiveness (OEE) is only 45 percent. According to Venkatesh (2007:5), OEE is a function of equipment availability or uptime, performance efficiency and rate of quality output, and is also used as a measurement for Total Productive Maintenance (TPM). The efficient and effective use of equipment in the manufacturing industry is a major contributor to the performance levels of the production function and the success of organization as a whole (Campbell & Reyes-Picknell, 2006:3-39)

The objective of TPM is to maximise the overall equipment efficiency by taking advantage of the abilities and skills of everybody in the organization. The result of TPM is to establish a complete maintenance system and improve the skills and knowledge of the shop floor operators (Campbell & Reyes-Picknell, 2006: 271-286).

### 1.1 Problem statement

The motor vehicle industry had a profound impact on society (Van der Wal, 2007:1-18) and through competition the manufacturing practices such as craft and mass production were replaced by lean manufacturing practises (Womack, Jones & Roos, 1990).The motor vehicle industry is competing on factors such as technological innovation, product reliability, quality, flexibility, time, information management and price. (Madu, 2000:937).

Lean manufacturing is a time–based strategy (Stevenson, 1996:53-59) where TPM is used as a tool for enabling effective flow of materials through the manufacturing process (Pieterse, 2006:33).

TPM is a world class improvement strategy, similar to lean manufacturing, six sigma and the theory of inventive problem solving (TRIZ), according to Bicheno (2006:11).

The TPM objectives include:

- achieving Zero breakdowns, Zero defects and Zero accidents in all functional areas within the organization;
- involving personnel from all levels of the organization; and
- Forming teams to reduce defects and perform self maintenance (Venkatesh, 2007:4).

The Faurecia Excellence System (FES) is derived from the Toyota Production System (TPS) which strives for continuous improvement in all business objectives including TPM objectives.

The researcher would like to determine if the Faurecia-implemented TPM methodology holds any benefit for the organization. This question leads to the main problem statement of this research paper:

**Evaluating the success of Total Productive Maintenance at Faurecia Interior Systems.**

## 1.2 Statement of sub-problems

- What does the literature reveal about TPM?
- Has the introduction of TPM resulted in reduced downtime at Faurecia Interior Systems in the Eastern Cape?
- Has the introduction of TPM resulted in improved OEE at Faurecia Interior Systems?
- Has TPM increased personnel involvement at all levels at Faurecia Interior Systems in the Eastern Cape?

## 1.3 Objectives of the research

The objectives of this study are:

- to identify the elements of TPM and guideline for overall performance;
- to establish how TPM can benefit the organization; and
- to determine which TPM targets have been achieved at Faurecia Interior Systems in the Eastern Cape.

## 1.4 Delimitations of the research

The research is limited to the following area:

### 1.4.1 Organization to be researched

This research paper will be limited to the TPM activities at Faurecia Interior System East London site, in the Eastern Cape.

### 1.4.2 Level of management

The research will be limited to the operator (shop floor employee) level employees.

## 1.5 Definition of concepts

1.5.1 Autonomous maintenance

Autonomous maintenance includes routine maintenance, preventative and predictive maintenance carried out by the operators, with or without assistance from the trade's person (Campbell & Reyes-Picknell, 2006:324).

1.5.2 Efficiency

Efficiency in this study refers to the ratio of useful work done to total energy expended (Fowler and Fowler, 1980:330).

1.5.3 Just-in-time (JIT)

It is a visual system, driven by Kanban, which signals the preceding step in the operation to supply material to the next step in the operation only once needed (Bicheno, 2004:107).

1.5.4 Lean Manufacturing

Lean manufacturing can be defined as a five step process which:

- defines customer value;
- defines the value stream;
- makes it flow;
- pulls from the customer; and
- strives for excellence (Womack &, 2003:19-26).

### 1.5.5 Productivity

Productivity is an index that measures the output (goods and services) relative to the input (and, material, equipment, and energy, labour) (Stevenson, 1996: 40).

### 1.5.6 Reliability–centered maintenance (RCM)

RCM is an analysis and decision-making method for determining the most appropriate policy for any asset in its present operating condition (Campbell & Reyes-Picknell, 2006:224-249).

### 1.5.7 Total productive maintenance

Total productive maintenance describes a synergistic relationship between all organisational functions, particularly between production and maintenance, for continuous improvement of product quality, operational efficiency, capacity assurance and safety (Jostes & Helms, 1994:18-20).

### 1.5.8 Total quality management (TQM)

Total quality management is a philosophy that involves all levels of an organization in its quest for quality, with customer satisfaction being the driving force. TQM encapsulates the philosophy of quality at the source whereby each worker is responsible for the quality of their work (Stevenson, 1996:101-103).

Total Quality Management is process driven with the interaction between people and the organisations resources, to continuously improve and serve the needs of the customer (Bounds, Bobbins & Fowler, 1995:19).

### 1.5.9 5S

The 5s is a basic housekeeping discipline for lean, quality and safety, (Bicheno, 2004:52) which is equally applicable to office and factory areas.

The 5s activities are performed by the personnel working in that area and consist out of the following steps:

Sort

The items need to be sorted into their different frequencies of use. Items not used must be red tagged to be thrown out, recycled or auctioned.

Straighten

Locate what is used in the best place, making use of shadow boards, inventory footprints, the right height and colour matching to link associated tools, inter alia, locate a place for everything and everything in its place.

Shine

Cleaning is checking which sees that operators are on the lookout for anything out of place and to correct it immediately. Operators are designated specific responsibilities during the cleaning process and the standard is known.

Standardise

Develop systems and procedures to maintain and monitor the three 5s.

Sustain

Everybody participates in 5s on an ongoing basis. Self–discipline is about participation and improvement.

## 1.6 Significance of the research.

The increased trend for globalisation, new technology changes (Hill, 2005:9-16), time-based manufacturing strategies and world class manufacturing practices are creating higher levels of competitiveness between organisations.  Higher levels of productivity and efficiency are, therefore, required to stay competitive.

The research paper aims to gain insight into the impact of TPM on the manufacturing performance of Faurecia Interior Systems which supplies interior trim components to all the original equipment manufacturers (OEM) in South Africa.

The research would also be useful for:

- comparing the results of TPM implementation among other motor vehicle manufacturing organisations;
- top management who use TPM to measure productivity, employee development, quality improvement and organisational change;
- autonomous maintenance teams who focus continuously on improving their processes;
- teams and team leaders who determine the implementation level and new areas of focus for improvement; and
- trainers who compare the comprehensiveness of current training materials and to make improvements.

## 1.7 Research methodology

The study comprises of a literature and empirical study.

### 1.7.1 Literature study

The literature study was performed to establish the key concepts related to the topic of TPM.

The information on the theory of TPM will be collected from secondary sources which include:

- text books and other published materials which are directly related or indirectly related to the topic; and
- on-line databases. (Collis & Hussey, 1997:88-103).

### 1.7.2 Empirical study

An empirical study is the use of the sense-data as valid information which is based on observation or experiment and not on theory (Fowler et al, 1964:339). "If it exists then it must be measured." Numbers need to be assigned to the data to make it measurable and through measurement, the data can be inspected, analysed and interpreted (Newby & Ertmer, 1997:24-30).

The empirical study consists of:

- observations, interviews and surveys (questionnaires) (Newby et al, 1997:189-202) at Faurecia Interior Systems Eastern Cape.

The observations, interviews and surveys would enable the researcher to:

- make direct contact with the management team, team leaders, team members and maintenance technicians to establish their expectations of TPM; and
- observe the activities that support the effectiveness of TPM.

## 1.8 Key assumptions

The key assumptions are that the literature study, combined with the results of the empirical study, will provide insight into the impact of TPM at Faurecia Interior Systems and identify areas for improvement.

## 1.9 Contents of the final report

The research paper is arranged as follows:
Chapter 1: Introduction and problem statement
Chapter 2: The history and elements of TPM
Chapter 3: Research design and methodology
Chapter 4: Research findings
Chapter 5: Conclusion and recommendations

## 1.10 Summary

In this chapter, the researcher sketched the manufacturing environment and questions the effectiveness of the implementation of TPM at Faurecia's East London site. Key definitions and an overview of the construct of research paper were also presented.

# CHAPTER 2

# THE HISTORY AND ELEMENTS OF TPM

## 2 Introduction

In chapter 1, the researcher introduced the reader to the problem and sub-problems which need to be investigated to establish if TPM holds any benefit for the organization. In chapter 2, the concept of TPM will be examined as well as the benefits, inter alia, to reduce product cost, improve quality, shorten lead times, and improve equipment reliability and maintainability (Suzuki, 1992).

## 2.1 Definition of TPM

According to Shirose (1992:16), the following points are central to the TPM definition:

- TPM aims at getting the most efficient use of equipment.
- It establishes a company-wide preventative maintenance (PM) system which consists of maintenance prevention, and improvement related maintenance.
- It requires the participation of equipment designers, equipment operators and maintenance department workers.
- It involves every employee from top management down.
- It promotes and implements PM, based on autonomous, small group activities.

## 2.2 TPM activities

The six TPM major activities are:

- The elimination of the six big losses (refer to section 2.15) by a project team. The team would consist of members from production, maintenance and plant engineering department: Problems are eliminated through innovative approaches, based on zero-oriented concepts.
- Planned maintenance which is conducted by the maintenance function through the use of a maintenance system which assists the TPM implementation activities: The purpose of implementing a maintenance system is to reduce variability of part life, extend part life, periodically restore deteriorated parts and predict part life.
- Autonomous maintenance activities which are performed by the operators with the assistance of the maintenance artisans: The objectives would be to establish basic equipment condition (cleaning, lubricating and tightening), observe usage condition of the equipment, restore deteriorated parts through overall inspection, develop a knowledgeable operator and to conduct autonomously operator supervised routine maintenance.
- Preventative engineering which is carried out by the engineering department: Equipment reliability, maintainability, operatibility and safety issues will be considered during the equipment procurement process.
- Easy-to-manufacture product design which is carried out mainly by the product design department: The ease of product manufacturing and quality assurance must be built in during the design stage.
- Educate operators to develop skills and knowledge to perform all the required aspects of TPM (Tajiri & Gotoh 1999:16-21).

## 2.3 TPM objectives

TPM was introduced to achieve the following objectives:

- to avoid waste;
- to produce goods without compromising product quality;
- to reduce cost;
- to produce small batch quantities; and
- to only supply defect-free products to the customer (Venkatesh, 2007).

## 2.4 TPM philosophy

The TPM philosophy includes the following principles:

- Change the mindset of the operators from “I run it, you fix it” by creating the feeling of ownership and responsibility for their equipment: Alert the operators’ senses to touch, sound and sight which should make them more aware of abnormalities in their equipment like noise, vibration and heat.
- Improve the character of the equipment with the aim of eliminating equipment-related losses.
- Improve the quality of people and equipment which naturally improves the organisation (Suzuki, 1992)

## 2.5 The origins and development of TPM

TPM had its origins in the Japanese automotive industry in 1970. It started at Nippon Denso which was a major supplier to the Toyota Car Company and integral to the new Toyota Production System. The belief was that TPM only incorporated Total Quality Control (TQC), Just-in-Time (JIT) and Total Employee

Involvement (TEI). Seiichi Nakajima was accredited for the development of TPM by the Western world, once an English publication on this topic became available in 1970.

During the introduction of the Toyota Production System at Toyota in Japan, buffer stock between major pieces of equipment had to be reduced to shorten lead times and improve quality (Kennedy, 2006).

Individual equipment problems affected the whole process because buffer stock was no longer available between machines. The availability of the process became the product of the availability of the individual pieces of equipment. The quality approach of "prevention at source" was translated to the maintenance function through the concept of TPM. This resulted in superior availability, reliability and maintainability of equipment but also significantly improved capacity with a substantial reduction in both maintenance and operational costs (Kennedy, 2006).

The operators were tasked to perform routine maintenance, also called autonomous maintenance, while the maintenance group performed essential equipment modifications for improving reliability which led to maintenance prevention. Thus, preventative maintenance, along with maintenance prevention and maintainability improvement, gave birth to productive maintenance (Venkatesh, 2007).

## 2.6 World class manufacturing and TPM

World class manufacturing is used to describe organisations which achieve a global competitive advantage through the use of its manufacturing capabilities as a competitive strategy. World class manufacturing focuses on speed, cost, quality, customer satisfaction and supply-partnership (Pieterse, 2005:2).

World class manufacturing principles encapsulate Just–In-Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), employee involvement and simplicity of operations (Mahadevan, 1998:645).

**2.7 TQM and TPM**

TPM closely resembles the Total quality Management (TQM) program. The same elements such as continuous improvement; competitive benchmarking, employee empowerment (Campbell & Reyes-Bicknell, 2006:273-280) and a team approach underline both programs (Stevenson 1996:102).The similarities are:

- Total commitment is required from all levels of the organization for both the programs. A decentralized, team-based approach (Campbell et al., 2006:267-269), with operators having a common mission, is followed and creates highly productive outputs.

  The operators are trained in the criteria of judging normal and abnormal conditions, strict enforcement of the condition management rule and the quick response to abnormalities (Shirose, 1992: 91).

- Employee empowerment grants operators autonomy with responsibility (Campbell et al., 2006:273) and decision making authority (Schultz et al., 2003:148). Empowerment refers to a change strategy with the objective of improving both the individuals and the organization ability to act (Schultz et al., 2003:151).

**2.8 Lean manufacturing and TPM**

The Toyota Production System forms the basis for lean manufacturing (Liker, 2004:07).

The focus of lean manufacturing is to eliminate waste which includes:

- Muda: -None value- added activities that lengthen lead times, extra movements for getting parts or tools, create excess inventory, or result in any waiting.
- Muri: Overburdening people or equipment beyond natural limits. In the case of people, this may result in safety and quality problems. In the case of equipment, the results could be breakdowns and defects. Lean implementation cannot be successful with high levels of breakdowns and therefore TPM should be regarded as an integral part to lean manufacturing (Bicheno, 2004:56).
- Mura: Uneven results from an irregular production schedule or fluctuating production volumes due to downtime or missing or defective parts (Liker, 2004:114).

Machine breakdowns delay the conversion process of raw material to finished goods which lengthens the lead time between an order and actual supply. This may also create a bottle-neck inventory in front of the broken down machine which are wasteful activities that need to be eliminated. Machine breakdowns can be avoided by operating the equipment within the boundaries of its design and maintenance requirements (Bicheno, 2004).

### 2.9 Toyota Production Systems (TPS) and TPM

The Toyota Production System is driven by four tools and techniques which include:

- A long-term philosophy, driven by top management, which establishes a learning organization through continuous improvement efforts.
- The right process will produce the right results. The ideal of one–piece flow results in the best quality, at the lowest cost, with high safety and morale. TPM is a lean tool that enables flow (Bicheno, 2004:50-60).

- Add value to the organization by developing the people and partners. The Toyota way includes a set of tools that are designed to support people continuously improving and developing.
- Continuous problem solving drives organization learning (Liker, 2004: xvii).

### 2.10 Different maintenance strategies

Three maintenance strategies can be used individually or in combination with others:

2.10.1 The asset-centric method is a proactive approach which focuses on improving the reliability of the physical asset in order to obtain more uptime through reliability centered maintenance (RCM), preventative maintenance (PM) and predictive maintenance.

2.10.2 The team-based methods like TPM focus on higher people performance which in turn gets more from the assets.

2.10.3 The process-centric methods refer to the process or maintenance system (Campbell et al., 2006:219).

Reactive maintenance is performed on equipment only after it has failed and is restricted to non-critical operations where failure will not influence the safety, environment or business performance (Campbell et al., 2006:119-120).

## 2.11 The different types of maintenance

Total maintenance systems include maintenance prevention (MP), maintainability improvement (MI), preventative maintenance (PM), and a maintenance plan for the equipment's entire life span. MP translates into maintenance-free design which is pursued during the equipment design stage. It translates into repairing or modifying the equipment to prevent breakdowns and to facilitate the ease of maintenance (Kister & Hawkins, 2006).

### 2.11.1 Preventative maintenance (PM)

Preventative maintenance (PM) is the set of tasks that are carried out in accordance to the recommendation of the equipment supplier and ensures that the equipment will not breakdown if the maintenance tasks are performed correctly.

The equipment supplier's recommended maintenance schedule is generic by nature and may result in some parts being under-maintained and others being over-maintained (Borris, 2006:299).

### 2.11.2 Reliability centred maintenance (RCM)

Reliability centred maintenance (RCM) is a set of tasks, generated on the basis of a systematic evaluation, that are used to develop or optimise a maintenance program. This maintenance system incorporates decision logic to ascertain the safety and operational consequences of failures and identifies the mechanisms responsible for those failures (Borris, 2006).

RCM techniques are more encompassing and hence a broader spectrum of potential failure conditions can be considered. Therefore, more maintenance options may be exposed (Borris, 2006).

RCM was developed from the design stage but can also be used after the asset has been installed to redevelop a failure management program.

The following techniques are used to strive for continuous improvement and reduction in maintenance failures:

- Performance management optimisation (PMO) is applicable to existing maintenance programs which evaluate the effectiveness and comprehensiveness of the current program and rearranges the results for effective use.
- Root cause failure analysis (RCFA) makes use of the “5 why’s” to establish the root cause of a failure and how the deficiency can be corrected in the design standard.
- Decision optimisation (Campbell et al., 2006:251-260).

### 2.11.3 Condition based maintenance (CBM)

Condition based maintenance, also known as predictive maintenance (PdM), is the ability to forecast the amounts of deterioration on a tool between different periods of use from the first time base check. The goal of any maintenance is to maximise the time between inspection, while ensuring that the tool, safety and the quality of the product is not compromised.

Unplanned breakdowns can be avoided by performing analysis and installing sensors for a specific purpose such as vibration sensors, particle counter, strain gauge, acoustic sensors, leak rate measures and flow meters (Borris, 2006).

## 2.12 Maintenance performance indicators

According to Campbell et al (2006:157-177), customer satisfaction is the best indicator and this priority exceeds market share and profitability. Productive maintenance should be measured from the customer's perspective and not solely from a cost perspective. The maintenance measurements can be grouped under the headings:

- Productivity: The comparison between input versus output which results in better equipment performance and is measured in production output terms.
- Equipment performance: It is measured by applying the standard formulation for availability, reliability, maintainability, process rate, quality rate and OEE.
- Cost performance: The maintenance cost items include, labour, materials, services, outside services, technical support and overheads, which are assigned to a specific area of the operation, a job or other expense types which can be assigned to key parts, consumables and services.
- Process performance: Maintenance management is a business process with cost inputs and equipment performance outputs. An optimal performance level needs to be established between these two variables. Process performance measures include: Maintenance spending as percentage of capital replacement cost, planned versus unplanned maintenance, PM schedule compliance, stores inventory turnover and stores stock-outs.

## 2.13 TPM targets

The TPM objectives for manufacturing organizations is to strive for improvement in productivity (P), quality (Q), cost (C), delivery or inventory (D),safety (S) and morale (M). It is abbreviated as PQCDSM (Tajiri & Gotoh, 1999:21).

Dennis (2006) identified four fundamentals business goals that need to be achieved in an organisation. These are:

- Profitability which can to be improved by cost reduction. This is attainable by increasing the throughput speed and improving the utilization rates;
- Delivery performance by building product to schedule, maintaining efficiency levels, machine availability and number of inventory days for the stock in plant;
- Customer satisfaction which can be achieved by reducing the quality cost, scrap rates, repair rates and defects per unit; and
- Employee satisfaction through the reduction of the quantity of accidents, absenteeism, labour turn over and the quantity of improvement ideas per employee implemented.

According to Venkatesh (2007), TPM targets contribute to the following results:

**Table 2.1: TPM targets**

| | |
|---|---|
| Motives of TPM | ▪ Adopting the life cycle approach for improving the overall performance of the production equipment.<br>▪ Improving the productivity of highly motivated workers which is achieved by job enlargement.<br>▪ Using voluntary small group activities for identifying the causes of failure, possible plant and equipment modification. |

| | |
|---|---|
| Uniqueness of TPM | The major difference between TPM and other concepts is that the operators are also involved in the maintenance process. |
| TPM objectives | ▪ Achieving zero defects, zero breakdown and zero accidents in all functional areas of the organisation.<br>▪ Involving people in all levels of the organisation.<br>▪ Forming different teams to reduce defects and self maintenance. |
| Direct benefits of TPM | ▪ Increasing productivity and Overall Plant Efficiency (OPE) by 1.5 or 2 times.<br>▪ Rectifying customer complaints.<br>▪ Reducing the manufacturing cost by 30%.<br>▪ Satisfying the customer needs by 100% (Delivering the right quantity at the right time, in the required quality.)<br>▪ Reducing accidents.<br>▪ Following pollution control measures. |
| Indirect benefits of TPM | ▪ Higher confidence level among the employees.<br>▪ Keeping the work place clean, neat and attractive.<br>▪ Favourable change in the attitude of the operators.<br>▪ Achieving goals by working as team.<br>▪ Sharing knowledge and experience.<br>▪ Horizontal deployment of a new concept in all areas of the organisation.<br>▪ The machine "ownership" is transferred to the workers. |

Source : Venkatesh (2007)

## 2.14 Measurements of TPM effectiveness

TPM increases:

- productivity;
- quality;
- optimises equipment life cycle cost; and
- broadens the base of every employee's knowledge and skill.

TPM performance is measured by establishing overall equipment effectiveness (Kister et al., 2006). Overall equipment effectiveness can be used on all types of equipment (Shirose, 1992). The importance of equipment and process performance on the bottom line results are recognised and these measures drive TPM and OEE which includes availability of equipment, performance rates and quality rates. A key objective of TPM is to cost effectively maximise overall equipment effectiveness through the elimination or minimisation of all losses (Kennedy, 2006).

### 2.14.1 TPM and teams

Although multi-skilling creates a flexible workforce, the experience indicates that motivation is lost because the operators do not stay long enough at one specific workstation to seek out basic equipment problems or defects which could lead to failures if left unchecked.

An area-based team approach promotes the development of base- and mastery-skills. It also encourages flexibility and ownership within the workplace. Correctly formed area-based teams create an environment where employees recognise the benefits of learning the correct method of operating their equipment and the best way of caring for their equipment by maintaining the basic equipment condition (Kennedy, 2006).

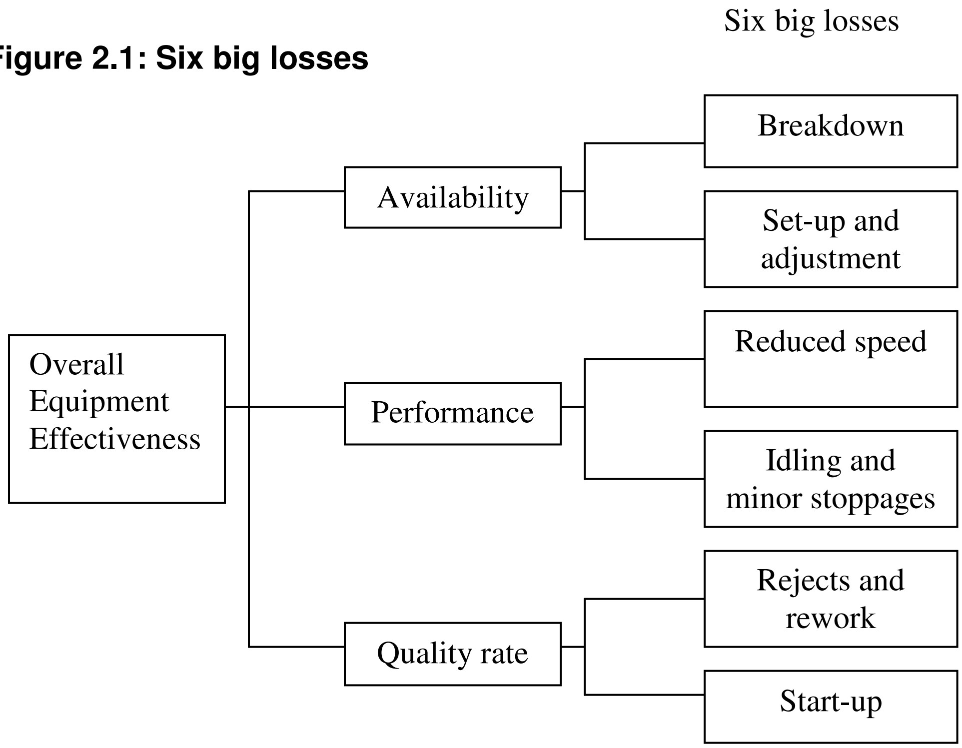
TPM is built around focal points which combine the concepts of continuous improvement, total quality and employee involvement:

- Activities that optimise overall equipment effectiveness;
- The elimination of breakdowns through thorough maintenance throughout the equipments' entire life span;
- Autonomous operator maintenance which does not imply that operators perform all maintenance;
- Daily maintenance activities involving the total work force;
- Company-directed and motivated autonomous small group activities with goals that coincide with company goals; and
- Continuous training which includes formal, on-the-job, one-point lessons and team members training each other (Kister et al., 2006).

**2.15 The six big losses**

One of the goals of TPM (Shirose, 1992:37-48) is to improve equipment efficiency. This can be achieved by making the most of the functions and performance features of the equipment or by eliminating the six big losses which are obstacles to efficiency.

**Figure 2.1: Six big losses**




Source: Kennedy (2002)

2.15.1 Breakdown losses

Breakdown losses can be classified into two categories, inter alia, failed function or reduced function breakdowns. Failed-function breakdowns occur suddenly and the equipment fails to perform as usual. A reduced-function breakdown enables the equipment to continue to operate but at a reduced level of efficiency. This type of breakdown could give rise to idling, minor stoppages, rework, and reduced speed. This may ultimately result in a failed function breakdown.

The slight defect needs equal attention as the major defects because accumulated slight defects may also cause a major breakdown.

Zero breakdowns can be achieved by performing the following actions:

- Prevent accelerated deterioration by performing prescribed lubrication, checking of equipment and tightening of any part coming loose.
- Maintain the basic equipment condition by performing the three basic conditions, namely, cleaning, lubricating and tightening bolts.
- Maintain the operating condition by not exceeding the specified operating parameter.
- Improve the maintenance quality by improving the skill of the maintenance personnel for performing the repair or installation correctly.
- Take the repair work beyond quick fix measures and replace components by establishing the root cause to the failures.
- Correct design weaknesses.
- Learn as much as possible from each breakdown and use the information to avoid future breakdowns.

Tajiri et al (1999:42) identified the following additional countermeasures for achieving zero breakdowns:

- Set and improve the usage condition of parts and equipment.
- Restore defective parts by set and follow routine inspection standards.
- Identify adequate Mean Time between Failures (MTBF), based on the results of routine inspection.
- Correct equipment design weaknesses.
- Enhance operation and maintenance skills by analysing all mistakes made by production or maintenance personnel and take corrective action.
- Install mistake-proof systems.
- The maintenance department should standardize servicing procedures.
- Establish a spare parts control system.

### 2.15.2 Set-up and adjustment losses

Set-up and adjustment losses are stoppage losses which occur during the procedure of a tool change and the time required for stopping current production to change to the next product. Adjustments can be difficult and unavoidable.

Avoidable adjustment is needed as a result of the accumulation of slight precision errors, inconsistent standards or measurement methods which have not been standardised. Zero adjustment to equipment can be achieved by:

- Improving the precision settings of the equipment, jigs and tools; and
- Promoting standardisation in setting clear, consistent and precise standards for all procedures.

### 2.15.3 Idling and minor stoppage losses

Idling and minor stoppages are caused by temporary problems in the equipment which can usually be restored quite easily. However, these tend to be overlooked and are not regarded as a loss. In unmanned factories, this type of loss could pose a major problem because the problem would not be corrected immediately.

Idling and minor stoppages can be overcome by:

- Carefully observing what is happening until the problem repeats itself and corrective action is taken to overcome the problem;
- Correcting slight defects as soon it is noticed; and
- Understanding the optimal working conditions of the equipment.

2.15.4 Reduced speed losses

Reduced speed loss occurs when there is a difference between the speed at which a machine is designed to operate and its actual speed. Operational personnel are not concerned about the reduced speed loss of the equipment for the following reasons:

- The design speed of the equipment is only vaguely defined.
- Different speeds have not been set for different products.
- The specified speed is attainable but not reached.
- The defective product and mechanical problems encountered at the specified speed have not been fully investigated.

Increasing the equipment speed is a good way to expose problems and it can improve the technical skills needed to overcome it.

2.15.5 Quality defects and reworks

This type of loss is incurred through quality defects and related repair or reworks. Sporadic quality defects are easier understood and corrected than chronic defects, which are difficult to understand and often resist corrective measures.

2.15.6 Start-up/yield losses

Start-up/yield losses incur because of the reduced yield between the time the machine is started up and when stable production is finally achieved. The extent of this loss varies with the stability of the processing conditions, the readiness of jigs and dies, and worker training (Shirose, 1992:37-48).

## 2.16 Sporadic and chronic loss

Breakdowns, defects and other abnormalities can occur sporadically (intermittently) or chronically (continuously).The causes for sporadic failures are easy to find and can be corrected by restoring the condition or component to its original state.

Chronic abnormalities are likely to persist after corrective measures have been taken because:

- A chronic problem can have a single identifiable cause and many other factors can become causes which can change from one occurrence to the next.
- A chronic problem with multiple causes may result in the combination of the problem changing from one occurrence to the next.

Optimal equipment performance can be achieved by:

- eliminating chronic losses by performing PM analysis;
- searching for slight defects and conditions that are not optimal; and
- restoring conditions that cause breakdowns (Shirose, 1984:59-88).

## 2.17. Overall equipment efficiency (OEE)

### 2.17.1 Availability

Availability is all the operating time available, minus all forms of non-operating time such as breakdowns, routine maintenance or breaks in the production schedule.

$$\text{Availability} = \frac{\text{loading time} - \text{downtime}}{\text{Loading time}}$$

2.17.2 Performance rate

The performance rate is based on the operating speed rate and the net operating time. The operating speed rate is the ratio of the standard cycle time over the actual cycle time.

$$\text{Operating speed rate} = \frac{\text{Standard cycle time}}{\text{Actual cycle time}}$$

The net operating time is the actual time the equipment operated within a specified period.

$$\text{Net operating time} = \frac{\text{Output } x \text{ actual cycle time}}{\text{Loading time - downtime}}$$

Performance rate = Operating speed rate *x* net operating time (Shirose, 1984:49-51).

2.17.3 Quality rate

The quality rate is the ratio of conforming product to the total product produced (Campbell, 2006:161).

$$\text{Quality rate} = \frac{\text{Total product produced – reject product}}{\text{Total product produced}}$$

The OEE calculation factors (Shirose, 1984:49-51) in the major losses that TPM seeks to eliminate under the formulae heading of equipment availability, performance efficiency and the quality rate.

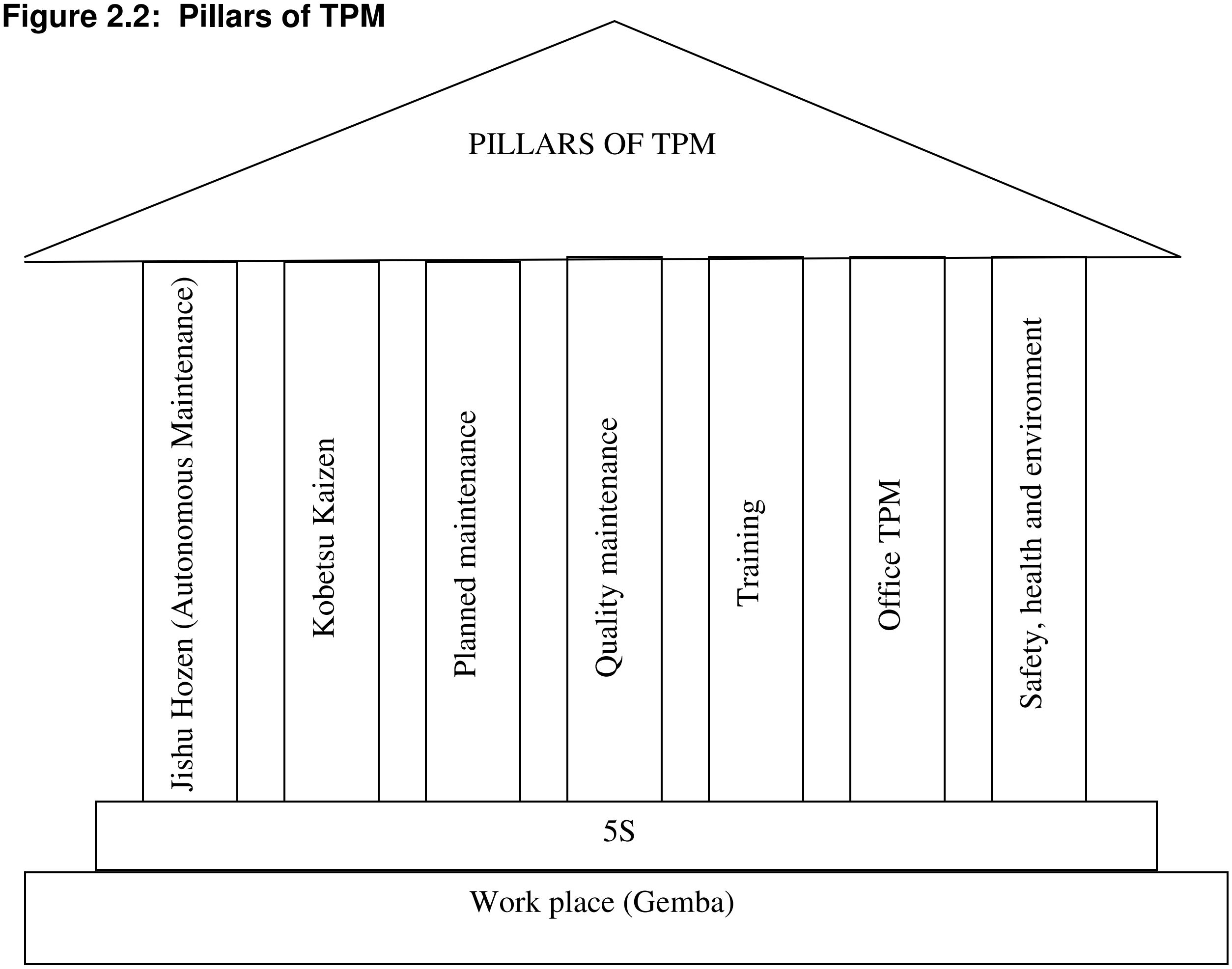
OEE (%) = Equipment availability (%) *x* performance efficiency (%) *x* rate of quality (%)

**Table 2.2: Improvement targets for the six big losses**

| LOSS | TARGET | DESCRIPTION |
|---|---|---|
| 1.Breakdown loss | Zero | Breakdown loss must be reduced to zero for all equipment. |
| 2.Setup/adjustment loss | Minimise | Minimise setup/adjustment loss by doing a single setup, lasting less than 10 minutes and with zero adjustment. |
| 3.Speed loss | Zero | Eliminate all differences between the actual versus the design conditions of the equipment. |
| 4.Idling and minor stoppages loss | Zero | Idling and minor stoppage losses must be completely eliminated in all equipment. |
| 5.Quality defects and reworks | Zero | Keep such losses within a minimum range in terms of ppm (parts per million) |
| 6.Startup loss | Minimise | |

Source: Shirose (1996.54)

**Figure 2.2: Pillars of TPM**




Source: Venkatesh (2007)

## 2.18 Pillars of TPM

### 2.18.1 Work place (Gemba)

The “work place” refers to the place of action and where facts are collected. The actual work place needs to be attended, the actual process needs to be visited, actual activities need to be observed and actual data needs to be collected (Birchen, 2004).

### 2.18.2 The 5s method

The 5s methodology is a Japanese system of housekeeping which consists of a five step ongoing process.

- Seiri (Sorting out): During this initial stage, items are sorted into critical, important, frequently used, useless or items not needed. Critical items should be stored close to where they are needed. Items not immediately needed should be stored elsewhere. The worth of the item should be decided based on utility and not cost.
- Seiton (Organise): There must be a place for everything and everything must be in its place after use. All storage spaces, including floors, should be labelled to enable quick identification of locations.
- Seiso (Shine): During this stage, the work area is “spring cleaned” in accordance to a cleaning map for the area. The equipment and chemicals needed to perform this task should be clearly defined.
- Seiketsu (Standardisation): The standard for maintaining a clean work area is established.
- Shitsuke (Self discipline): Commitment and acceptance of the 5s method as a way of life is confirmed (Venkatesh, 2007).

The benefits of the 5S include:

- A clean work environment which promotes safety where the work area is organised with no items obstructing and restricting free movement;
- Tool and equipment life which can be extended because of limited contamination by dirt; and
- Within an organised work area, it is easier to observe alternative layouts and to make improvements (Borris, 2006).

### 2.18.3 Autonomous maintenance (Jishu Hozen)

It is not cost effective for technicians and engineers to carry out eliminatory maintenance tasks which can be completed by trained operators. If the operators perform these maintenance tasks, their skills base improve, they are more responsible for the operations of the tools, their job prospects increase while the technician is freed to perform more complex tasks.

The operators are taught to identify abnormalities for their equipment by adopting the “clean and inspect” procedure. The operators will be able to perform more complex activities as their skills improve with time (Borris, 2006).

### 2.18.4 Kubetsu Kaizen

“Kai” means change and “Zen” means good (for the better) according to Venkatesh (2007). Kaizen means the continuous improvement, involving all levels within the organisation, and forms the basis for the total quality control (TQC) philosophy.  Kaizen is the small improvements made to the status quo as a result of ongoing efforts. Innovation is the drastic improvement because of a large investment in new technology and/or equipment.

The major thrust of TQC is to improve the overall management quality while TPM is directed at equipment improvement. The Kaizen mindset would result in a reduction in the number of breakdowns, tool replacement time, equipment operating ratio, cost of defectives and labour productivity.

Kaizen generates process-orientated thinking, since processes must be improved before improved results can be achieved. The Kaizen philosophy is a long term and not short term strategy (Imai, 1986).

### 2.18.5 Planned maintenance (PM)

Planned maintenance investigates the underlying causes of equipment failure, identifies the root causes and implements matching solutions. The purpose of preventative maintenance would be to prevent breakdowns.

Planned maintenance is a cross functional team activity. The team, also called the zero fail (ZF) teams consist of operators and technicians. In addition to the basic problems of the autonomous teams, the zero fail teams resolve more complex issues such as eliminating recurring problems and improving equipment efficiency (Borris: 2006).

### 2.18.6 Quality maintenance

The purpose of quality maintenance is to ensure that only the conforming product is manufactured to the customers' delight. It needs to be established which part of the equipment affects the current product quality and which should be eliminated before moving to potential quality concerns. The transition should be from reactive to proactive.

Quality maintenance aims to prevent quality defects. It is based on the concept that perfectly maintained equipment produces a perfect product (Venkatesh: 2007).

### 2.18.7 Training

The aim of training is to have multi-skilled and revitalized employees whose morale is high, who are eager to work and perform all the required functions effectively and independently. The operators' skills need to be upgraded from "know-how" to "know-why" through education. It is through experience that "know-how" is gained in overcoming problems. The operators do not know the root cause of the problem and the reason for performing the action, therefore they need to be trained in the “know-why”.

The training required for achieving the four phases of skill development is as follows:

- Phase 1: Do not know.
- Phase 2: Know the theory but cannot do.
- Phase 3: Can do but cannot teach.
- Phase 4: Can do and also teach (Venkatesh, 2007)

### 2.18.8 Office TPM

Office TPM must be followed to improve productivity, efficiency in the administration function and for the identification and elimination of losses. This includes analysing processes and procedures for increased office automation.

Office TPM addresses the following losses:

- Processing losses;
- Cost losses including areas such as procurement, accounts, marketing, sales leading to high inventories;
- Communication, idle, set-up and accuracy losses;
- Office equipment breakdowns;
- Communication channel breakdown, telephone and fax lines;
- Time spent on retrieval of information;
- Non-availability of correct on line stock status; and
- Customer complaints due to logistics (Venkatesh, 2007)

2.18.9 Safety, health and environment.

The targets for this last pillar of TPM are zero accidents, zero health damages and zero fires (Venkatesh, 2007).

The autonomous maintenance teams were not employed with maintenance in mind and should therefore be protected. The operators must be trained to perform risk assessments to build confidence and hazard maps should be made available to avoid unnecessary exposure to possible danger (Borris, 2006).

## 2.19 Current measures of TPM performance

In this paper, the researcher will focus on the manufacturing performance measurements related to TPM at plant level.

The organizations policy deployment (Dennis, 2006) is disseminated from top management to all departments within the organization with targets for a pre-determined period. The targets at departmental level are converted to meaningful measurable objectives for the next organizational level before further dissemination. The plan-do-check-act (PDCA) cycle, with the supporting quality techniques, needs to be performed where targets were not achieved.

According to Campbell et al (2006) the manufacturing performance measurements that are applicable to this study are:

- Cost performance: Maintenance costs associated with a specific area include labour, materials, services and technical support costs.
- Equipment performance: The OEE of each critical piece of equipment in an area. The reliability and maintainability will also be used as a measurement for equipment performance.
- Process performance: The percentage of planned versus unplanned maintenance activities will be compared.

- Safety: The quantity of accidents will confirm if the operators have been trained to identify the risks when performing the autonomous maintenance activities.

### 2.20 TPM benefits

- Capital optimisation: The increased machine availability and extended life span of the equipment allows for reduced investment requirements.
- Productivity improvement: The equipment will be more available to produce product and down time losses will be reduced. Equipment reliability would have a strong impact on manufacturing process productivity.
- Quality improvement: Unplanned stoppages often create scrap or the need for rework, therefore improving machine reliability will also increase its quality.
- Reduction in work-in-process inventory: Safety stock is often necessary to protect downstream processes from upstream unplanned stoppages. If these stoppages are eliminated, safety stock will no longer be required.
- Employee empowerment: Successful TPM implementation leads to knowledge and responsibility transfer from the maintenance technicians to the operators which increase their motivation and commitment.

### 2.21 Summary

The definition, philosophy and TPM activities orientated the reader further by indicating how TPM fits with other world class improvement strategies such as TQM, Lean, Toyota Production Systems and World Class manufacturing. The reader was also exposed to different maintenance strategies, the six basic losses in manufacturing and overall equipment efficiency calculation methods. The discussion was concluded by the different TPM pillars.

# CHAPTER 3

# RESEARCH DESIGN AND METHODOLOGY

## 3. Introduction

In this chapter, the researcher will present the research design and the methodology that will be used to collect and interpret the relevant data to draw a meaningful and comprehensive conclusion of the research topic.

The Faurecia Interior Systems East London JIT site in the Eastern Cape was selected to establish if TPM had had the desired impact and if it had directly contributed to the reduction of down time, improved OEE and increased personnel involvement at all levels.

## 3.1 Faurecia Interior Systems South Africa

Faurecia Interior systems South Africa is an automotive component supplier of interior trim components such as door trim and instrument panels to all South African-based original equipment manufacturers (OEM). The organization has four geographic separated sites which are technology and JIT assembly operations or a combination of the two, closely located to an OEM. A total of 400 people are employed in the South Africa operation. Forty four employees are employed at the East London JIT site which will be used for the purpose of the research.

## 3.2 Definition of research

Research can be defined (Pellisier, 2007:06) as the diligent and systematic process of enquiry in order to discover, interpret or revise facts, events, behaviours, theories or applications with the assistance of such facts, laws or theories. Centre to the definition of research is that:

- Research is a process of enquiry and investigation.
- It is systematic and methodical.
- It increases knowledge (Collis & Hussey, 2003:1).

**3.3 Research design and problem structure**

Research design can be defined as the visualization of the data and the problems associated with the employment of those data in the entire research project and the common sense and the clear thinking necessary for the management of the entire research endeavour – the complete strategy of attack on the central research problem. Only once the problem has been formulated can the design be developed which would provide the detailed steps of the study. The type of design will dependent on the type of problem statement Leedy1997:93-94).

The different types of research can be classified according to:

- The purpose or the reason why the research is conducted;
- The process or method of data collection and analysis;
- The logic of the research; and
- The outcome of the research where a particular problem needs to solved or just making a general contribution to knowledge (Collis et al., 2003).

Table 3.1 Classification of the main types of research

| Type of research | Basis of classification |
|---|---|
| Exploratory, descriptive, analytical or explanatory research and predictive research. | Purpose of the research. |
| Quantitative or qualitative research | Process of the research. |
| Deductive or inductive research | Logic of the research |
| Applied or basic research | Outcome of the research. |

Source Collis and Hussey (2003).

### 3.3.1 Exploratory research

Exploratory research is conducted where there are very few or no earlier studies available to answer the research problem. The aim of this type of study would be to look for patterns or ideas, rather than testing or confirming the result of questions. In exploratory research, the focus is on gaining more insight of the subject area for more in depth investigation at a later stage. The techniques that are used in this type of research are case studies, observations and historical analysis which can provide qualitative and quantitative data. The main characteristic of this type of research is that it is very flexible with very few constraints on the nature of activities employed or the type of data that is collected (Collis et al., 1997:11).

### 3.3.2 Descriptive research

Descriptive research is research which describes phenomena as is it exists. It is used to identify and obtain information on the characteristic of a particular problem. The data collected is often quantitative and statistical techniques are used to summarise the information. Descriptive research goes further in examining a problem than exploratory research, since it is to find out more and to describe the characteristic of the research problem (Collis et al., 1997).

Questionnaire techniques are used in descriptive research where the attitude or opinion on organizational practices will be identified and described (Saunders, Lewis and Thornhill, 1997:244).Descriptive research will be used in this research paper.

### 3.3.3 Analytical or explanatory research

Analytical research is a continuation of the descriptive research whereby the researcher goes beyond describing the characteristics but also analyses and explains the reason why it happened. Analytical research aims to understand phenomena by discovering and measuring causes and the relationship among them (Collins et al., 1997).

The use of questionnaires for explanatory research enables the researcher to examine and explain “cause and effect” relationships between variables (Saunders et al., 1997:244).

### 3.3.4 Predictive research

Predictive research forecasts the likelihood of a situation occurring which has already occurred somewhere else. The solution to a certain study will be applicable to the same type of problem elsewhere, should predictive research provide a sound solution based on a clear understanding of the relevant cause (Collis et al., 1997).

### 3.3.5 Quantitative and qualitative research

The quantitative approach is objective in nature and concentrates on measuring the phenomena which is the cause to the question. In this approach, the collected data needs to be analysed by numerical means. In contrast, the qualitative approach is subjective in nature and examines the perceptions of human and social issues to gain insight (Collis et al., 2003).

### 3.3.6 Applied and basic research

Applied research has been designed to solve specific and existing problems where basic research deals with less specific problems but aims to improve the understanding of general issues (Collis et al., 2003).

## 3.4 Literature sources

A range of data is available from primary and secondary literature sources. Secondary data sources include:

- Documentary secondary data which consists of written documents such as books; journals and newspapers .It also includes documents in a non-written format such as video recordings, pictures and drawings.
- Survey–based secondary data which refers to data collected by three distinct surveys namely: censuses, continuous and regular surveys, and ad hoc surveys.
- Multiple-source secondary data which are based solely on documentary, survey data or a combination of the two (Saunders et al., 1997:158-169).

Saunders et al (1997) indicated that primary data can be collected by:

- Observations - It could be participant observation which is qualitative or structured observation which is quantitative and more concerned with the frequency of those actions. The researcher will observe if the action in the questionnaire are performed on the shop floor to support the findings.
- Interviews - These could be structured, semi-structured or unstructured interviews. Structured interviews will be conducted with the respondents to establish the validity of their responses to the questionnaire.
- Questionnaires

Primary data will be collected by questionnaire due to time and cost constraints.

### 3.4.1 Advantages and disadvantages of secondary data

Saunders et al (1997) identified the following advantages of secondary data:

- It is less expensive and time consuming.
- There is higher quality of data.
- Collected data reduces the risk and harm in an organizational setting.
- Longitudinal studies may be feasible.
- It can provide comparative and contextual data.
- It can result in unforeseen discoveries.

The disadvantages include:

- The collected data may not match the need.
- Access may be difficult or costly.
- The data sets cannot be combined and definitions may be unsuited.

## 3.5 Quantitative research methods

Quantitative research methods are used where large populations are studied at once and it is the most cost effective way of data collection. The data is mostly collected by means of a survey which consists out of questionnaire where a large number of the targeted population answers structured questions and its findings are then statistically analysed. These results are considered to be valid and reliable (Pellisier, 2007).

Quantitative research deals with hard data and a snapshot approach of the facts as these appear at the present moment. The strength of this type of research method," lies in the application of mathematical analysis to explain social phenomena by showing the key constructs, their inter-relationship and their relative strengths within these inter-relationships" (Pellisier, 2007).

### 3.6 Qualitative research methods

Most qualitative research methods make use of in depth one-to-one interviews and focus groups. By using qualitative research methods, the topic is researched in greater detail by probing and understanding the respondent's attitudes, motivations and behaviour.

The validity of the findings on the research can, however, be questioned by a variety of experts who approach the research problem from a different perspective or discipline (Pellisier, 2007).

The main features and differences between quantitative and qualitative research are expressed by Collis et al (2003), between the two main paradigms.

Table 3.2 Features of the two main paradigms

| Positivistic paradigm | Phenomenological paradigm |
|---|---|
| ▪ Tends to produce quantitative data | ▪ Tends to produce qualitative data |
| ▪ Uses large samples | ▪ Uses small samples |
| ▪ Concerned with hypothesis testing | ▪ Concerned with generating theories |
| ▪ The data is highly specific and precise. | ▪ Data is descriptive and subjective |
| ▪ The location is artificial | ▪ The location is natural |
| ▪ The reliability is high | ▪ Reliability is low |
| ▪ Validity is low | ▪ Validity is high |
| ▪ Generalises from sample to population | ▪ Generalises from one place to another |

Source. Collis and Hussey (2003).

### 3.7 Quantitative and qualitative research methods

Robson (1993) as cited by Saunders et al (1997) listed three traditional research methods namely:

- Experiments which are the classic form of research used in natural sciences studies, but are also used in social science research, particularly psychology;
- Surveys which are used in business and management research. The survey questions are structured and collected by the use of a questionnaire; and
- Case studies which entail the development of a detailed and intensive knowledge about a single case. Case studies are a qualitative research method and the data is collected by structured and semi-structured interviews (Leedy,1997:157)

Leedy (1997) identified the following qualitative research methods, namely:

- Ethnography research entails the collection of primary and participative observational data from a cultural group in a natural setting over a long period of time.
- Phenomenological research method attempts to understand the participant's perspectives and views of social realities. Data is collected by in depth unstructured interviews from purposely selected participants. The interview could take the form of a dialogue or conversation.
- Grounded theory research is a set of procedures for the analysis of data that will lead to the development of theory useful to a specific discipline. The data is collected by historical records, interviews and observations.

Historic research deals with the meaning of events, not just focusing on what happened but also to why it happened. The data is obtained through primary data sources which recreate that specific moment in time applicable to the research (Leedy, 1997).

### 3.8 Multi research methods

A single research study can combine quantitative and qualitative research methods and simultaneously making use of primary and secondary data. Saunders et al (1997) identified two major advantages namely:

- The researcher would interview the respondents to get the feel for the key issues before performing a survey; and
- Different data collection methods within a study are used in order to ensure that the data supports the expected outcome.

## 4. Research surveys and interviews

Both experiments and case-study research strategies can make use of questionnaires for data collection in the research survey. A questionnaire includes all techniques of data collection in which each respondent is asked the same set of questions in a predetermined order, prior to quantitative data analysis (Saunders et al., 1997).

Structured and unstructured interviews are another method of data collection. During structured interviews, the interviewer physically meets the respondent to answer the standard questions which appear in the questionnaire. An unstructured interview contains non-standard questions and is informal (Saunders et al., 1997).

### 4.1 The detailed on the research design and methodology used

The research design and methodology used during this study is descriptive in nature. Primary and secondary data sources were used during the research process. The primary data was collected from questionnaires which were handed out during September 2009, as well as through personal observation of the personnel which are responsible for performing Total Productive Maintenance activities at the Faurecia JIT site. The secondary data for this research paper was obtained through a literature review. The collected data can be converted into numerical indices and statistical analysis techniques which can then be used to generalize the findings from the sample to the population (Leedy, 1997:189).

During the descriptive survey process and for this research paper, the researcher will observe:

- The population which is bound by the research parameter; and
- Records the observation which could be used for later study. The survey will be observed and evaluated by using the attitude scale (Leedy, 1997:190).

**4.2 Questionnaire design**

Key issues from the literature study were incorporated into the questionnaire to answer the research questions and to address the research objectives. The questions covered all aspects of TPM which were identified as important in the literature study.

According to Saunders et al (1997), scale or rating questions are used to collect attitude data. The respondent is asked to show to which extent he or she agreed or disagreed with the statement on a four point scale. The researcher decided to use the four point scale instead of the five point scale which would force the respondent to make a “more definitive” choice.

The questionnaire which was used to conduct the survey at operator level at the Faurecia Interior Systems plant is as shown in **Annexure B**.

### 4.3 Attitude

Attitudes can be defined as the evaluation that people make concerning objects, people or events which are influenced by the person's value system according to Schultz et al (2005). Attitudes reflect the person's response to a specific situation, object or person.

The attitudes that are job and organization related include:

- Job satisfaction is a collection of attitudes which include a number of aspects related to the person's work such as the work it self, workplace interaction and relationships, rewards and incentive schemes, and personal characteristic.
- Job involvement is where the person feels a sense of belonging in a specific job and would therefore strive to perform well.
- Organizational commitment is the degree to which a person identifies with a specific organisation and its goals, and wishes to maintain membership of the organization (Shultz et al., 2005).

### 4.4 Pretesting the questionnaire

The completed questionnaire was presented to five operators to establish if they would have any difficulties in answering the questions which would then be eliminated so that there are no difficulties in recording of the data. Bell (1993), as cited by Saunders et al (1997), suggested that pre-test should be performed to establish:

- The length of time it took to complete the questionnaire;
- Which questions were unclear or ambiguous; and
- If there were any significant topic omissions.

The questionnaire was divided into three sections where each section focused on answering individual sub-problems to the main research question. The themes, per section, were:

- Section A – Downtime reduction;
- Section B - Overall Equipment Efficiency(OEE); and
- Section C – Involvement of all personnel.

Amendments were made to the questionnaire which consisted out of 27 Likert Scale questions.

The Likert Scale which was used recorded preference as follows:
1 = strongly disagree
2 = disagree
3 = agree
4 = strongly agree

**4.5 Research population**

The site has a total of 44 people on site of which 30 are at operator level. All these operators are trained and are currently exposed to Total Productive Maintenance practises. According to Leedy (1997), “the results of a survey are no more trustworthy than the quality of the population or the representativeness of the sample.” From a population size of 30, a sample size of 28 is considered as adequate, according to Krejcie and Morgan (1970), as cited by Leedy (1997).There was doubt if the 30 operators would be adequate for a representative sample.

A high response rate had to be ensured due to the small population size. A covering letter, as shown in **Annexure A,** was attached to the questionnaire and given to each respondent for completion.

### 4.6 The survey

The researcher introduced the respondents to the survey and gave guidance in completing the entire questionnaire. Thirty questionnaires were handed out during normal working hours and all were returned after completion which resulted in a **100** per cent response rate.

### 4.7 Summary

In this chapter, the researcher presented the research design and methodology for this research project. The main features and differences between quantitative and qualitative research methods were expanded to reveal the different research types which underlie these main paradigms. The different types of data sources were also identified and the method of collection established. The result from the empirical study will be presented in the next chapter.

# CHAPTER 4

# RESEARCH FINDINGS

## 4. Introduction

In chapter 3, the researcher presented the research design and methodology that is to be used in this study. In this chapter, the researcher will present the empirical findings to establish the level to which Total Productive Maintenance impacted and directly contributed to the reduction of downtime, improved Overall Equipment Efficiency (OEE) and increased personnel involvement at all levels at the East London site of Faurecia Interior Systems.

A total of 30 operator level personnel completed the questionnaires. The findings of the questionnaire (Annexure B) are presented in table 4.1.

### 4.1 The questionnaire results

The questionnaire was constructed to measure downtime reduction, OEE and the involvement of all personnel which were described in chapter 2.

- Questions 1-15 covered the theme of downtime reduction;
- Questions 16-21 covered the theme of OEE; and
- Questions 22-30 covered the theme of involvement of all personnel.

The Faurecia Group has its own Faurecia Excellence System (FES) which consists out of three operational modules, namely; quality systems efficiency (QSE), production systems efficiency (PSE) and employee empowerment (EE). Each module consists out of sub-modules of which Total Productive Maintenance (TPM) is one of the sub-modules of PSE. The aim of the Faurecia TPM module is to improve productivity and quality, reduce work in process and to empower the employees to act.

Table 4.1 Primary data from research questionnaire

SECTION A.

| Questions | No % | Likert scale 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| 1. Through TPM, the equipment is maintained in a clean basic condition by remedying the sources of contamination. | No | 19 | 11 | 0 | 0 |
| | % | 63 | 37 | 0 | 0 |
| 2. The lubrication points/surfaces are identified and serviced as per the specified standard. | No | 25 | 5 | 0 | 0 |
| | % | 83 | 17 | 0 | 0 |
| 3. Loose fasteners on equipment are immediately secured if observed. | No | 18 | 11 | 0 | 1 |
| | % | 60 | 37 | 0 | 3 |
| 4. The equipment is used as per the manufacturer's guideline. | No | 14 | 16 | 0 | 0 |
| | % | 47 | 53 | 0 | 0 |
| 5. Through TPM, the maintenance department performs routine inspections on all the equipment on site. | No | 19 | 10 | 1 | 0 |
| | % | 63 | 33 | 4 | 0 |
| 6. The maintenance department restores or replaces defective parts as required. | No | 22 | 8 | 0 | 0 |
| | % | 73 | 27 | 0 | 0 |
| 7. Adequate targets have been established for Mean Time between Failures (MTBF), based on the results of routine inspections. | No | 10 | 19 | 1 | 0 |
| | % | 34 | 63 | 3 | 0 |
| 8. The maintenance/engineering department corrects equipment design weaknesses. | No | 11 | 17 | 2 | 0 |
| | % | 37 | 57 | 6 | 0 |
| 9. The maintenance department follows a standardized servicing procedure. | No | 24 | 6 | 0 | 0 |
| | % | 80 | 20 | 0 | 0 |
| 10. Mistake proof systems (poka yoke) are installed on the equipment. | No | 18 | 11 | 1 | 0 |
| | % | 60 | 37 | 3 | 0 |

| Questions | No<br>% | Likert scale 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| 11. The maintenance department maintains critical spares for all equipment. | **No** | 17 | 10 | 2 | 1 |
| | % | 57 | 33 | 7 | 3 |
| 12. All line stoppages which last longer than five minutes are recorded and tracked on displays in the production area. | **No** | 22 | 4 | 3 | 1 |
| | % | 73 | 13 | 10 | 4 |
| 13. The maintenance technician's workmanship is to standard. | **No** | 10 | 19 | 1 | 0 |
| | % | 34 | 63 | 3 | 0 |
| 14. Through the implementation of TPM, the downtime has been reduced. | **No** | 8 | 19 | 3 | 0 |
| | % | 27 | 63 | 10 | 0 |
| 15. TPM reduces maintenance costs. | **No** | 19 | 9 | 1 | 1 |
| | % | 64 | 30 | 3 | 3 |

SECTION B.

| Questions | No<br>% | Likert scale 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| 16. All micro failures are recorded and tracked on displays in the production area. | **No** | 14 | 14 | 2 | 0 |
| | % | 47 | 47 | 6 | 0 |
| 17. Each breakdown that lasts longer than five minutes is analysed, the root cause established and corrective action taken. | **No** | 12 | 17 | 1 | 0 |
| | % | 40 | 57 | 3 | 0 |
| 18. Adjustments are made to the equipment when the quality of the product is no longer acceptable. | **No** | 9 | 15 | 6 | 0 |
| | % | 30 | 50 | 20 | 0 |
| 19. The causes of defects and reworks are removed from the equipment at the first incident. | **No** | 7 | 17 | 6 | 0 |
| | % | 23 | 57 | 20 | 0 |
| 20. The quantity of reworks are recorded and tracked on displays in the production area. | **No** | 15 | 13 | 2 | 0 |
| | % | 50 | 43 | 7 | 0 |

| Questions | No<br>% | Likert scale | | | |
|---|---|---|---|---|---|
| | | 4 | 3 | 2 | 1 |
| 21. Through TPM, machine speed losses are detected. | No | 12 | 17 | 1 | 0 |
| | % | 40 | 57 | 3 | 0 |

SECTION C.

| Questions | No<br>% | Likert scale | | | |
|---|---|---|---|---|---|
| | | 4 | 3 | 2 | 1 |
| 22. The TPM, principles are applied at Faurecia. | No | 17 | 12 | 0 | 1 |
| | % | 57 | 40 | 0 | 3 |
| 23. The operators are grouped into teams with common objectives which are aligned to the site objectives. | No | 10 | 15 | 4 | 1 |
| | % | 34 | 50 | 13 | 3 |
| 24. The team operates autonomously to achieve the daily objectives. | No | 10 | 19 | 0 | 1 |
| | % | 34 | 63 | 0 | 3 |
| 25. The team performs own problem solving in a structured manner. | No | 7 | 21 | 0 | 2 |
| | % | 23 | 70 | 0 | 7 |
| 26. The operators have been trained by the maintenance technician to perform TPM activities. | No | 15 | 14 | 1 | 0 |
| | % | 50 | 47 | 3 | 0 |
| 27. TPM improves the teamwork between the production, maintenance and engineering departments. | No | 13 | 15 | 2 | 0 |
| | % | 43 | 50 | 7 | 0 |
| 28. TPM involves every single employee, from top management to operators on the shop floor. | No | 16 | 13 | 0 | 1 |
| | % | 54 | 43 | 0 | 3 |

| Questions | No<br>% | Likert scale | | | |
|---|---|---|---|---|---|
| | | 4 | 3 | 2 | 1 |
| 29. The operators have been trained by the maintenance technician to perform lock out procedures before performing autonomous maintenance activities on the equipment. | **No** | 19 | 9 | 2 | 0 |
| | **%** | 63 | 30 | 7 | 0 |
| 30. TPM aims to achieve zero accidents. | **No** | 20 | 8 | 2 | 0 |
| | **%** | 67 | 27 | 6 | 0 |

Source: Survey questionnaire.

### 4.1.1 Results from Section A –Downtime reduction

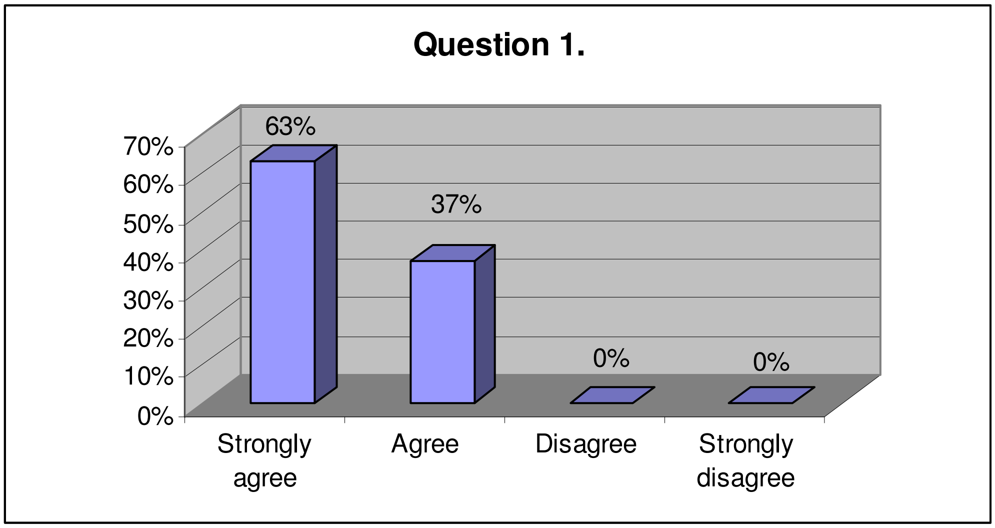
The results of the questionnaire (Annexure B) are presented in table 4.1. In the first column of table 4.1, the questions from the questionnaire appear in sequence from one to 30, in the second column the number (**No**) represents the number of responses per question, according to the Likert scale and each response is expressed as a percentage (**%**) of the total responses directly below the number. The response, per the Likert scale, is:

4 - strongly agree
3 - agree
2 – disagree
1 – strongly disagree.

The results from the survey revealed:

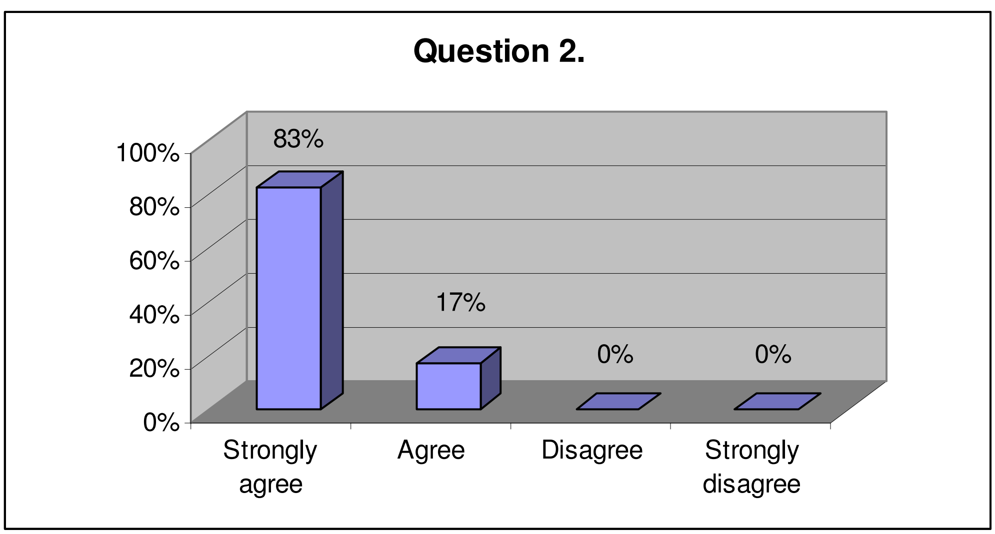
**SECTION A: Downtime reduction**

**Question 1:** Sixty three percent strongly agreed and 37 percent agreed that the equipment is maintained in a clean basic condition by remedying the sources of contamination. The operators applied the 5s methodology of sift, short, clean, standardized and respect to the equipment. This result also indicates that the operators are aware that inspections need to be performed when cleaning to identify potential sources of contamination to the equipment.



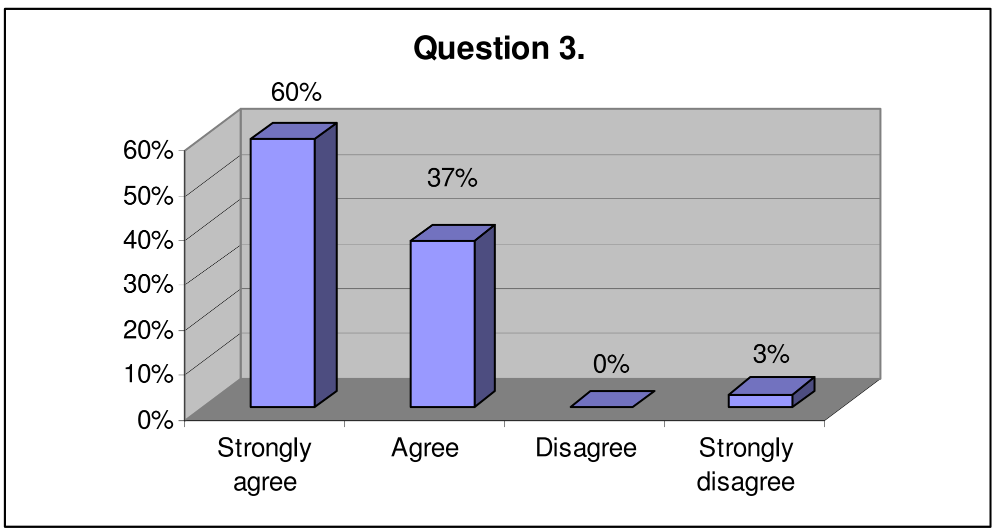

Source: Question 1 result from Questionnaire

**Question 2:** Eighty three percent strongly agree and 17 percent agree that all lubrication points/surfaces are identified and serviced as per the specified standards. This result indicates that the operators are familiar with the number and location of the lubrication points/surfaces. The operators are also aware of the lubrication standard in so far the quantity of lubricant that needs to be applied.



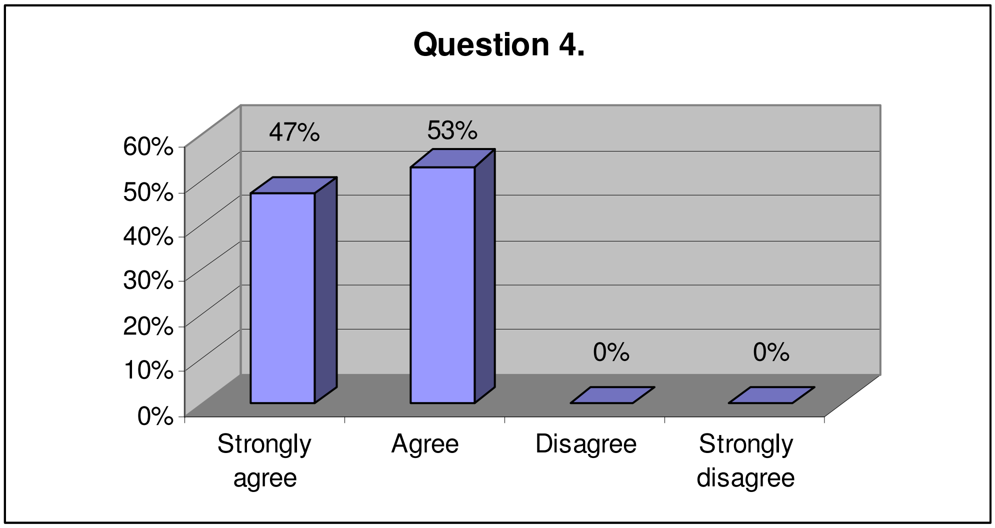
Source: Question 2 result from Questionnaire

**Question 3:** Sixty percent strongly agree, 37 percent agree and 3 percent strongly disagree that loose fasteners on equipment are immediately secured if observed. This result demonstrates that the operational personnel understand the consequences of loose fasteners for the equipment. It is evident that the operators are familiar with maintaining equipment in the basic condition which includes cleaning, lubrication and fastening loose fasteners. Some of the respondents which strongly disagree could be of the opinion that the response time between reporting a loose fastener and actual repair is excessive. This result also indicates that some operators are still in the mindset of “I run it, you fix it”.



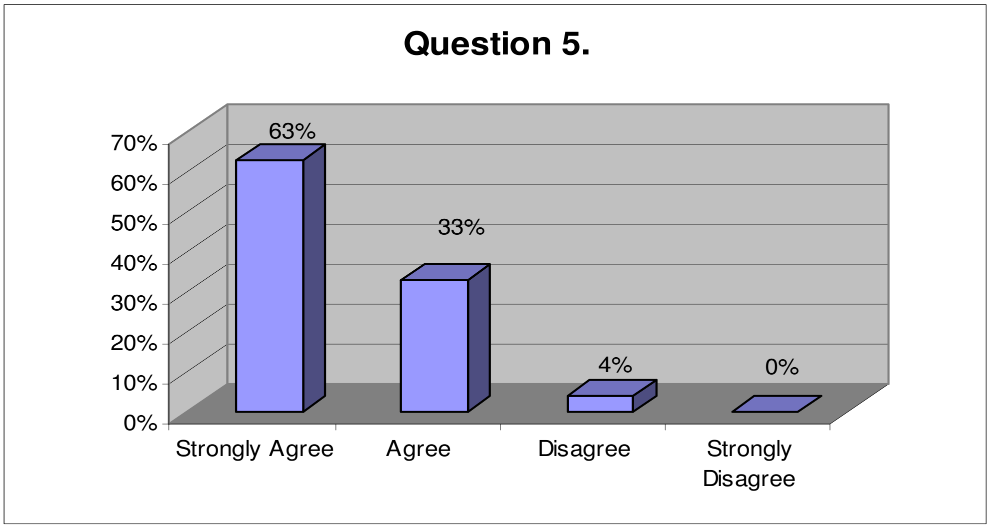

Source: Question 3 result from Questionnaire

**Question 4:** Forty seven percent strongly agree and 53 percent agree that the equipment is used as per the manufacturer’s guideline. The operators adhere to the loading and off loading procedures of the equipment, safety and emergency procedures as required. There could be some uncertainty among the respondents as to whether the equipment is being used correctly and if they have been correctly trained in the use of the equipment. The equipment is purpose specific and cannot be used for anything else.



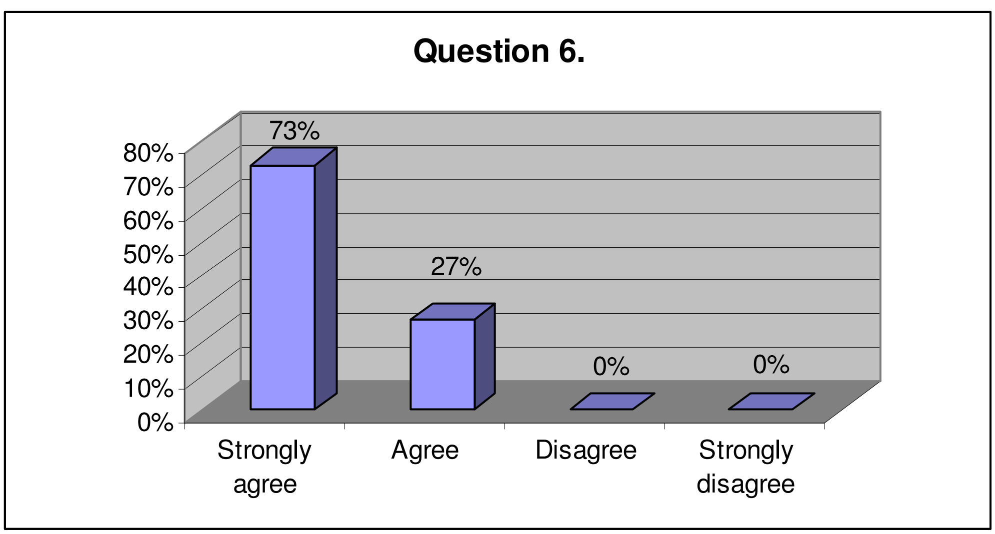

Source: Question 4 result from Questionnaire

**Question 5:** Sixty three percent strongly agree, 33 percent agree and 4 percent disagree that through TPM, the maintenance department performs routine inspections on all the equipment on site. Inspection are performed to prevent deterioration by restoring deteriorated parts, performing condition monitoring and machine diagnosis in order to estimate a critical part's life and to improve equipment reliability and maintainability as described by Tajiri et al (1999).



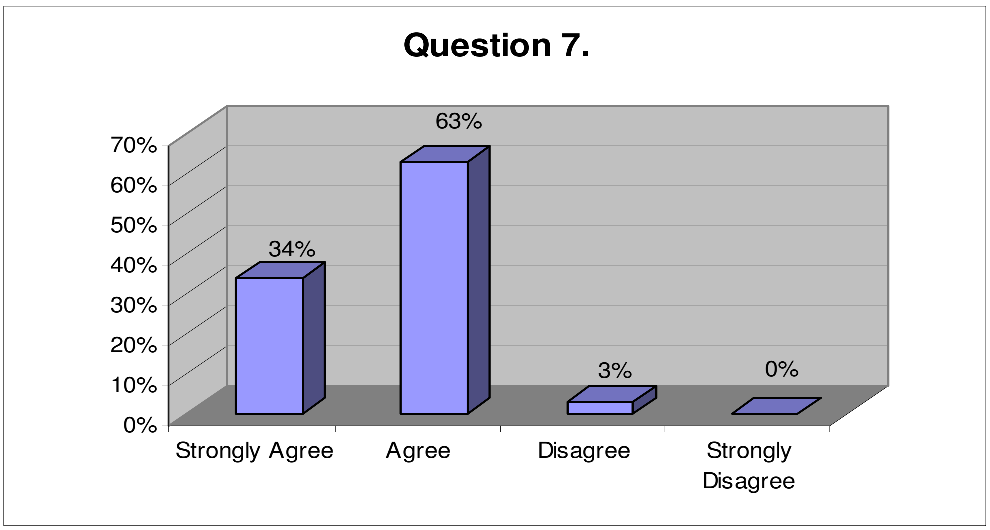

Source: Question 5 result from Questionnaire

**Question 6:** Seventy three percent strongly agree, 27 percent agree that the maintenance department restores or replaces defective parts as required. The maintenance department would inspect for deterioration by performing condition monitoring to establish a critical part's life and deteriorated parts would be replaced to avoid sudden breakdowns. This positive result indicates the effectiveness of the maintenance department.



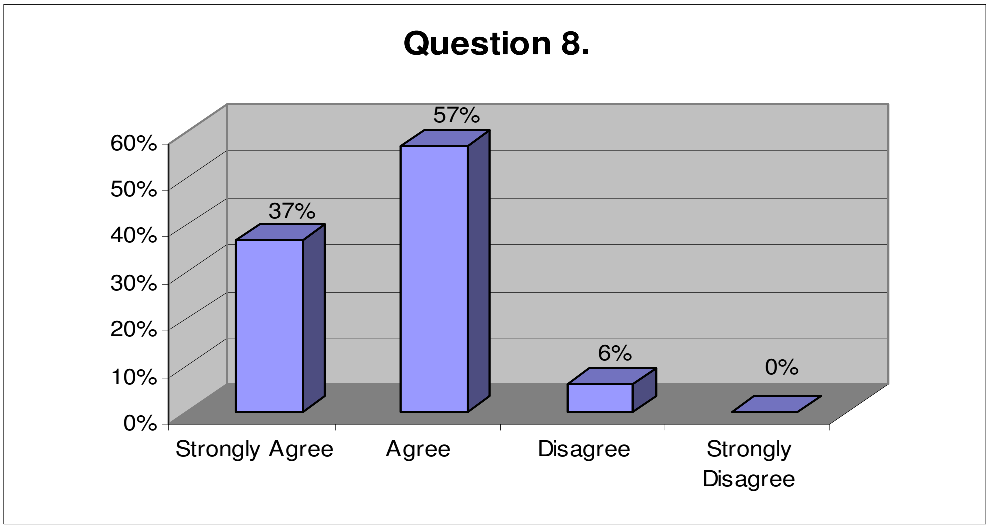

Source: Question 6 result from Questionnaire

**Question 7:** Thirty four percent strongly agree, 63 percent agree and 3 percent disagree that adequate targets have been established for Mean between Failures (MTBF), based on the results of routine inspection (Annexure C). The speed of deterioration would be used to estimate a critical part's life and the frequency of replacement or restoration. The operational personnel are aware of a target but are in doubt as to the actual figure.



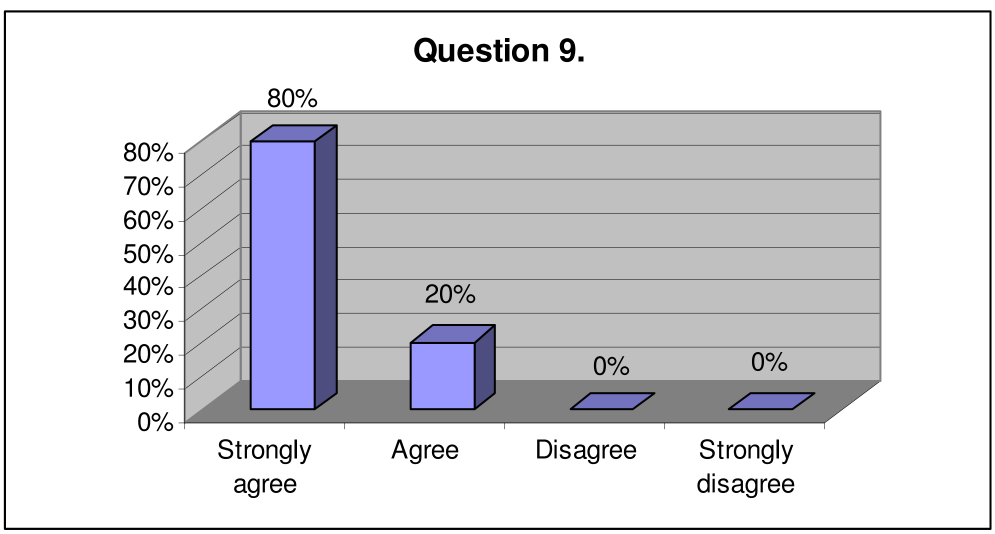

Source: Question 7 result from Questionnaire

**Question 8:** Thirty seven percent strongly agree, 57 percent agree and 6 percent disagree that the maintenance/engineering department correct equipment design weaknesses. The causes of design weaknesses could be poorly designed mechanisms, bad systems configuration or incorrect materials selection (Shirose, 1992).During product quality optimisation, it has been necessary to machine some of the equipments housing down to improve adjustment flexibility but only a limited number of operators were aware of this improvement.



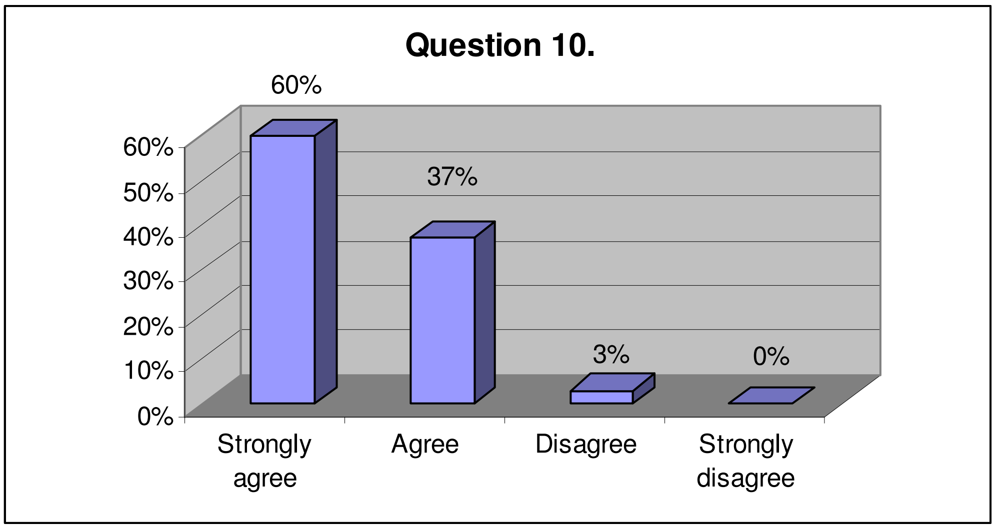

Source: Question 8 result from Questionnaire

**Question 9:** Eighty percent strongly agree and 20 percent agree that the maintenance department is following a standardized servicing procedure. The operational personnel have been exposed to the routine inspection and standardized servicing procedure (Annexure D) followed by the maintenance department and this is reflected in this very positive result.



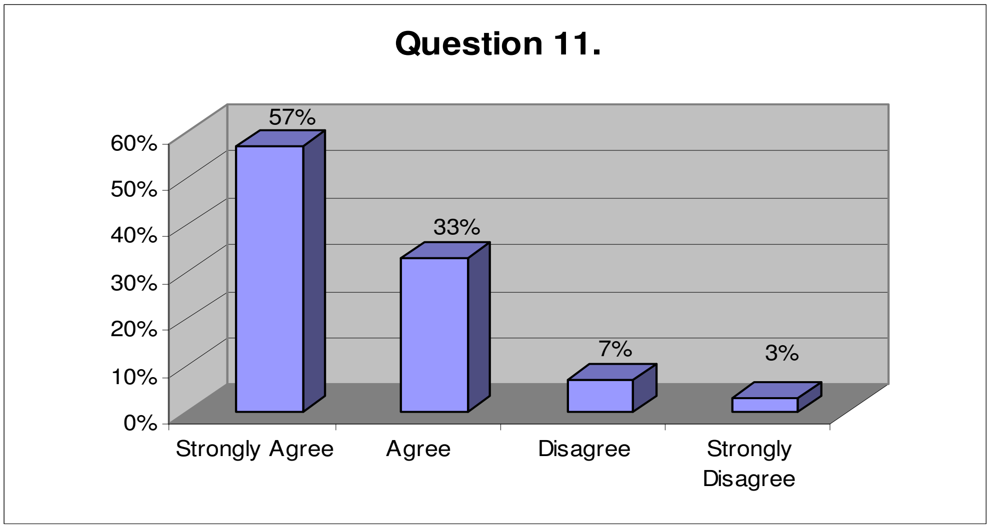

Source: Question 9 result from Questionnaire

**Question 10:** Sixty percent strongly agree, 37 percent agree and 3 percent disagree that mistake proof systems are installed on the equipment. This result shows that 97 percent of the respondents agree that the equipment has mistake proof systems installed as part of the design. The jigs for the plastic welding equipment have sensors installed for piece part detection and will not cycle unless fully loaded. Each welder also has a roller safety door that is touch sensitive which also prevents normal operation unless closed.



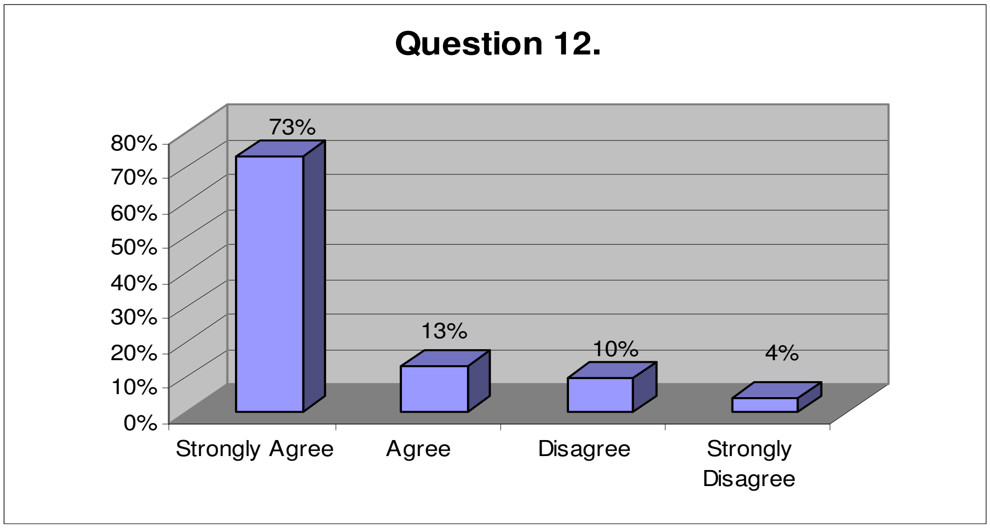

Source: Question 10 result from Questionnaire

**Question 11:** 57 percent strongly agree, 33 percent agree, 7 percent disagree and 3 percent strongly disagree that the maintenance department maintains critical spare parts for all equipment (Annexure E). Critical spares are maintained for the replacement of failed parts within the shortest time frame. This keeps machine downtime to the minimum. This result also indicates that not all the operational personnel are aware of the existence of these spare parts in the maintenance department.




Source: Question 11 result from Questionnaire

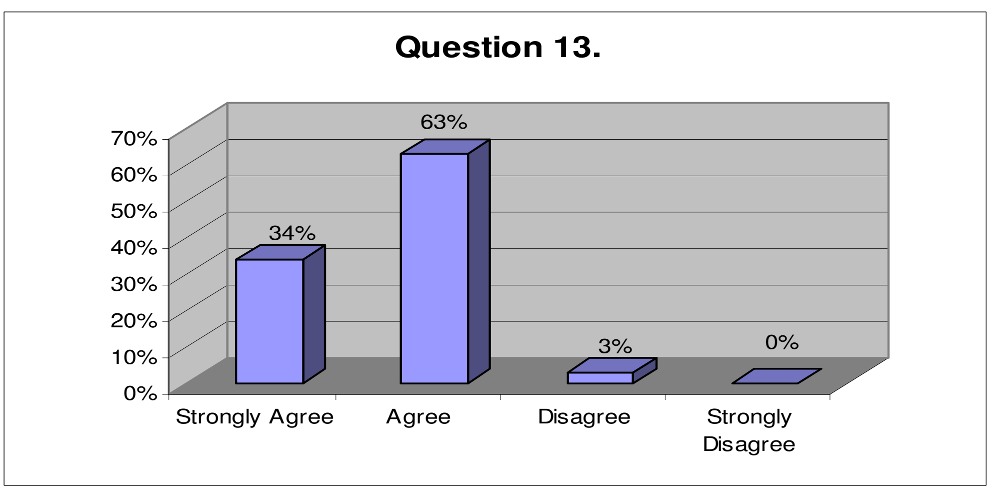
**Question 12:** 73 percent strongly agree, 13 percent agree, 10 percent disagree and 4 percent strongly disagree that all line stoppages which last longer than five minutes are recorded and tracked on displays in the production area. The process productivity will be negatively influenced by the absence of material, labour, energy or machine uptime (Kanawaty, 1996).The operators are responsible for collecting and reporting all line stoppages in order to justify failing to reach shift output targets. Higher efficiency levels will be required to recover all unrecorded loss time. Sufficient spare capacity would mask the unrecorded line stoppage with the target still being achieved.




Source: Question 12 result from Questionnaire

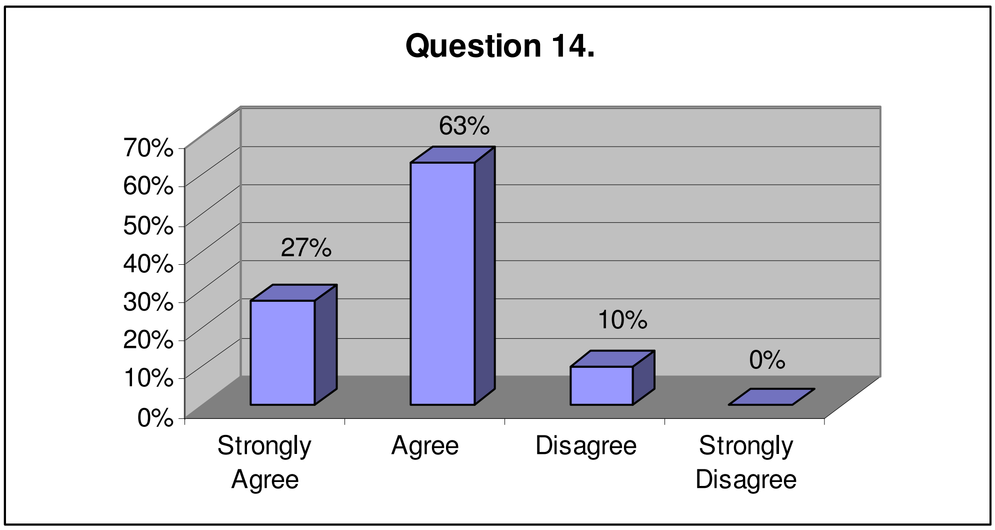
**Question 13:** The result reveals that 34 percent strongly agree, 63 percent agree and 3 percent disagree that the maintenance technician's workmanship is to standard.

The equipment is always maintained to its original condition and it is also applicable to the maintenance technician applying the standard. Poor quality maintenance would affect the breakdown frequency which is expressed as the Mean Time between Failure (MTBF).Observation indicates that engineering standards are maintained on all the equipment.



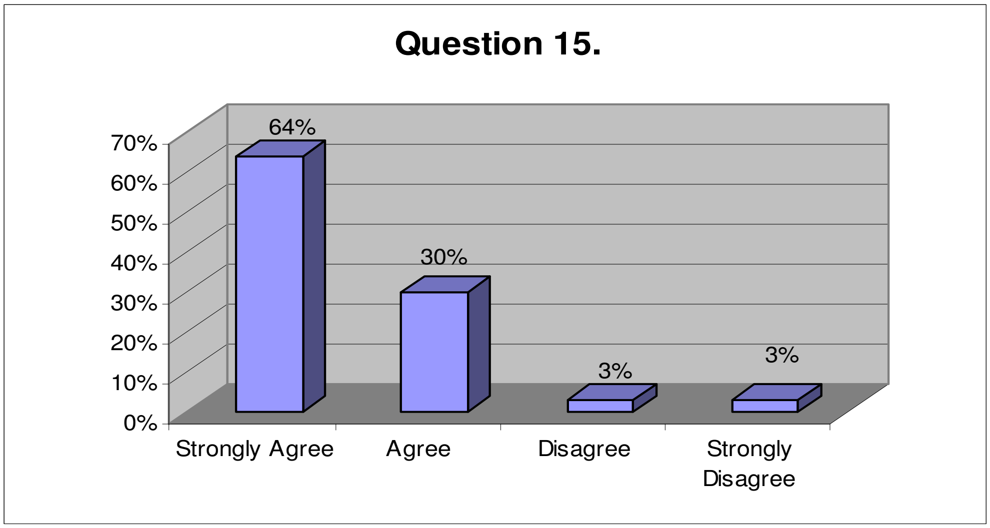

Source: Question 13 results from Questionnaire

**Question 14:** Twenty seven percent of the respondents strongly agree, 63 percent agree and 10 percent disagree that through the implementation of TPM, downtime has been reduced. The positive result of 90 percent is excellent, but 10 percent of the respondents disagreed with this statement. The downtime target has been reduced from 2, 5 percent last year to 2 percent for the current year (Annexure F).




Source: Question 14 results from Questionnaire

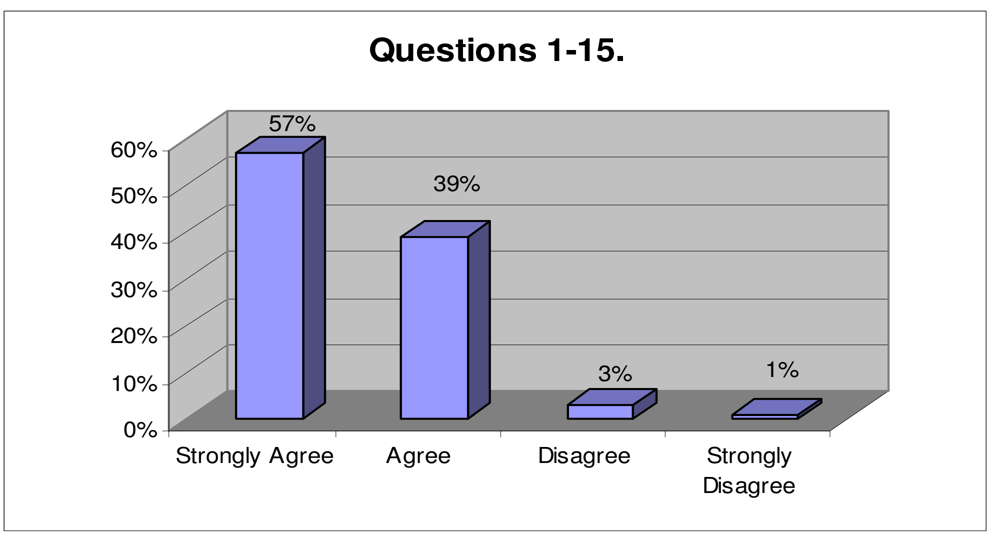
**Question 15:** 64 percent strongly agree, 30 percent agree, 3 percent disagree and 3 percent strongly disagree that TPM reduces maintenance cost. The respondents believe that maintaining the equipment in basic condition would delay the replacement and restoration of parts. The 6 per cent negative response to this statement indicates that a number of operational personnel are unaware of the cost implication of TPM on maintenance.




Source: Question 15 results from Questionnaire

**SECTION A – Down time reduction summary**

Through the use of ordinal statistical techniques, the data sets from questions 1 to 15 which refers to the reduction of downtime indicates that 57 percent strongly agree, with 39 percent agree, 3 percent disagree and 1 percent strongly disagree.




Source: Question 1-15 results from questionnaire

The interpretation indicates that 96 percent of all the operational personnel are in agreement that the downtime has been reduced with the introduction of TPM at the site. Ten temporary workers are used on a rotation basis and could have contributed to the negative response to the survey.

Table 4.2 Statistical results question 1-15

| Statistical terminology | Results / values |
|---|---|
| Mode | 4 = Strongly agree |
| Median | 4 = Strongly agree |
| Mean | 3,44 |
| Inter quartile range | 1 |
| Quartile Q1 | 3 = Agree |
| Quartile Q3 | 4 = Strongly agree |
| Range | 3 |

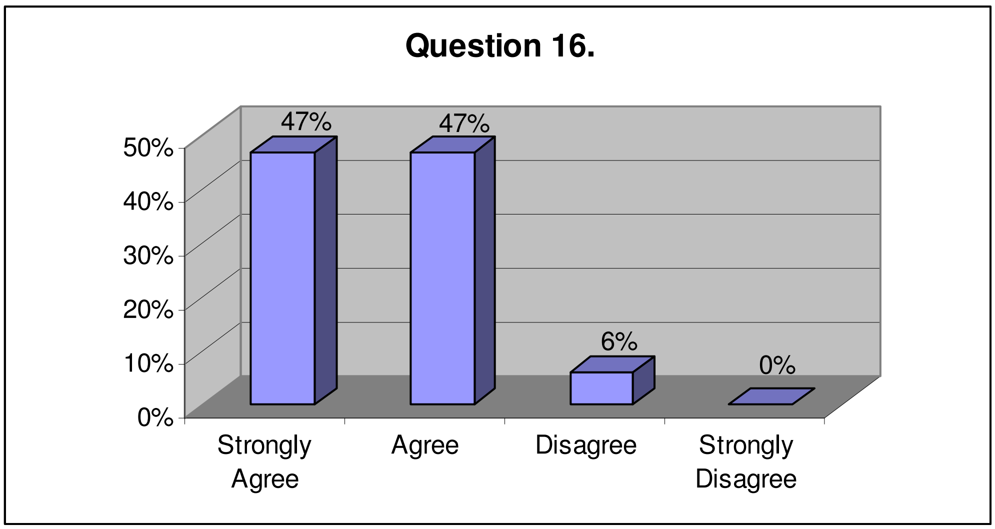
Source: Question 1-15 results from questionnaire

The interpretation of statistical terminology (Wegner, 2007) applied are as follows:

- Mode – the most frequently occurring value is 4 which matches the legend of strongly agree.
- Median – the middle number of this ordered set data is 4 and matches the legend of strongly agree.
- Mean – the average for the set of data is 3, 44 and indicates that it strongly leans from agree towards strongly agree.
- Inter quartile range – is the difference between the upper and lower quartiles data values and is 1 in this data set. The interpretation is that 50 percent of the results span an interval of 1 between the lower quartile Q1 value 3 and the upper quartile Q3 value 4.

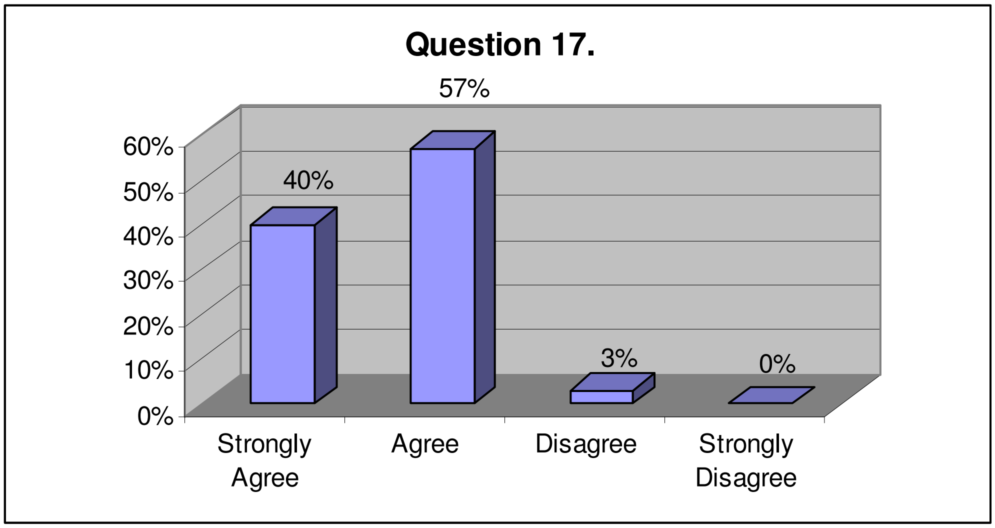
## SECTION B: Overall Equipment Efficiency

**Question 16:** Of the respondents, 47 percent strongly agree, 47 percent agree, 6 percent disagree that all micro failures (chronic losses) are recorded and tracked on displays in the production area (Annexure G). Although 94 percent of the respondents reacted positively, 6 percent responded negatively to this question. The timely and accurate process data collection supports the continuous improvement process and failure undermines this mindset.



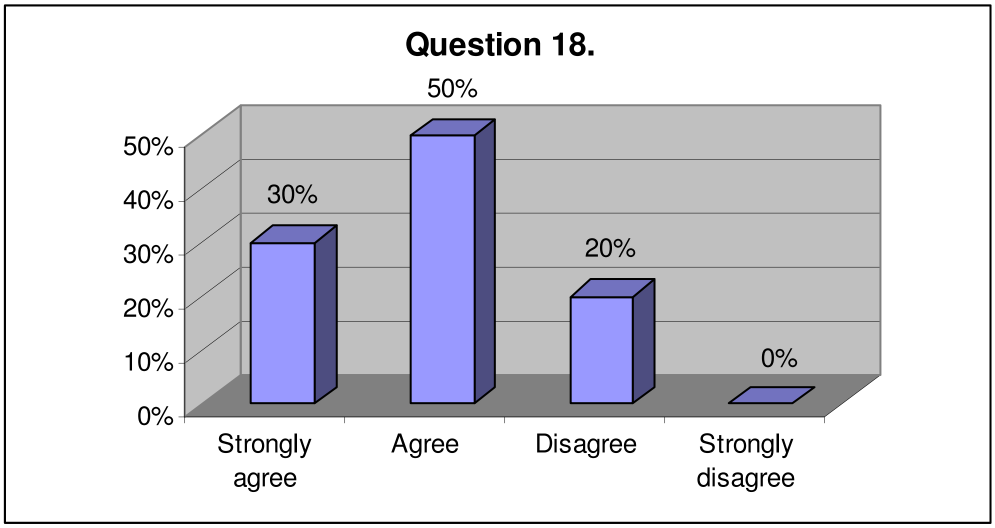

Source: Question 16 results from Questionnaire

**Question 17:** Forty percent strongly agree, 57 percent agree and 3 percent disagree that each breakdown (sporadic loss) that lasts longer than five minutes is analysed, the root cause established and corrective action taken. The relevant machine operator, supervisor and maintenance technician will initiate the breakdown analysis, establish the root cause and take corrective action. Faurecia has a focused problem solving methodology (Annexure H) which is called “Quick Response Quality Control” (QRQC) which starts at an operator level and unsolved breakdowns will be escalated to the next organizational level which would include the maintenance technician, quality engineer, supervisor and line manager. The operators are not always involved with the problem solving at higher level and it could be the reason for the response rate moving from “strongly agree” to “only agree”.



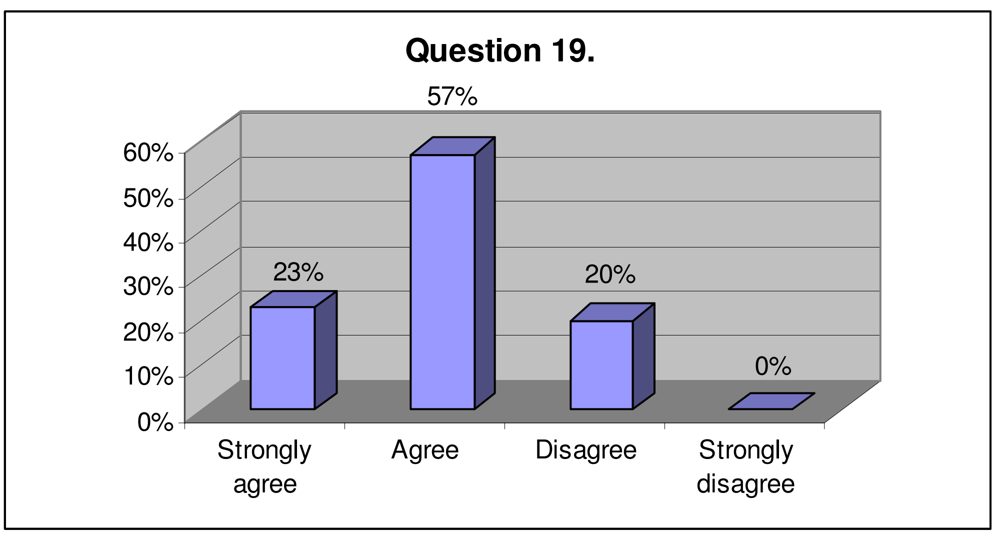

Source: Question 17 results from Questionnaire

**Question 18:** The results revealed that 30 percent strongly agree, 50 percent agree and 20 percent disagree that adjustments are made to the equipment when the quality of the product is no longer acceptable. Although an 80 percent positive result was recorded, 20 percent disagree with the statement. The operators at Faurecia have the authority to stop the process (Annexure I) in the event of poor product quality and to initiate corrective action. The principle of quality at the source must be ensured at each workstation and no defective product may be passed to the next workstation which is aligned with the TQM. The negative response rate of 20 percent indicates that adjustments are not being made when the quality is no longer acceptable.



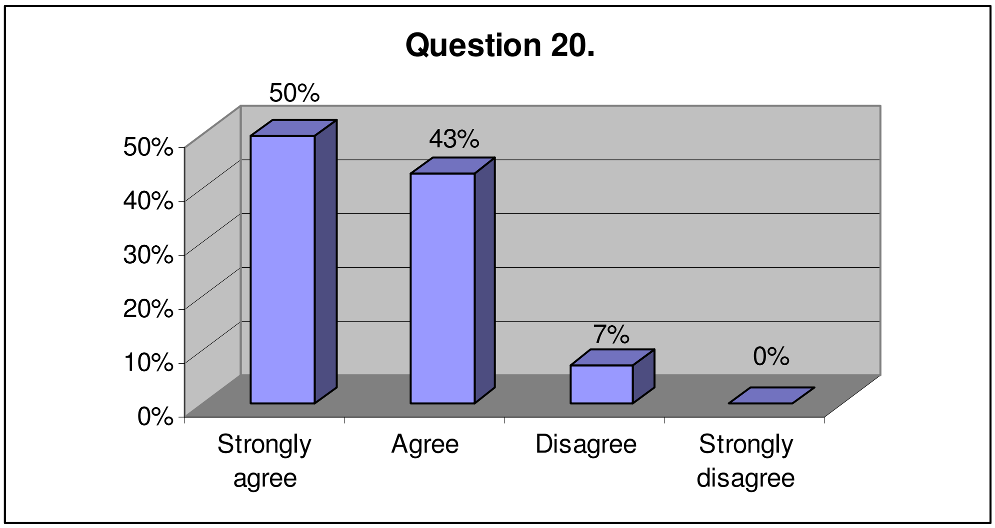

Source: Question 18 result from Questionnaire

**Question 19:** Twenty three percent strongly agree, 57 percent agree and 20 percent disagree that the causes of defects and reworks are removed from the equipment at the first incident. The Faurecia system has different "stop at defect" rules for different equipment, where a single incident would force the operator to stop while another would allow the operator to accumulate three defects over the whole shift before a stop is required to correct the cause of the defect (Annexure I). The negative response indicates that adherence to this rule is not always enforced or followed.



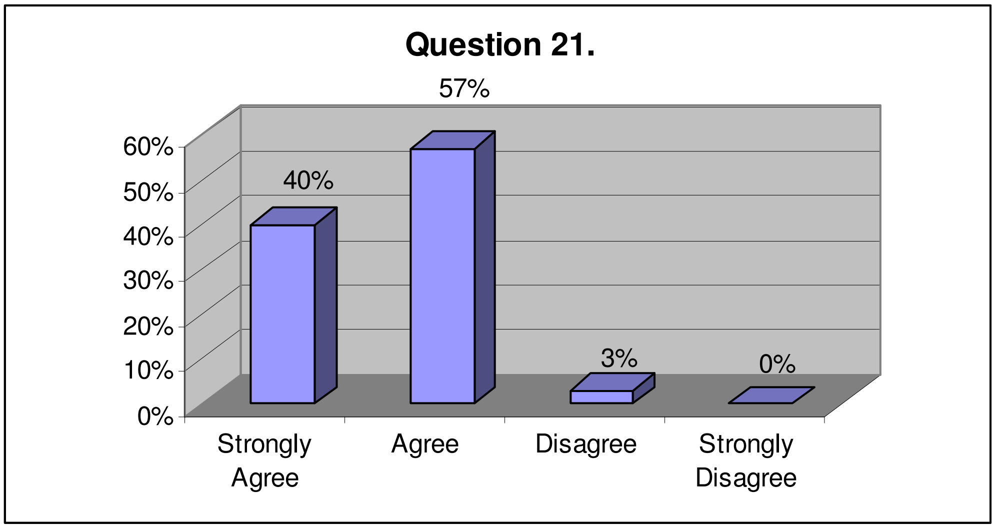

Source: Question 19 result from Questionnaire

**Question 20:** Fifty percent strongly agree, 43 percent agree and 7 percent disagree that the quantity of reworks are recorded and tracked on displays in the production area. Although a positive result of 93 percent was recorded, 7 percent disagreed with this statement. The reworks are recorded (Annexure J) after a repair and the quantity of reworks (Annexure K) is tracked on a daily basis in the autonomous team area. The quantity of reworks is also supported by a Pareto analysis (Annexure L), which would be used as the focus point for the following shift meeting.




Source: Question 20 result from Questionnaire

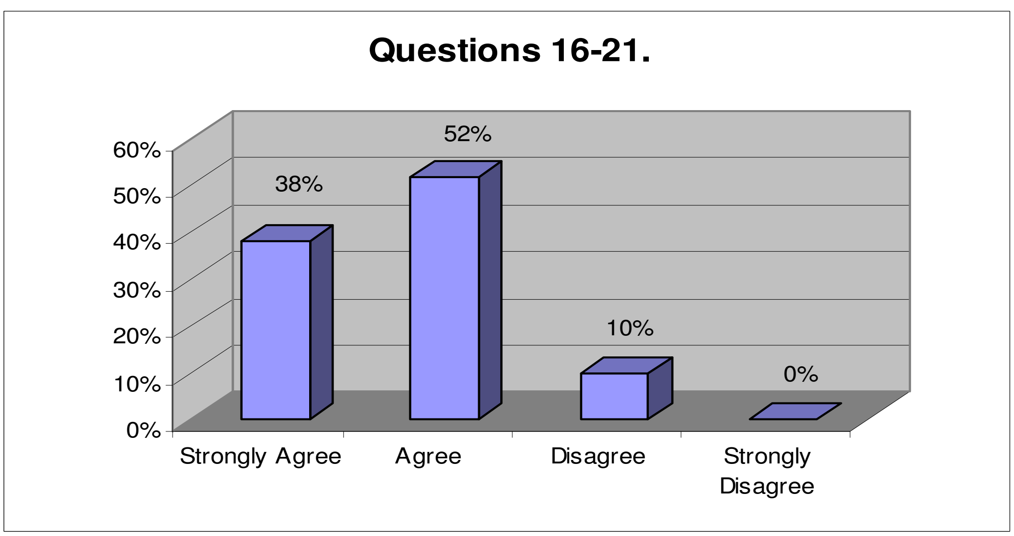
**Question 21:** Forty percent strongly agree, 57 percent agree and 3 percent disagree that total productive maintenance detects speed losses. Critical equipment is driven by programmable logics controller (PLC) and the cycle time can be changed depending on the effect this change would have on the product quality. The equipment PLC display would indicate an error if the "planned cycle time" has been exceeded by the actual run time. The error signal would cause a warning light to flash until it is reset by the maintenance technician, who would investigate the cause of the error signal. This concept is very difficult to explain if the basic technical skills are lacking in the operators.




Source: Question 21 result from Questionnaire

**SECTION B – OEE summary**

The data sets from question 16 to 21 which refer to the theme of OEE indicate that 38 percent strongly agree, 52 percent agree and 10 percent disagree. Although a positive result was achieved from the results, 10 percent of the personnel disagreed with the statements from this section.




Source: Questions 16-21 results from the questionnaire

The questions that mostly influenced the negative results of this section were:

- That adjustments are made to the equipment when the quality of the product is no longer accepted,
- The causes of defects and reworks are removed from the equipment at the first incident.

It was establish after the survey that a number of respondents could not make a clear differentiation between these statements.

Table 4.3 Statistical results question 16-21

| Statistical terminology | Results / values |
|---|---|
| Mode | 3 = Agree |
| Median | 3 = agree |
| Mean | 3,28 |
| Inter quartile range | 1 |
| Quartile Q1 | 3 = Agree |
| Quartile Q3 | 4 = Strongly agree |
| Range | 3 |

Source: Question 16-21 results from questionnaire

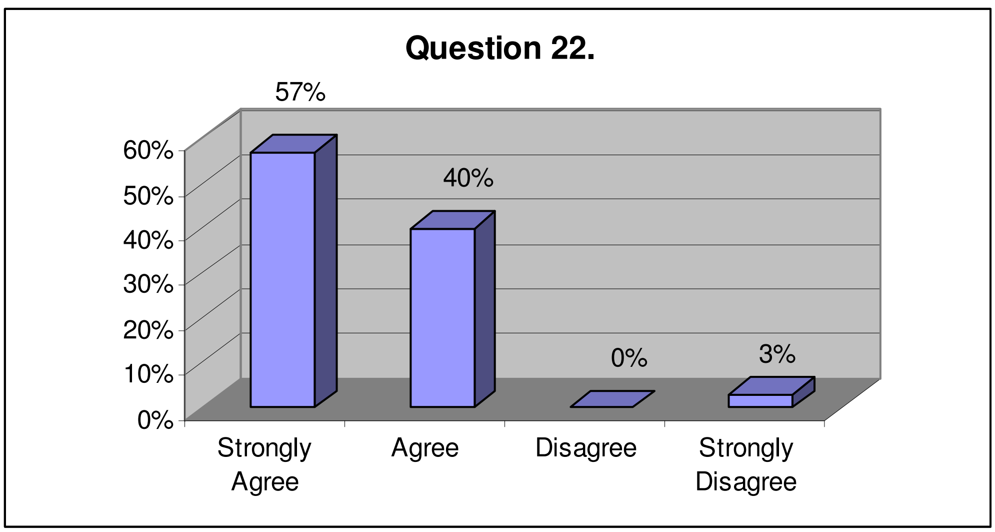
The interpretation of statistical terminology (Wegner, 2007) applied are as follows:

- Mode – the most frequently occurring value is 3 which matches the legend of agree.
- Median – the middle number of this ordered set data is 3 and matches the legend of agree.
- Mean – the average for the set of data is 3, 28 and indicates that it strongly leans from agree towards strongly agree. Positive skewed.
- Inter quartile range – is the difference between the upper and lower quartiles data values and is 1 in this data set. The interpretation is that 50 percent of the results span an interval of 1 between the lower quartile Q1 value 3 and the upper quartile Q3 value 4.

The response from the questionnaire serves to confirm that the campaign to improve OEE has been successful. The data compiled from operating records indicates that downtime has decreased from 2. 5 percent to 2 percent (Annexure F).Minor stoppages has reduced, first time pass of the product quality increased with the implementation of effective corrective actions to address the root cause of possible inefficiency or non conformity.

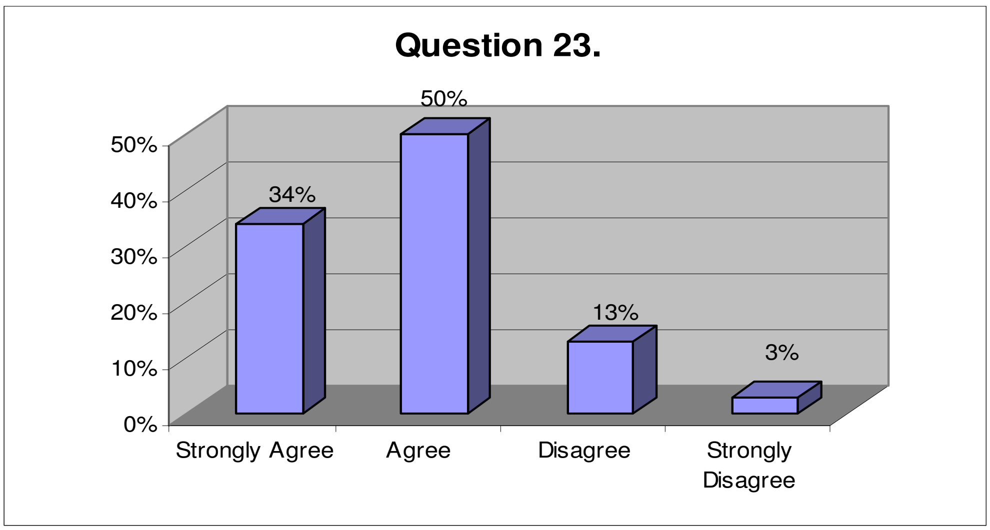
**SECTION C: Involvement of all personnel**

**Question 22:** Fifty seven percent strongly agree, 40 percent agree and 3 percent strongly disagree that Total Productive Maintenance (TPM) principles are applied at Faurecia. A 97 percent positive response was achieved with a tail of 3 percent strongly disagreeing to this statement.



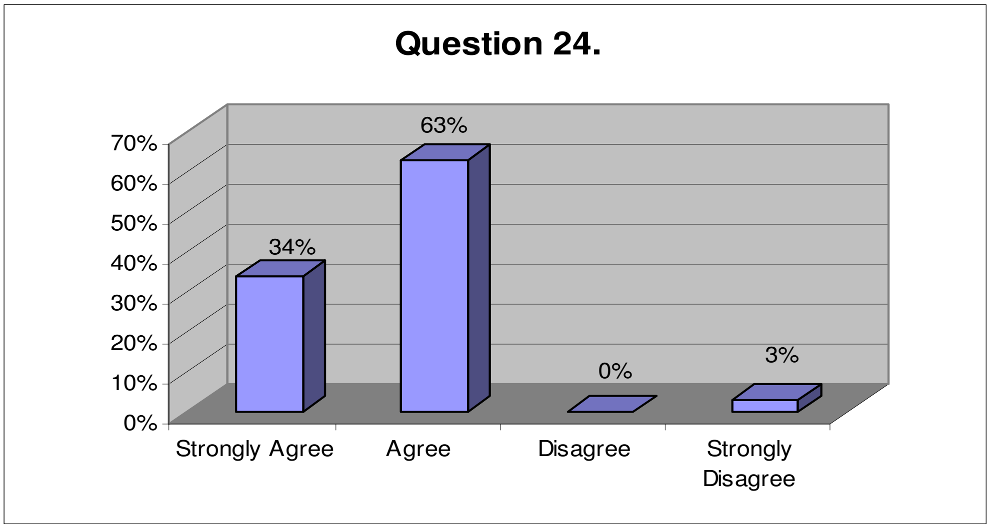

Source: Question 22 result from Questionnaire

**Question 23:** Thirty four percent strongly agree, 50 percent agree, 13 percent disagree and 3 percent strongly disagree that operators are grouped into teams with common objectives which are aligned to the site objectives. The researcher confirmed through observation that the operational personnel at Faurecia are grouped into autonomous working groups which consist out of two to eight members which work in the same area with the same technology and within the same time frame. The optimal size of the team is eight members which includes a team leader. One of the team members is trained to perform the duties of a team leader which includes a structured meeting at the start of the shift. This meeting covers the quality, delivery, cost and morale tracking graphs which are displayed in the work area. The team's daily objectives stem from the site's semester objectives (Annexure M) which are expressed in simple easy-to-understand terminology. Monthly feedback (Annexure N) is given to all site members on the performance of the site.




Source: Question 23 result from Questionnaire

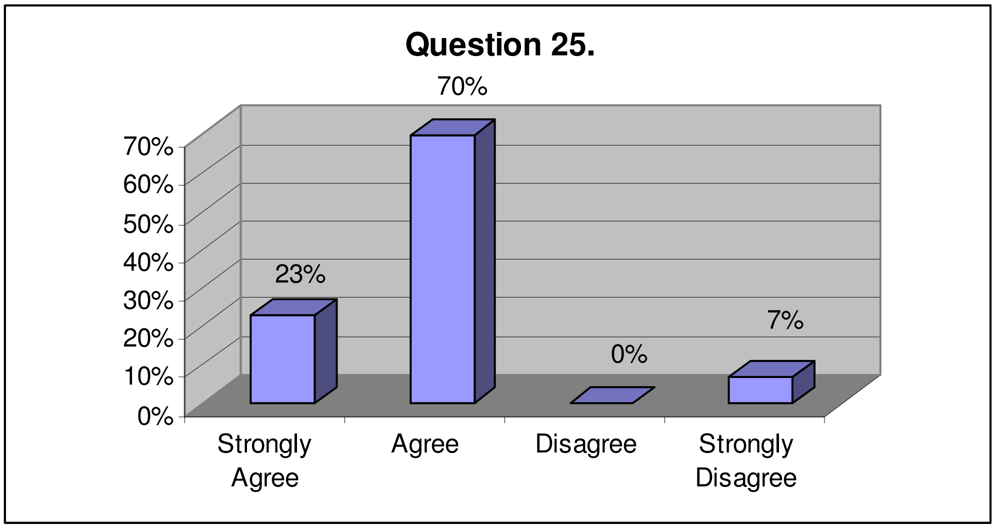
**Question 24:** The result revealed that 34 per cent strongly agree, 63 per cent agree and 3 per cent strongly disagree that the team operates autonomously to achieve the daily objectives. Although an overall positive result of 96 percent was achieved, a much higher "agree" response to "strongly agree" was achieved, indicating that the operators are uncertain about the level of autonomy at which they are operating. The researcher was shown an hourly target board which needs to be updated hourly. Reasons for failing to achieve the hourly target must be displayed on this board and corrective measures taken to avoid a repeat.




Source: Question 24 result from Questionnaire

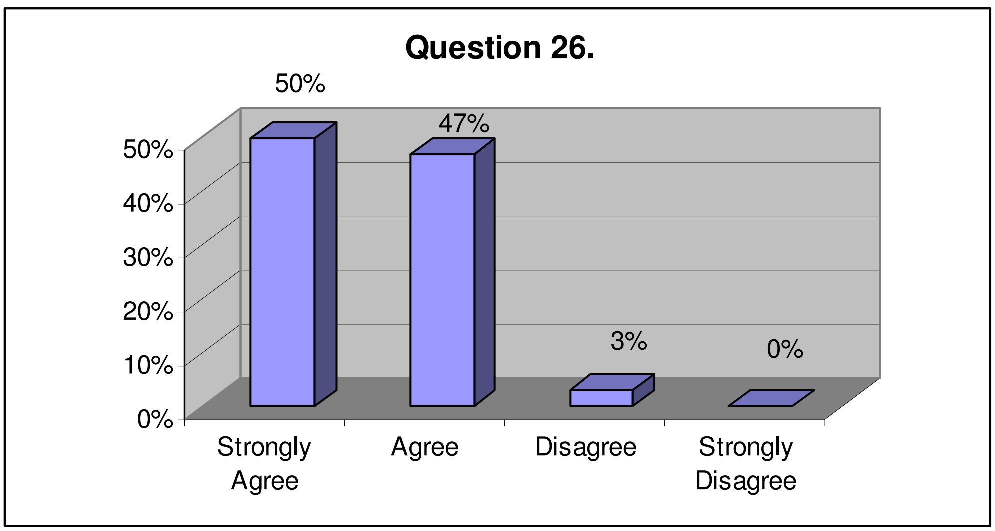
**Question 25:** Twenty three percent strongly disagree, 70 percent agree and 7 percent strongly disagree that the team performs own problem solving in a structured manner. Within the Faurecia system, the team leader leads the structured problem solving with the concerned operator once the trigger point of “stop at defect” has been reached. The assistance of the maintenance technician and supervisor will be requested if the problem is beyond the group to solve.

A single individual may have decided not to cooperate with the survey or displayed a very negative attitude in comparison to all other operational personnel. This resulted in a continuous trail of “strongly disagreed” data being reflected. The individual operator was questioned after the survey to the reasons for his negative response. He was under the impression that everybody would answer the questionnaire negatively. The reliability of the results from the questionnaire could have been improved if this individual responded more honestly.



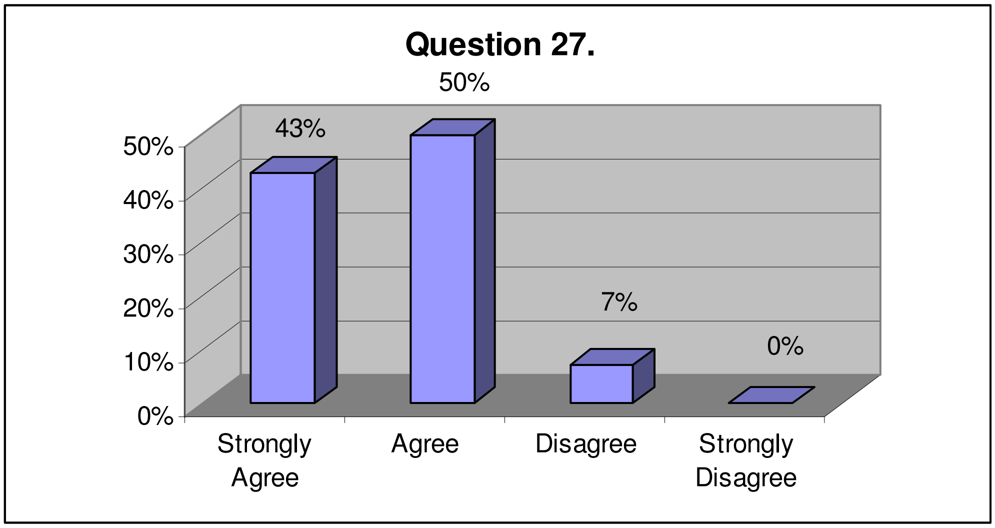

Source: Question 25 result from Questionnaire.

**Question 26:** Fifty percent strongly agreed, 47 percent agreed and 3 percent disagreed that the operators have been trained by the maintenance technician to perform TPM activities. The results indicate that some individuals disagree about being trained to performed TPM activities.



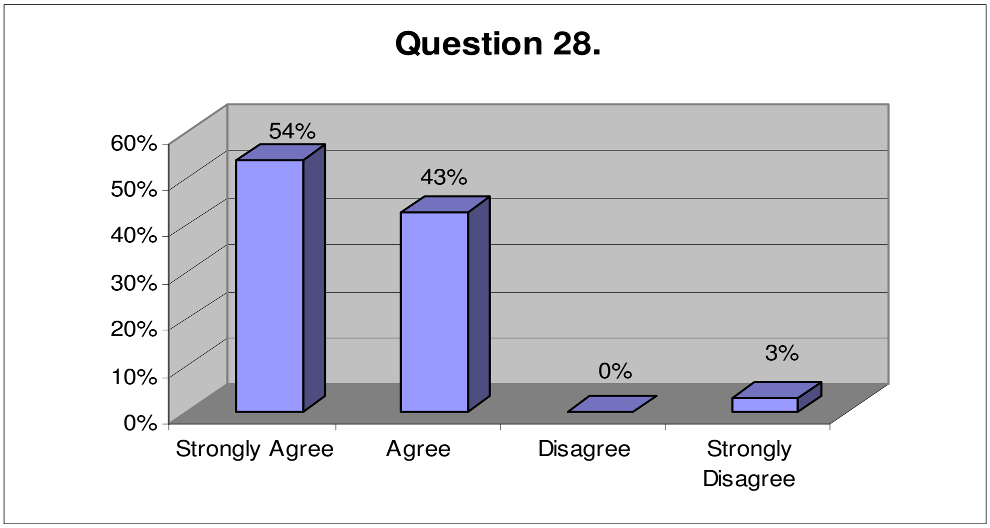

Source: Question 26 result from Questionnaire

**Question 27:** Forty three percent strongly agree, 50 percent agree and 7 percent disagree that TPM improves the teamwork of the production, maintenance and engineering departments. The operators do not “strongly agree" fully with this statement because the maintenance technicians could have different immediate objectives which could be in conflict with the operators own objectives. This could result in a delay in service or support from the maintenance personnel. The 7 percent reflects the negative perception of the statement.



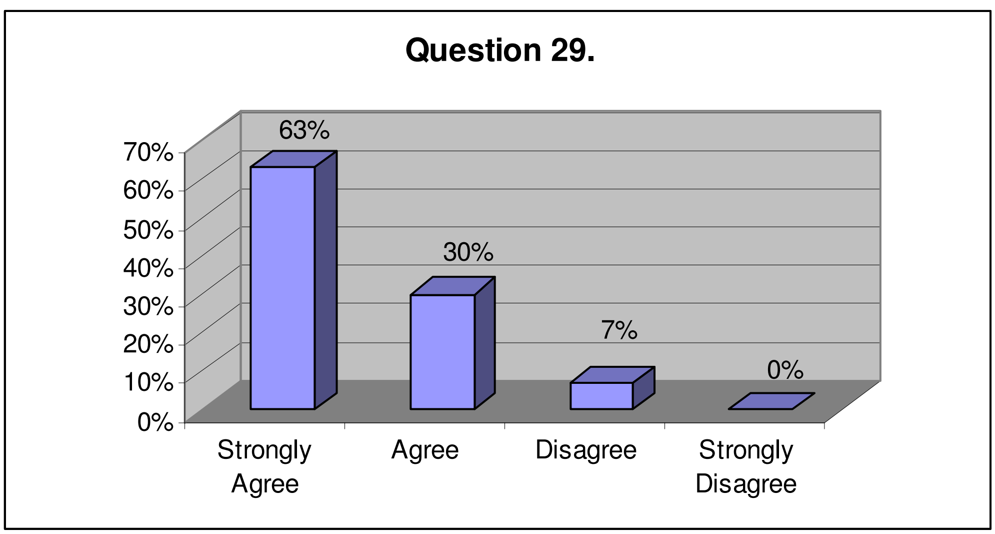

Source: Question 27 result from Questionnaire

**Question 28:** Fifty four percent strongly agree, 43 percent agree and 3 percent strongly disagree that TPM involves every single employee from top management to the operator on the shop floor. The TPM methodology is created at group level and plant level implementation is required by all operational personnel. It is used as an improvement strategy.



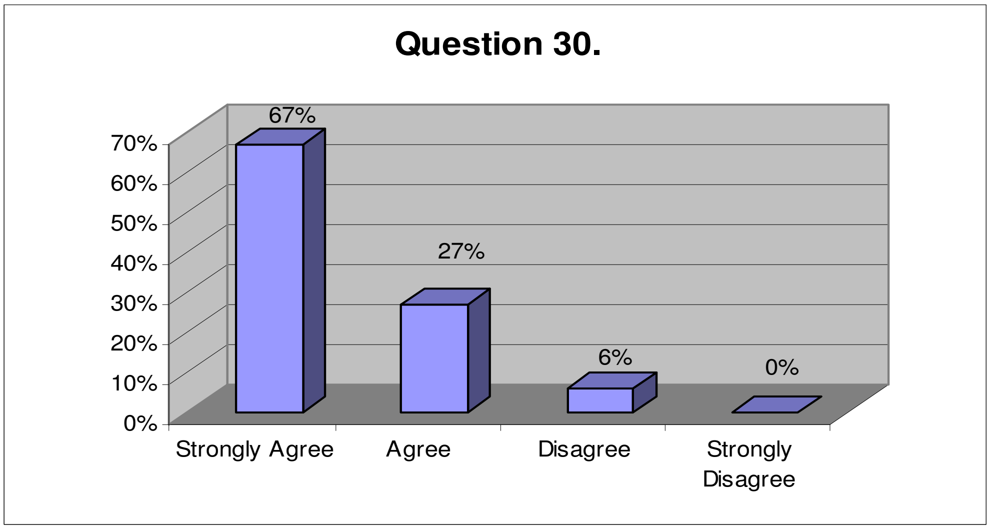

Source: Question 28 result from Questionnaire

**Question 29:** Sixty three percent strongly agree, 30 percent agree and 7 percent disagree that the operators have been trained by the maintenance technician to perform lock out procedures before performing autonomous maintenance activities on the equipment. The 7 percent who disagreed could be two operators who were absent from the training sessions. The shift supervisor was previously responsible for the lock out training and all operational personnel have been trained to perform lock outs.




Source: Question 29 result from Questionnaire

**Question 30:** Sixty seven percent strongly agree, 27 percent agree and 7 percent disagree that TPM aims to achieve zero accidents. This positive result indicates that the operators are aware of the risk assessment prior to commissioning the equipment and take responsibility for their own safety during operation of the equipment by adhering to all prescribed safety instructions.

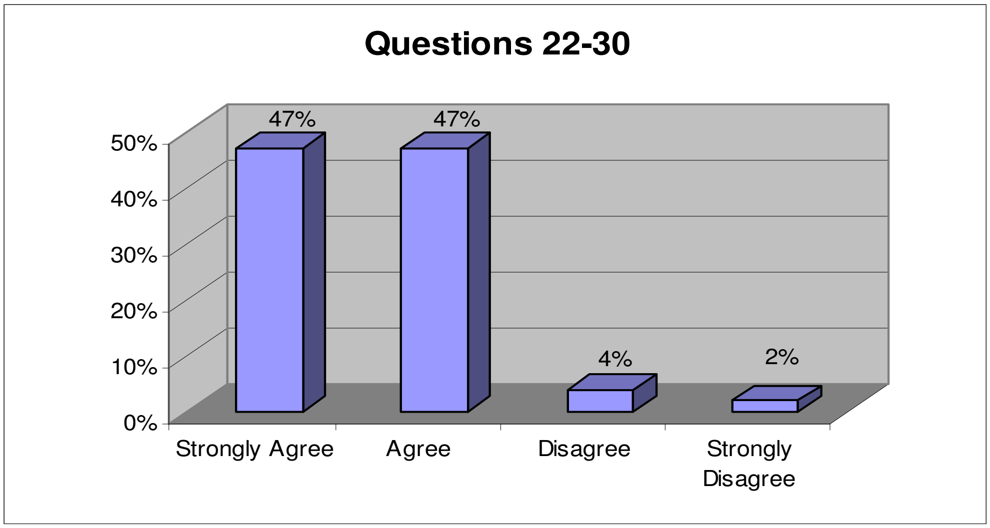



Source: Question 30 result from Questionnaire

The company's semester goals (Annexure M) support the key performance indicators (Annexure N) which requires that everybody on site works towards these common goals. The uptime and effective use of the equipment by the trained and committed operators, maintenance technicians and management makes the biggest contribution in achieving the objectives for the site.

**SECTION C – Involvement of personnel summary**

The data set for questions 22 to 30 indicates that 47 percent strongly agree, 47 percent agree, 4 percent disagree and 2 percent strongly disagree. A positive result of 94 percent indicates that all operational personnel belong to an organization which operate in teams to achieve common objectives (Annexure M) which are measure on a monthly basis (Annexure N).




Source: Question 22-30 results from questionnaire

Table 4.4 Statistical results question 22-30

| Statistical terminology | Results / values |
|---|---|
| Mode | 4 = Strongly agree |
| Median | 3 = Agree |
| Mean | 3,39 |
| Inter quartile range | 1 |
| Quartile Q1 | 3 = Agree |
| Quartile Q3 | 4 = Strongly agree |
| Range | 3 |

Source: Question 22-30 results from questionnaire

The interpretation of statistical terminology (Wegner, 2007) applied is as follows:

- Mode – the most frequently occurring value is 4 which matches the legend of strongly agree.
- Median – the middle number of this ordered set data is 3 and matches the legend of agree.
- Mean – the average for the set of data is 3, 39 and indicates that it strongly leans from agree towards strongly agree.

- Inter quartile range – The interpretation is that 50 percent of the results span an interval of 1 between the lower quartile Q1 value 3 and the upper quartile Q3 value 4.This interval is between agree and strongly agree.

**4.2 Testing of the data**

The results of the questions 18-19 from the questionnaire triggered a similar response with 80 percent responding positively and 20 percent negatively. The two statements:

- Adjustments are made to the equipment when the quality of the product is no longer accepted, and
- The causes of defects and reworks are removed from the equipment at the first incident, are worded differently but the conclusion should be the same.

The correct research procedure (Collis et al., 2003) and accurate measurement were followed to ensure the validity of the data.

**4.3 Summary**

In this chapter, the researcher presented and analysed the research questionnaire (Annexure B). The results from the questionnaire were aligned with the literature review as presented in chapter 2.

In the next chapter, the researcher will present the summary of the research findings and conclusions which are based on the empirical survey. Recommendations and additional research opportunities will also be presented in the final chapter.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5. Introduction

This chapter provides a brief summary of the results of the research conducted at Faurecia Just in Sequence (JIS) assembly site. The purpose of the research, as stated in chapter 1, was to establish if the introduction of Total Productive Maintenance resulted in:

- reduced downtime;
- improved Overall Equipment Efficiency(OEE); and
- increased personnel involvement at all levels.

## 5.1 Summary of research

Taking in consideration the sub problem questions in chapter 1, the research has shown the following:

- The literature study indicates that TPM is an improvement strategy that could be used alone or in combination with other improvement strategies to increase the organization's performance through equipment optimisation.

- It appears that weaknesses remain in the current TPM system which is restrictive to further downtime reduction. Although downtime has been reduced, there needs to be a greater focus on implementation in order to achieve world class performance levels.

- The results from the research survey indicate that the Overall Equipment Efficiency (OEE) has increased and that the equipment is available when needed with the reduction of downtime as a major contributor to the success. More training will be needed to reduce the response time to eliminate inferior product quality from the equipment.

- Under the theme of personnel involvement, more training is needed to make the operators understand the formation of teams with common objectives to the site objectives, and that all personnel need to be trained by the maintenance technician to perform a lock out.

The research paper indicates that TPM has been successfully implemented at Faurecia Interior Systems and with minor adjustments further improvements in manufacturing performance can be achieved.

### 5.2 Conclusion from research

The primary objective or main problem mentioned in chapter one was:
**Evaluating the success of Total Productive Maintenance at Faurecia Interior Systems.**

In order to address the above mentioned primary objective, the following secondary objectives need to be investigated:

- What does the literature reveal about TPM?

In chapter two, TPM was defined as getting the most efficient use of the equipment by the participation of all operational personnel. The six major activities as stated in section 2.2 were expanded on through out the chapter.

- Has the introduction of TPM resulted in reduced downtime at Faurecia Interior Systems in the Eastern Cape?

In chapter two, breakdown losses were identified as one of the six big losses which also include, set-up adjustment losses, idling and minor stoppage losses, reduced speed losses, quality defects and start-up /yield losses. In section 2.15.1 the actions for achieving zero breakdowns were identified and implemented would result in reduced breakdowns.

- Has the introduction of TPM resulted in improved OEE at Faurecia Interior Systems?

In chapter two section 2.17 the overall equipment efficiency factors in the major losses that TPM seeks to eliminate under formulae heading of availability, performance efficiency and quality rate were presented. The calculation included: Overall equipment efficiency = equipment availability (%) x performance efficiency (%) x rate of quality (%)

The targets were established in chapter two to improve the impact of the six big losses which also influence the overall equipment efficiency.

- Has TPM increased personnel involvement at all levels at Faurecia Interior Systems in the Eastern Cape?

The pillars of TPM as presented in section 2.19 of chapter two encapsulated the involvement of the personnel at Faurecia Interior system.

The conclusion of the research paper indicates that the introduction of TPM reduced downtime, improved OEE and increased personnel involvement at all levels.

### 5.3 Recommendation from this research

The Faurecia Interior System site has had different levels of success in the implementation of TPM methodology. The following areas have been identified for improvement:

- All employees should be orientated regarding the functioning of the maintenance department. This orientation can take the form of a structured induction programme which can give an overview of specific key activities that are performed in this department.

- Awareness should be created regarding the technical standards by exposing the operators to acceptable and unacceptable maintenance practices. A picture album supported by a short description can be created to differentiate between the extremes. It should be expanded beyond the local site and could incorporate all other Faurecia sites.

- The operators must be trained on the functioning of the equipment. ”What happens when the start button is pressed?” The basic functioning of the electric, pneumatic and hydraulic circuits and gearboxes must be explained from a training module specifically created for this purpose.

- Skills transfer should take place between the maintenance technician and the operators in easy-to-perform maintenance activities when a breakdown occurs. The workmanship standard must be established by the maintenance technician through demonstration and only once this level of competence has been reached, will the operator be allowed to perform this activity autonomously.

- Although structured problem solving is available, the operators are not exposed nor trained in other problem solving techniques such as cause and effect diagrams, brainstorming and the 5 why's and 2 how's. Limited technical exposure at this level restricts meaningful problem solving in so far breakdown elimination.

- The OEE performance levels should be tracked daily in the operational area. The variables that influence the OEE calculation results should be isolated and assigned to specific incidents where the targets were not achieved. It would eliminate the slow response from the operators to correct poor quality from the equipment.

- The micro failures are tracked by the operators on tally sheets which are not always accurate. The equipment on these workstations is software driven and the failures appear on a monitor from where the operators retrieve the information for the tally sheets. The software program must be adapted to collect the failure data and to make it available in a daily report format.

- The maintenance costs are not displayed on the tracking charts in the operational area. The established running cost per machine must be supported by details such as the cost for components having to be repaired or replaced. The value of the critical spares must also be considered during this process.

## 5.4 Opportunities for further research

This research paper provided insight to the level of successful implementation of TPM at Faurecia Interior System. During the research process, opportunities for further research have been identified:

- **The impact of Six Sigma implementation on a TPM project:**
  A study could be conducted to investigate the benefits that could be derived from process improvement using the Six Sigma methodology.

- **The impact of world class manufacturing techniques on manufacturing performance:**
  Organizations stand to benefit from the implementation of the world class manufacturing techniques where lean focus on waste reduction, TQM will improve quality at the source, TPM will increase overall equipment efficiency and Six Sigma will reduce variation.

### 5.5 Summary

The research conclusions were presented which indicated that TPM has successfully been implemented at Faurecia Interior System. Recommendations were made to areas where improvements are needed. The recommendations are aimed at the operator and operational level personnel of the organization where improvement of the existing TPM system is required. The chapter was concluded by outlining opportunities for further research.

**List of resources**


Bicheno, J. (2004). *The New Lean Toolbox*. Buckingham: Moreton Press.

Bicheno, J. (2006). *Fishbone Flow: Integrating Lean, Six Sigma, TPM and TRIZ*. Buckingham: Moreton Press.

Blancard, B.S. (1997). *An enhanced approach for implementing total productive maintenance in the manufacturing environment* . Vol. 3 , No. 2 . Print location: MCB university Press.

Borris, S. (2006). *Total Productive Maintenance-Proven strategies and techniques to keep equipment running at peak efficiency*. Print location: McGraw-Hill.

Campbell, J.D. & Reyes-Picknell, J.V. (2006). *Uptime Strategies for Excellence in Maintenance Management*. 2nd ed. Print location: Productivity Press.

Collis, J. & Hussey, R. (2003). *Business Research. A practical guide for undergraduate and postgraduate students*. 2nd ed. Print location: Palgrave Macmillan.

Dennis, P. (2006). *Getting the right things done: A leaders guide to planning and executing*. Print location: Lean Enterprise Institute.

Fowler, H.W. & Fowler, F.G. (Editors). (1980). *The Concise Oxford Dictionary*. 6th ed. Print location: University Press

Hill, C.W.L. (2005). *International business: Competing in the Global Marketplace.* 5th ed. Print location: New York : McGraw-Hill/Irwin .

Imai, M. (1986). Kaizen: *The key to Japan's Competitive Success*. Print location: McGraw-Hill.

Jostes, R.S. and Helms, M.M. (1994). *Total Productive Maintenance and Its link to Total Quality Management. Work Study*, Vol. 43 No. 7 Print location: Publisher.

Kanawaty, G. (1996*). Introduction to work study*. 4th ed. Print location: Skotaville Publishers.

Kennedy, R. (2006). *Examining the process of RCM and TPM: What do they ultimately achieve and are the two approaches compatible?* Australasia: The Centre for TPM.

Kister, T.C. & Hawkins, B. (2006). *Maintenance Planning and Scheduling Handbook*. Butterworth:Heinemann Elsevier.

Leedy, P.D. (1997). *Practical research planning and design*. 6th ed. Print location: Prentice-Hall.

Liker, J.K. (2004). *The Toyota way*. Print location: McGraw-Hill.

Madu, N.M. (2000). *Competing through maintenance strategies*. Vol. 17, No. 9, Print location: MCB University Press.

Mahadevan, B. (1998). *Principles of World Class Manufacturing*. Print location: the management accountant.

Newby, T.J. & Ertmer, P.A. (1997). *Practical Research Planning and Design*. 6th ed. Print location: Prentice –Hall.

Pellisier, R. (2007). Business Research made easy. Print Location: Juta.

Pieterse, K. (2005). *Leaning the South African way: Implementing Lean manufacturing in the Rainbow Country*. Print location: Trilean.

Saunders, M.N.K., Lewis, P., & Thornhill, A. (1997). *Research Methods for Business Students*. Print location: Pitman Publishers.

Schultz, H., Bagrain, T., Potgieter, T., Viedge, C., & Werner, A. (2003). *Organizational Behaviour a contempory South African perspective.* 2nd ed. Pretoria: Van Schaik.

Shirose, K. (1992). *TPM for Workshop Leaders*. New York: Productivity Press.

Stevenson, W.J. (1996). *Production/Operations Management*. 5th ed. Print location: The Irwin series.

Suzuki, T. (1992). *New Direction for TPM*. Print location: Productivity Press.

Tajiri, M.& Gotoh, F. (1999). *Autonomous Maintenance in seven steps: Implementing TPM on the shop floor.* Print location: Productivity Press.

Van der Wal, S.Y. (2007). *Evolutionary change in automotive technology: Long term developments, artefacts, producers and consumers*. Print location: Eindhoven Centre for Innovation Studies.

Venkatesh, J. (1996 -2005). *An Introduction to Total Productive Maintenance. Plant Maintenance Resource Center*. Print location: Plant Maintenance Resource Center.

Wegner, T. (2007). *Applied Business Statistics*. 2nd ed. Print location: Juta & Co.

Womack, J.P. Jones, D.T. & Roos, D. 1990. *The machine that changed the world.* New York: Rawson Associates.

## ANNEXURE A

## QUESTIONNAIRE COVERING LETTER

Dear Respondent

**<u>RE: Evaluating the success of Total Productive Maintenance at Faurecia Interior Systems.</u>**

I hereby request your assistance in answering the questions to the attached questionnaire. The questionnaire is part of my research paper to fore fill the requirements of a Masters Degree in Business Administration (MBA) at the Nelson Mandela Metropolitan University (NMMU).

I am currently conducting a survey to establish the effectiveness of Total Productive Maintenance (TPM) in reducing downtime, improved the Overall Equipment Efficiency (OEE) and increased personnel involvement at all levels at our site. The attached questionnaire will only take a few minutes to complete and must be returned to me before the 23rd September 2009.

I hope you find enjoyment in completing the questionnaire and want to thank you for taking the time to help me. If you have any queries or would like more information, I may be contacted at 043-7312919 or per mobile 082 651 0964.

Yours Faithfully

John Faber

## ANNEXURE B

## RESEARCH QUESTIONNAIRE

The purpose of this survey is to establish a better understanding of your work environment with regards to Total Productive Maintenance (TPM).

Total Productive Maintenance (TPM) can be described as the synergistic relationship between all organisational functions, particular between production and maintenance, for continuous improvement of product quality, operational efficiency, capacity assurance and safety.

### SECTION A: Downtime reduction

Please mark the appropriate box with an **X** and only mark each question once. Also ensure to answer all the questions.

1. Through TPM the equipment is maintained in a clean basic condition by remedying the sources of contamination.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

2. The lubrication points/surfaces are identified on the equipment and serviced as per the specified standard.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

3. Loose fasteners on equipment are immediately secured if observed.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

4. The equipment is used as per the manufacturer's guideline.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

5. Through TPM the maintenance department perform routine inspection on all the equipment on site.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

6. The maintenance department restore or replaces defective parts as required.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

7. Adequate targets have been established for Mean Time between Failures (MTBF) based on the results of routine inspection.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

8. The maintenance/engineering department correct equipment design weaknesses.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

9. The maintenance department is following a standardized servicing procedure.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

10. Mistake proof systems (poka yoke) are installed on the equipment.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

11. The maintenance department maintain critical spare parts for all equipment.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

12. All line stoppages which last longer than five minutes are recorded and tracked on displays in the production area.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

13. The maintenance technician's workmanship is to standard.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

14. Through the implementation of TPM the downtime has been reduced.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

15. TPM reduces maintenance cost.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

**SECTION B: Overall Equipment Efficiency (OEE)**

16. All micro failures are recorded and tracked on displays in the production area.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

17. Each breakdown that last longer than 5 minutes is analysed, root cause established and corrective action taken.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

18. Adjustments are made to the equipment when the quality of the product is no longer acceptable.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

19. The causes to defects and reworks are removed from the equipment at the first incident.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

20. The quantity of reworks are recorded and tracked on displays in the production area.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

21. Through Total Productive Maintenance machine speed losses are detected.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

**SECTION C: Involvement of all personnel**

22. The Total productive Maintenance (TPM) principles are applied at Faurecia.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

23. The operators are grouped into teams with common objectives which are aligned to the site objectives.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

24. The team operate autonomously to achieve the daily objectives.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

25. The team perform own problem solving in a structured manner.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

26. The operators have been trained by the maintenance technician to perform TPM activities.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

27. TPM improves the teamwork between the production, maintenance and engineering departments.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

28. TPM involves every single employee, from top management to the operator on the shop floor.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

29. The operators have been trained by the maintenance technician to perform a lock out procedures before performing autonomous maintenance activities on the equipment.

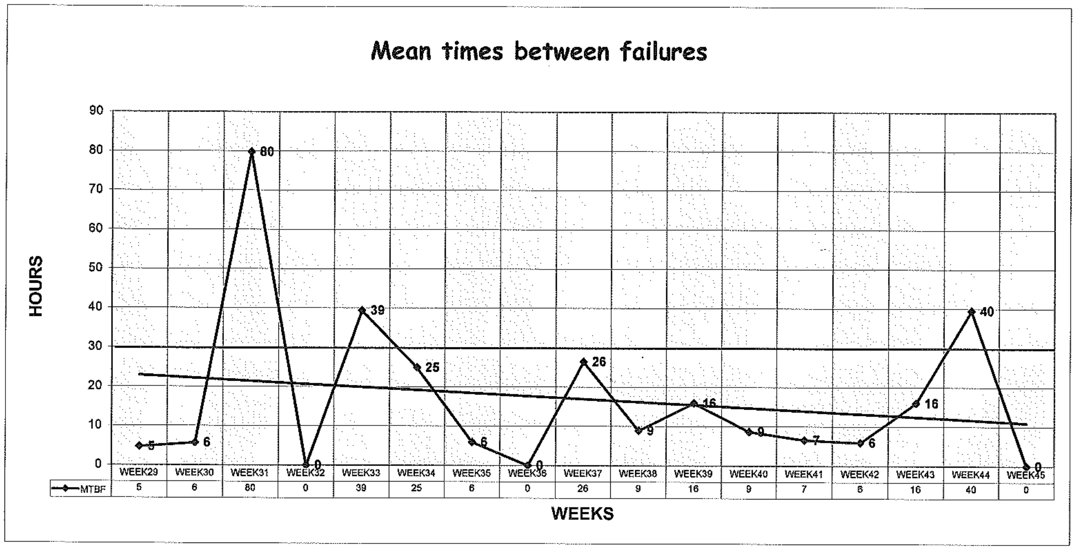
| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

30. TPM aims to achieve zero accidents.

| Strongly Agree | Agree | Disagree | Strongly disagree |
|---|---|---|---|
| | | | |

**THANK YOU FOR YOUR COOPERATION.**

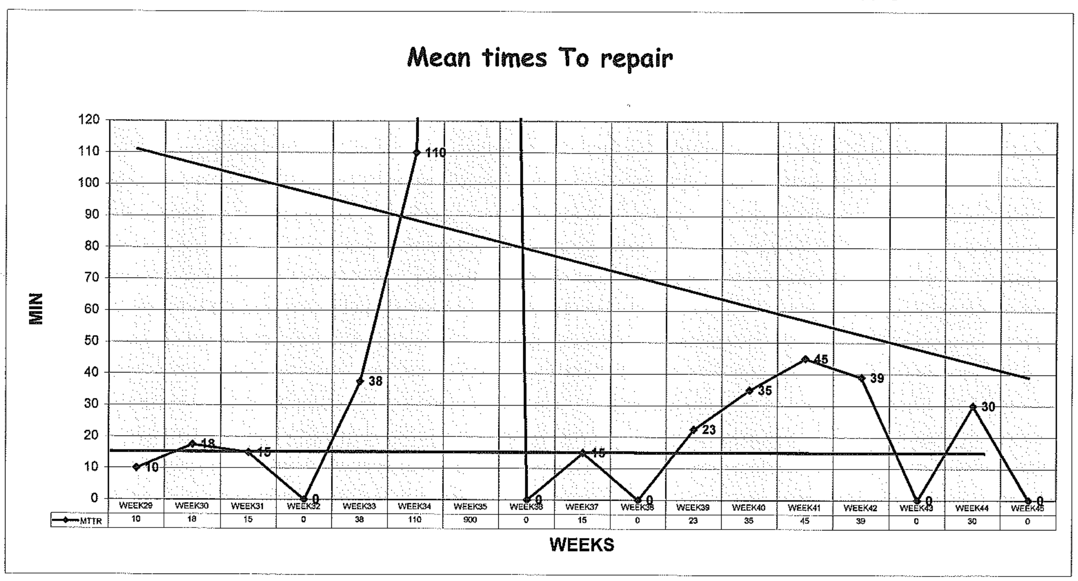
# ANNEXURE C




| | WEEK29 | WEEK30 | WEEK31 | WEEK32 | WEEK33 | WEEK34 | WEEK35 | WEEK36 | WEEK37 | WEEK38 | WEEK39 | WEEK40 | WEEK41 | WEEK42 | WEEK43 | WEEK44 | WEEK45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBF | 5 | 6 | 80 | 0 | 39 | 25 | 6 | 0 | 26 | 9 | 16 | 9 | 7 | 6 | 16 | 40 | 0 |

MTTR = <u>Stoppage Time X 60</u>
Number of stoppages w/o micro - stops

MTBF = <u>Actual production time</u>
Number of stoppages




| | WEEK29 | WEEK30 | WEEK31 | WEEK32 | WEEK33 | WEEK34 | WEEK35 | WEEK36 | WEEK37 | WEEK38 | WEEK39 | WEEK40 | WEEK41 | WEEK42 | WEEK43 | WEEK44 | WEEK45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MTTR | 10 | 18 | 15 | 0 | 38 | 110 | 900 | 0 | 15 | 0 | 23 | 35 | 45 | 39 | 0 | 30 | 0 |

# ANNEXURE D



MECHANICAL 01 MONTHLY - PLASTIC WELDER

| | | | |
|---|---|---|---|
| **Task No.** | EL01M-005 | **Request Date** | 2009/11/09 |
| **Tenant** | | **Request Time** | 15:59:57 |
| **Assigned By** | | **Originator** | |
| **Assigned To** | A202831 | **Telephone No.** | |
| **Scheduled Start Date** | 2009/10/26 00:00:00 | **Extension** | |
| **Scheduled Finish Date** | 2009/10/29 | **WO Type** | PM |
| **Perform by Warranty** | No | **Completion Date** | ____________ |
| **Priority** | 1.00 | **Completion Time** | ____________ |
| **Expense Class** | | | |

| Craft | Crew Size | Estimated Labor Hours |
|---|---|---|
| MAINTECH | 2.00 | 4.00 |

| | | | |
|---|---|---|---|
| **Equipment No.** | EL51.109 | | |
| **Equipment Description** | RHR U/S WELDER | | |
| **Serial No.** | | **Critacality** | 1 |
| **Cost Center** | | **User-defined Field 2** | |
| **General Ledger No.** | | **User-defined Field 3** | |
| **Department** | PRE-ASSEM | **User-defined Field 4** | |
| **Location** | EAST LONDON FACTORY | **User-defined Field 5** | |
| **Sub-location 1** | PRE-ASSEMBLY | **Must Be Down** | Yes |
| **Sub-location 2** | - | **Down Time** | |
| **Sub-location 3** | - | **Estimated Down Time** | 4.00 |
| **Reason for Outage** | ____________________ | | |

## Safety Notes

IDENTIFY HAZARDS & MAKE SAFE BEFORE STARTING WORK
FOLLOW LOCK OUT PROCEDURE BEFORE STARTING WORK

## Comments

| Equipment No. | Meter Name | Meter Reading |
|---|---|---|
| | | |

| Item No. | Equipment No. | Description | Qty Required | Date Used | Qty Used | Total Unit Cost |
|---|---|---|---|---|---|---|

**List extra parts and comments here**

| Employee Code | Equipment No. | Work Date | First Name | Last Name | Regular Hours | Overtime Hours |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Task Instructions**

# ANNEXURE D



1. OPEN ROLLER SHUTTER DOOR.
2. OPEN MAINTENANCE DOOR.
3. CLEAN ENTIRE MACHINE AND RECOATE HORNS WITH A HERSCHELL RECOATE SPRAY.
4. CHECK GUIDE WAYS ON BRIDGES 2 AND 3 FOR DAMAGES
5. CHECK DOWNHOLDERS FOR CORRECT FUNCTION.
6. CHECK ALL WELDING SONOTRODE(HORN) ARE SECURED TIGHT AND ALIGNED
7. CHECK THAT ALL CALOTTE COOLING PIPES ARE IN PROPER POSITION.
8. CHECK AND CLEAN CALOTTES IF NECESSARY.
9. VISUAL INSPECTION OF THE COMPRESSED-AIR MAINTENANCE UNIT.
10. CHECK ALL PNEUMATIC SETTING NOBS ARE LOCKED
11. CLOSE MAINTENANCE DOORS.
12. CHECK MACHINE FOR CORRECT OPERATION.

NOTE:THIS SERVICE GETS DONE WITH THE ELECTRICAL SERVICE.

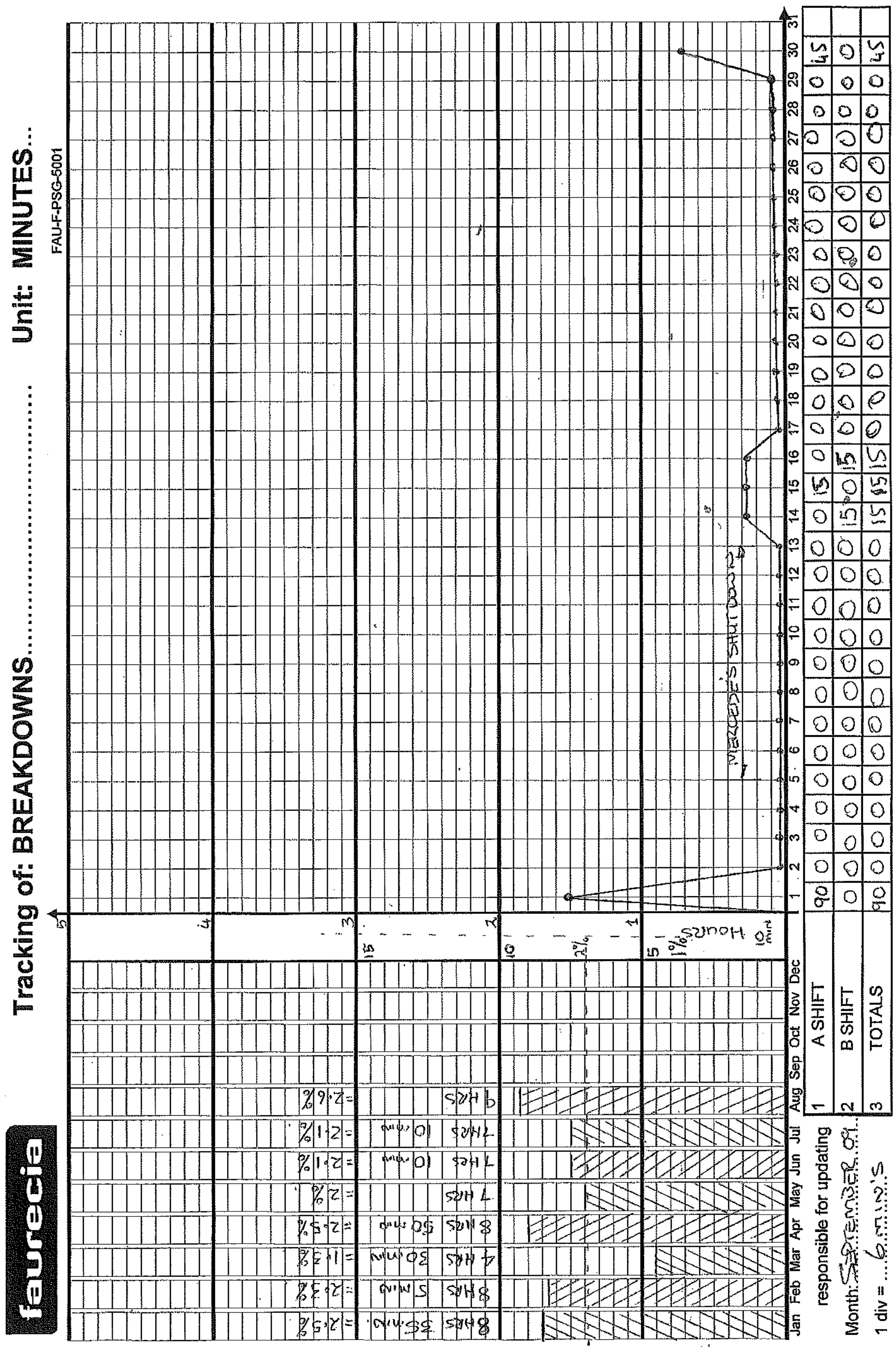
ANNEXURE E

# W204 WELDING MACHINES CRITICAL SPARES

Faurecia East London — Stock count date: 13/08/2009

| BIN No | PART DESCRIPTION | Min Level | stock onhand | Supplier Part No. | Lead Time | MACHINE | SUPPLIER | Contact Details |
|---|---|---|---|---|---|---|---|---|
| W204/001/EL51.106-109 | Inductive Switch | 1 | 2 | BES 516-300-S166-S49 | 8Weeks | Welding M/C's | Balluf | Rolf Liebermann +49(0)7424 701-127 |
| W204/002 | Reed Switch | 0 | 1 | SME-3 SQ- LED-24-B | 3Weeks | | Festo | Festo 043 731 2095 |
| W204/003 | Inductive Switch | 2 | 5 | BES 516-3005-G-E5-C-S49 | 8Weeks | | Balluf | Rolf Liebermann +49(0)7424 701-127 |
| W204/004 | Reed Switch | 1 | 1 | PSEN2.2p-21/No523121 | 8Weeks | | Pilz | Rolf Liebermann +49(0)7424 701-127 |
| W204/005 | Reed Switch | 1 | 1 | RZT6-03ZRS-KPO 1023974 | 8Weeks | | Sick | Rolf Liebermann +49(0)7424 701-127 |
| W204/006 | Photo-electric Proximity | 1 | 4 | WTB 140-P330 | 8Weeks | | Sick | Rolf Liebermann +49(0)7424 701-127 |
| W204/007 | Magnetic sensor | 1 | 1 | PSEN2.2-20/No 513120 | 8Weeks | | Pilz | Rolf Liebermann +49(0)7424 701-127 |
| W204/008 | Limit Switch | 1 | 1 | XCK P2118 G11 | 1Week | | Telemecanique | EPM 043 743 0212 |
| W204/009 | Contactor | 1 | 1 | 3RT 1025-1BB40 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/010 | Safety Relay | 1 | 1 | PNOZE31.1P/No.774139 | 8Weeks | | Pilz | Rolf Liebermann +49(0)7424 701-127 |
| W204/011 | Safety Relay | 1 | 1 | PZEX4V /7745801 22619 | 8Weeks | | Pilz | Rolf Liebermann +49(0)7424 701-127 |
| W204/012 | Safety Relay | 1 | 1 | PNOX X3/No.774318830871 | 8Weeks | | Pilz | Rolf Liebermann +49(0)7424 701-127 |
| W204/013 | Contactor | 1 | 1 | 3RH1140-1BB40 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/014 | Contactor | 1 | 1 | 3RT1016-1BB41 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/015 | Sensor/Actor Box | 1 | 2 | MVK-MP D18/No.55307 | 8Weeks | | Murr Electronik | Rolf Liebermann +49(0)7424 701-127 |
| W204/016 | Wago Input Module | 1 | 1 | 750-466 | 8Weeks | | Wago | Rolf Liebermann +49(0)7424 701-127 |
| W204/017 | Relay | 1 | 1 | V23057-800006-B601 | 8Weeks | | Schrack | Rolf Liebermann +49(0)7424 701-127 |
| W204/018 | Digital Output Module | 1 | 1 | 6ES7322-1BLOO-0AA0 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/019 | Repeater RS485 | 1 | 2 | 6ES7972-0AA01-0XA0 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/020 | Digital Output Module | 1 | 1 | 6ES7321-1BL00-0AA0 | 3Weeks | | Siemens | Power Flo 043 736 2215 |
| W204/021 | Pressure Piece | 1 | 1 | 0135 304545.0 | 8Weeks | | Machinenfabrik spaichingen | Rolf Liebermann +49(0)7424 701-127 |
| W204/022 | V Oil Brake | 1 | 2 | 0146 309305.0 | 8Weeks | | Machinenfabrik spaichingen | Rolf Liebermann +49(0)7424 701-127 |
| W204/023 | HF Plug(gen.side) | 1 | 2 | FFA.1S.405.CTAC32 | 8Weeks | | Wedmulle | Rolf Liebermann +49(0)7424 701-127 |
| W204/024 | HF Plug(conv.side) | 1 | 2 | FFA.15.405.CTLC32 | 8Weeks | | Lemo | Rolf Liebermann +49(0)7424 701-127 |
| W204/025 | Down Holder | 1 | 1 | T-No161362 | 3Weeks | | Festo | Festo 043 731 2095 |
| W204/026 | Key oper.switch 3pos. | 1 | 2 | M22-WRS3 | 3Weeks | | Moeller | EPM 043 743 0212 |
| W204/027a | Ultrasonic horn | 1 | 1 | 42853/09300 | 8Weeks | | Sonotronic | Rolf Liebermann +49(0)7424 701-127 |
| W204/027b | Ultrasonic horn | 1 | 1 | 42853/09100 | 8Weeks | | Sonotronic | Rolf Liebermann +49(0)7424 701-127 |

ANNEXURE F



faurecia
Tracking of: BREAKDOWNS
Unit: MINUTES
FAU-F-PSG-5001
MERCEDES SHUTDOWN
A SHIFT
B SHIFT
TOTALS
responsible for updating
Month: SEPTEMBER 09
1 div = 6 min's

# ANNEXURE G

faurecia

## TALLY COUNT

FAU-F-LS-0218/en
Issue 02

EQUIPMENT :AutoTorque machine

Workstation:Rear Torque station

PROBLEM: Auto Torque failed

| PROBABLE CAUSE | Week: 33 | SHIFT | B Spindle No | Total |
|---|---|---|---|---|
| Nut not Flushing | 10 Monday | Morning | | |
| | | Afternoon | | |
| Nut not Flushing | 11 Tuesday | Morning | 6, 6, 6, | |
| | | Afternoon | | |
| Nut not Flushing | 12 Wednesday | Morning | | |
| | | Afternoon | | |
| Nut not Flushing | 13 Thursday | Morning | 5, 10, 1 | |
| | | Afternoon | | |
| Nut not Flushing | 14 Friday | Morning | | |
| | | Afternoon | 6 | |
| Nut not Flushing | 15 Saturday | Morning | | |
| | | Afternoon | | |

| PROBABLE CAUSE | Day | Shift | A Time lost | |
|---|---|---|---|---|
| | | Morning | | |
| | | Afternoon | | |
| | | Morning | | |
| | | Afternoon | | |
| | | Morning | | |
| | | Afternoon | | |
| | | Morning | | |
| | | Afternoon | | |

EXAMPLE

SHOULD YOU HAVE TO USE THE MANUAL TORQUE TOOL TO TORQUE NUTS FOUR TIMES ON POINT 5 AND THEN 3 TIMES ON POINT8 ON MORNING SHIFT, RECORD IT AS FOLLOWS

| | | | | |
|---|---|---|---|---|
| Nut not Flushing | Day 11/08/09 | Morning | 5555888 | |
| | | Afternoon | | |

# ANNEXURE H

## Production

faurecia

| | QRQC Follow up | |
|---|---|---|
| Team: Keith/Shawn / John /Stanley/Danie | | Opened: 07/10/08 |
| Steps | Meeting dates | Milestone review (name / sign-off) |
| D1 to D3 | 07/10/2008 | D3: by Quality |
| D4 to D5 | 08/10/2008 | D5: by Problem leader |
| D6 to D8 | 27/10/2009 | D8: by Plant Manager |

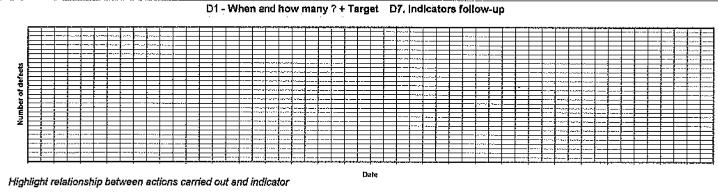
**D1 - Problem Description**

| IS | IS NOT & DIFFERENCES | D2 - Risks on similar products and processes |
|---|---|---|
| Defective parts? Problem?<br>Where / by whom *detected* and how?<br>Where / by whom *created* and how? | between defect locations, operators, machines, references, shifts, days… | |
| **Problem:** Turn table cycle interfered **Where detected: By whom detected and how: Where created: By whom created and how:**<br>LHF welding machine turn table /operator notice the turn table stopped before end of cycle/the operator noticed the error message on PLC display/created at the LHF turn table /defect created by machine/electrical part failure. | No difference between machines.<br>Is not RHF/RHR/LHR Machines.<br>No difference between operators.<br>Is not operator error.<br>Is not a temperature problem.<br>No difference between S.A.& Magna welding machines. | Risk on RHF/RHR/LHR Machines. |

### D3 - Containment

| Action | Pilot | Dead line | Check by shift / Sorting results |
|---|---|---|---|
| Technical team called out. | Keith | 7/10/08 | N/A |
| Possible causes identified | Keith | 7/10/08 | N/A |
| Process of elimination of possible causes carried out. | Keith | 7/10/08 | N/A |

D1 - When and how many ? + Target D7. Indicators follow-up




*Highlight relationship between actions carried out and indicator*

| | Factor | Control Point | Standard | REAL situation: NOK parts | REAL situation: OK parts | Real vs. Std? | Std OK? | Investigation Plan to validate / eliminate factor: Investigation Action | Responsible / Deadline | Result - Defect reproduced? | Factor vali-dated? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D4 - Causes of Non Detection | Electrical limit switch on turn table | Contact between roller & micro switch plunger | 3mm clearance in extended position | Switch operating operating mechanism lagging in switching | Free moving switch mechanism. | NOK | OK | Simulated switching in open & closed position. | Keith 7/10/2008 | No | Yes |
| | | | | | | | | Replaced suspect switch | Keith 7/10/2008 | No | yes |
| D5 - Causes of Occurrence | Electrical limit switch on turn table | Micro switch | Free moving spring loaded action. | Not able to identify defect. | Free moving micro switch | Doubt | OK | Removed switch &opened the switch for investigation. Could not find any defects. | Keith /Danie 7/10/2008 | No | No |

| D4 & D5 - 5 Why's | Why? | V | Why? | V | Why? | V | Why? | V | Why? | V | D4 & D5 - Root causes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turn table cycle interrupted. | v | Faulty limit switch under turn table. | v | Micro switch mechanism sticking in limit switch housing. | v | Failure unknown(No visible signs of defect) | | | | Limit switch failed |

O = OK, X= NOK, Δ= Doubt , V= verify

### D6 - Corrective Action Plan

| Action | Responsible | Deadline | Check by shift |
|---|---|---|---|
| 1) Electrical turn table limit switch added to critical spares list. | Keith | 08/10/08 | Shawn |
| 2) Physical check of switch added to preventative maintenance check list. | Keith/Stanley | 08/10/08 | Shawn |
| 3) Update MP2 System to reflect incident report & history | | | |
| Lesson Learned Sheet | | | |

### D8 - Lessons learned

| Action | Responsible | Date |
|---|---|---|
| Objectives met | | |
| Operators informed | N/A | |
| Workstation docs. updated | Keith/Stanley | 08/10/08 |
| FMEA updated | N/A | |
| Control plan updated | N/A | |
| Design standards updated | N/A | |
| Lesson learnt Sheet | Shawn | 24/10/08 |
| Plant manager validation | | |

# ANNEXURE I

| faurecia > sistemas de interior | Stop at Defect | Ref.: | W204-038 |
|---|---|---|---|
| | W204 | Revision: | 6 |
| | | Date: | 25.06.09 |

Workstation: Assembly

Cross the number for each defect found in the workstation

* First Level Reaction

Date: 11 - 11 - 2009

| | Cod. | Defect Found | Number of defects &Reaction | | | | | | | | | | Left | Right | Running QRQC No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | E1 | Dents on top roll | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E2 | Dents on armrest | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E3 | Dents on insert | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E4 | Scratches on top roll | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E5 | Scratches on armrest | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E6 | Wrong part supplied | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E7 | Gap condition at armrest | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E8 | Gap condition at door light | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| INTERNAL | E9 | Chrome ring cracked | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E10 | Switch not fitted properly | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E11 | Loose Screw | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E12 | Loose décor strip/blender bolt | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E13 | Loose crash bolt | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E14 | Speaker grille bulging | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E15 | Clip Missing | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E16 | Taping poor | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E17 | Map pocket scratched | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E18 | Glue on insert | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E19 | Glue on armrest | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E20 | Cut on insert | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E21 | Map pocket stiffner poor fit | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E22 | Décor strip scratched/chipped | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E23 | Harmann Kardon logo missing/loose | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E24 | Marks on door opener chrome | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E25 | Welding heads pulled off | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E26 | Deep welding | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E27 | Loose welding | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E28 | Door light gap or bulging | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E29 | Broken pin on Insert/Blender | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E30 | Scratch on armrest bracket | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E31 | Guide bush missing | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| SUPPLIER | E32 | Material protruding | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E33 | Décor strip proud / poor fit. | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E34 | Loose stiffner | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E35 | Map pocket dirty | 1Y | 2R | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | E36 | Insert Clip holder poor moulding | 1R | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |
| | | | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 1st Stop | 2nd Stop | 3rd Stop | | | |

| | |
|---|---|
| | Identify the part with a red / yellow sticker and place them into the red bin inform internal supplier. |
| Y | First action - Call gapleader - gapleader do sorting, remove bad parts & replace with good parts |
| R | **Operator stop the workstation / line - Gapleader & operator do line QRQC - 1st stop** |
| B | If a new type of defect is detected please inform the quality Engineer |

Written by: M. Magaxa. Operators involved: Hibana a Runny

Process: F Assembly

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ANNEXURE J

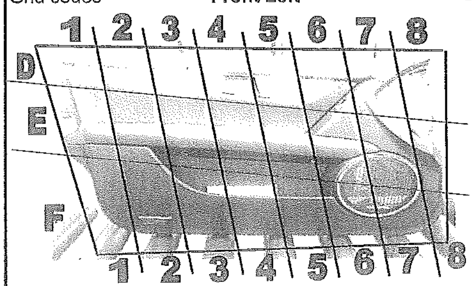
faurecia
Interior systems

REPAIR SHEET FRONTS

Date: 11/11/09

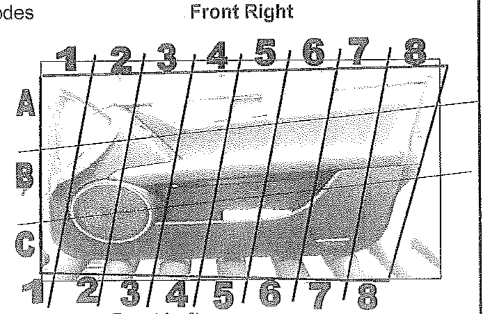
Shift : B
Repair Operator: ..............

Grid codes Front Left




Front Right

Grid codes Front Right




Front Left

| Defect code | Defect description |
|---|---|
| A | Damaged / missing clips |
| B | Anti squeak cream on speaker grille |
| C | Deco strip nut not flush |
| D | Glue on insert/armrest |
| E | Welding head pulled off. |
| F | Loose welding |
| G | Gap at décor strip & insert |
| H | Tight /Squeaking door lever |
| I | Tapes loose / missing |
| J | Loose screw |
| K | Scratches on door lever |
| L | Wrong part supplied |
| M | Speaker grille bulging |
| N | Dent on insert |
| O | Anti squeak tape poorly applied |
| P | Rosette damaged/Not fitted |
| Q | Dent on armrest |
| R | Scratches on décor strip |
| S | Dent on top roll |
| T | Switch poorly fitted |
| U | Scratches on map pocket |
| V | Scratches inside door opener |
| W | Crack on chrome ring |
| X | Squeaking speaker grills |
| Y | No Sound logo |
| Z | Décor strip nut not flush |
| AA | Scratch on top roll |
| AB | Lock switch bracket loose |
| AC | Door lever tight |
| AD | Cut on Armrest |
| AE | Cut on insert |
| AF | Loose clip holder |
| AG | Curtesy light not pierced |
| AH | Crash bolt nut not flush |

| | Grid code | Defect code |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |
| 18 | | |
| 19 | | |
| 20 | | |
| 21 | | |
| 22 | | |
| 23 | | |
| 24 | | |
| 25 | | |
| 26 | | |
| 27 | | |
| 28 | | |
| 29 | | |
| 30 | | |
| 31 | | |
| 32 | | |
| 33 | | |

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1 of 1

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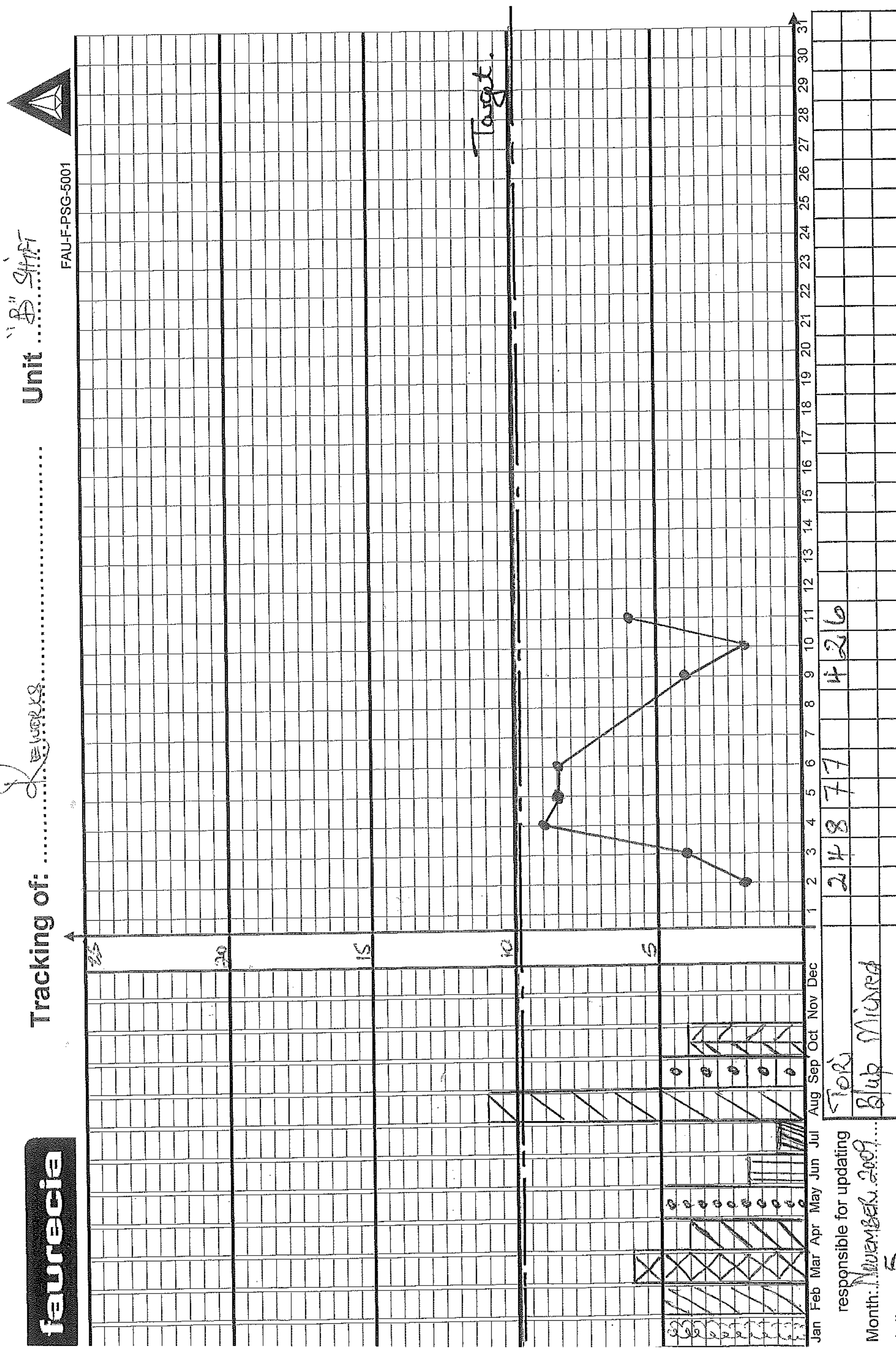
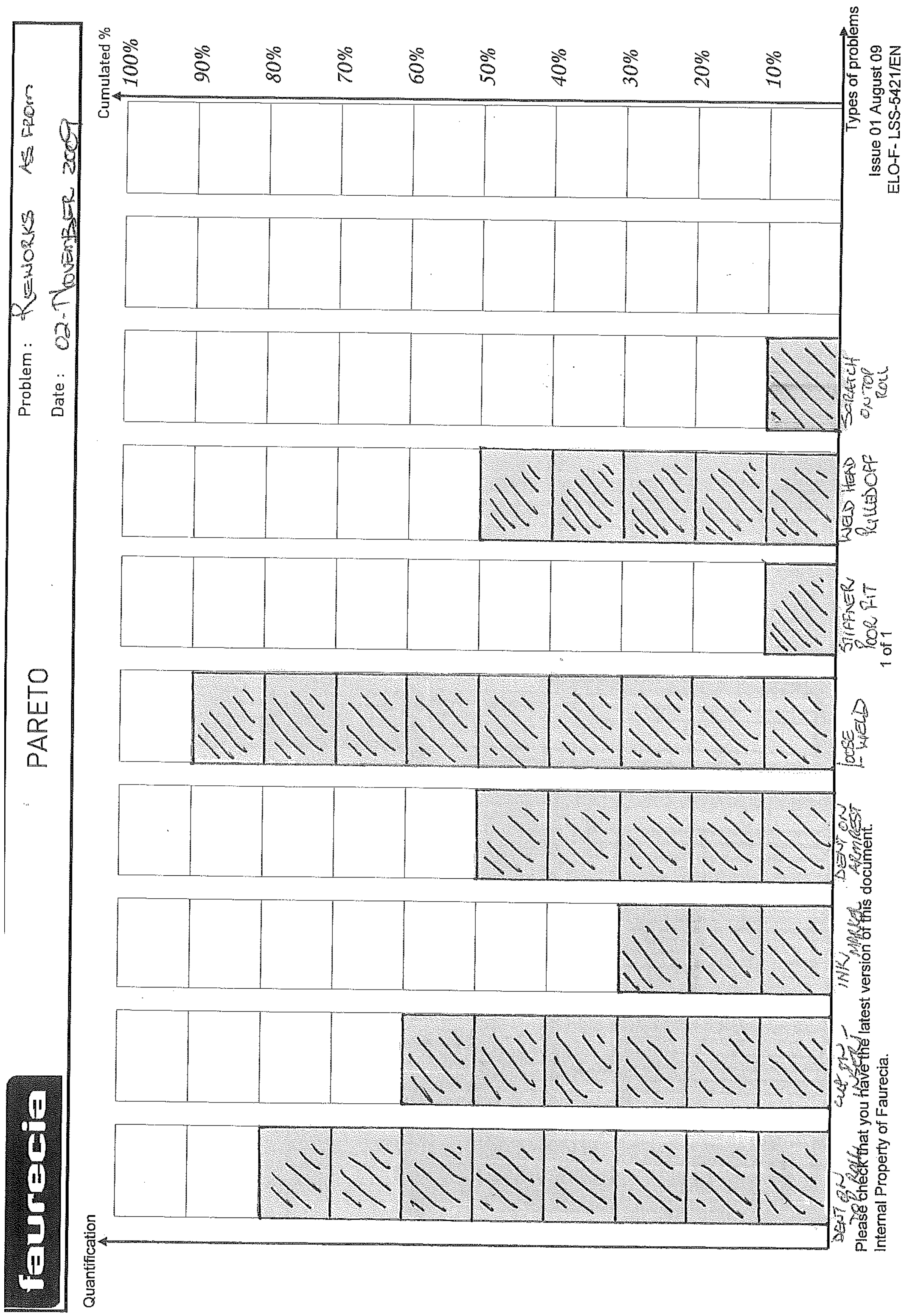
Issue 01 August 09
ELO-F-LSS-5421/EN

ANNEXURE K


faurecia
Tracking of:
Unit
FAU-F-PSG-5001
Target
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
responsible for updating
Month:
1 div =

ANNEXURE L


PARETO
Problem : REWORKS AS FROM
Date : 02-NOVEMBER 2009
Cumulated %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
Quantification
Types of problems
Issue 01 August 09
ELO-F- LSS-5421/EN
1 of 1
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Internal Property of Faurecia.

ANNEXURE M

faurecia

> interior systems

# COMPANY GOALS FOR 2009, 2nd. SEMESTER

## EAST LONDON PLANT

| | | | |
|---|---|---|---|
| 1. | FR0t RATE (ACCIDENT) | | 0 |
| 2. | FR1t | | < 22 |
| 3. | FR2t | | < 55 |
| 3. | ACHIEVE FES SCORE | | > 48% |
| 4. | NUMBER OF IMPLEMENTED IDEAS / PERSON / SEMESTER | | > 6 |
| 6. | CUSTOMER MPM | | 0 |
| 7. | ABSENTEEISM | | < 3,0% |
| 8. | INTERNAL REJECTS | Final Assembly | < 350 PPM |
| 9. | EXTERNAL REJECTS | Intier / MBSA<br>Customer Complaints | < 11 PPM<br>< 1 |
| 10. | COST OF NON-QUALITY | As percentage of sales | < 1.4 % |
| 11. | REDUCE ELECTRICITY USAGE | | > 0,5%/annum |

QUALITY MANAGER SITE MANAGER PP. PLANT MANAGER

Rev. 0

Date : 06/07/2009

CONTROLLED

# ANNEXURE N

| faurecia | FAURECIA EXCELLENCE SYSTEM - KPI DASHBOARD | Month | June | 09 |
|---|---|---|---|---|

**ZA03-IBD-LON - EAST LONDON**

| INDICATORS | | | ACTUAL RESULTS | | | | | | TARGET | | RESULTS ANALYSIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOPIC | NAME | FLOW UNIT | 2009.01 | 2009.02 | 2009.03 | 2009.04 | 2009.05 | 2009.06 | MONTH | SEM. | STATUS | TREND | CURVE | COMMENTS | ACTION PLAN |
| Safety | 1) FR0t | 12MR | | | | | | | | | ☺ | → | | | |
| Safety | 2) FR1t | 12MR | | | | | | | 20.8 * | 20.8 | ☺ | → | | | |
| Quality | 3 a) Customer PPM | 6MR | | | | | | | 11 * | 11 | ☺ | → | | | |
| Quality | 3 b) Supplier PPM | 6MR | | | | | | | | | ☺ | → | | | |
| Quality | 4) Shipped PPM | M | | | | | | | | | ☺ | → | | | |
| Quality | 5) Customer Complaints | M | | | | | | | 1 * | 1 | ☺ | → | | | |
| Quality | 6) Scrap in PPM | M | 489 | 261 | 385 | 297 | 313 | 188 | | | ☺ | → | | | |
| Delivery | 7 a) Customer MPM: J.I.T. | 6MR | | | | | | | 0 ** | 0 ** | ☺ | → | | | |
| Delivery | 7 b) Customer MPM: non J.I.T. | 6MR | | | | | | | | | ☺ | → | | | |
| Resource Efficiency | 8) Direct Labor Efficiency | M | | | | | | 46.6% | | | ☹ | | | | |
| Resource Efficiency | 9 a) Material Scrap Costs | M / KZAR | -19 | -29 | -32 | -18 | -37 | -10 | -33 | -33 | ☺ | → | | | |
| Resource Efficiency | 9 b) Total Scrap Costs | M / KZAR | -19 | -35 | -40 | -17 | -37 | -20 | | -39 | ☺ | → | | | |
| Resource Efficiency | 9 c) Total Scrap Costs (as a % of sal | M | 1.60 % | 1.80 % | 2.07 % | 1.43 % | 2.27 % | 1.52 % | 1.86 % * | 1.86 % | ☺ | ↘ | | | |
| Resource Efficiency | 10) Gross Inventory Accuracy | M | | | | | | | | | | | | | |
| Technical Productivity | 12) Direct Labor Productivity | M | | | | | | 100.0% | | | ☺ | → | | | |
| Technical Productivity | 13) Material Productivity | M | | | | | | | | | | | | | |
| Cash | 14 a) Production Inventory | KZAR | | | | | | | | | | | | | |
| Cash | 14 b) Stock In-Transit | KZAR | | | | | | | | | | | | | |
| Cash | 14 c) Inventory Level (% of sales) | 12MR | | | | | | | | | | | | | |
| Cash | 15) Days' supply of Raw Materials | Nb days | | | | | | | | | | | | | |
| Cash | 16) Days' supply of R.M. in transit | Nb days | | | | | | | | | | | | | |
| Cash | 17) Days' Work in Process (W.I.P.) | Nb days | | | | | | | | | | | | | |
| Cash | 18) Days' supply of Finished Goods | Nb days | | | | | | | | | | | | | |
| People | 19) Direct absenteeism rate | M | 4.8 % | 2.5 % | 2.9 % | 6.9 % | 5.7 % | 11.6 % | 3.2 % * | 3.2 % | ☺ | ↗ | | | |
| People | 20) Implemented Improv. Ideas Ratio | 12MR | 11.5 | 10.8 | 11.3 | 11.7 | 12.1 | 11.2 | 10.4 * | 10.4 | ☺ | → | | | |

☺ Better than budgeted
☺ Under special attention
☹ Special recovery plan needed

↗ Ratio increase
→ Ratio stability
↘ Ratio decrease

* For Indicator resulting from Budget-Q & Budget-HR, Month Target is equal to Semester Target.
** MPM JIT Budget/Target is 0

ANNEXURE N

# FAURECIA EXCELLENCE SYSTEM - KPI DASHBOARD

faurecia

Month Sept. 09

**ZA03-IBD-LON - EAST LONDON**

| TOPIC | INDICATORS NAME | FLOW UNIT | ACTUAL RESULTS 2009.07 | 2009.08 | 2009.09 | 2009.10 | 2009.11 | 2009.12 | TARGET MONTH | SEM. | RESULTS ANALYSIS STATUS | TREND | CURVE | COMMENTS | ACTION PLAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Safety | 1) FR0t | 12MR | - | - | - | | | | | | | → | | | |
| Safety | 2) FR1t | 12MR | - | - | - | | | | 22.3 * | 22.3 | | → | | | |
| Quality | 3 a) Customer PPM | 6MR | - | - | - | | | | 11 * | 11 | | → | | | |
| Quality | 3 b) Supplier PPM | 6MR | - | - | - | | | | | | | → | | | |
| Quality | 4) Shipped PPM | M | - | - | - | | | | | | | → | | | |
| Quality | 5) Customer Complaints | M | - | 1 | - | | | | 1 * | 1 | | → | | | |
| Quality | 6) Scrap in PPM | M | 349 | 326 | 387 | | | | | | | ↗ | | | |
| Delive | 7 a) Customer MPM: J.I.T. | 6MR | - | - | - | | | | 0 ** | 0 ** | | → | | | |
| Resource Efficiency | 8) Direct Labor Efficiency | M | 51.7% | 80.3% | 66.8% | | | | 64.6% | 64.6% | | | | | |
| Resource Efficiency | 9 a) Material Scrap Costs | M / KZAR | -33 | -32 | -27 | | | | -25 | -16 | | → | | | |
| Resource Efficiency | 9 b) Total Scrap Costs | M / KZAR | -33 | -32 | -37 | | | | -53 | -34 | | → | | | |
| Resource Efficiency | 9 c) Total Scrap Costs (as a % of sal | M | 1.4% | 1.4% | 1.9% | | | | 3.19 % * | 3.19 % | | ↘ | | | |
| Resource Efficiency | 10) Gross Inventory Accuracy | M | - | - | - | | | | | | | | | | |
| Resource Efficiency | 11 a) TRS - No Value | M | - | - | - | | | | | | | | | | |
| Technical Productivity | 12) Direct Labor Productivity | M | 100% | 100% | 100% | | | | 100.0% | 100.0% | | → | | | |
| Technical Productivity | 13) Material Productivity | M | - | - | - | | | | | | | | | | |
| Cash | 14 a) Production Inventory | KZAR | - | - | - | | | | | | | | | | |
| Cash | 14 b) Stock In-Transit | KZAR | - | - | - | | | | | | | | | | |
| Cash | 14 c) Inventory Level (% of sales) | 12MR | - | - | - | | | | | | | | | | |
| Cash | 15) Days' supply of Raw Materials | Nb days | - | - | - | | | | | | | | | | |
| Cash | 16) Days' supply of R.M. in transit | Nb days | - | - | - | | | | | | | | | | |
| Cash | 17) Days' Work In Process (W.I.P.) | Nb days | - | - | - | | | | | | | | | | |
| Cash | 18) Days' supply of Finished Goods | Nb days | - | - | - | | | | | | | | | | |
| People | 19) Direct absenteeism rate | M | 7.5% | 7.6% | 5.5% | | | | 3.0 % * | 3.0 % | | ↘ | | | |
| People | 20) Implemented Improv. Ideas Ratio | 12MR | 10.9 | 10.5 | 10.5 | | | | 10.8 * | 10.8 | | → | | | |

Better than budgeted
Under special attention
Special recovery plan needed

↗ Ratio increase
→ Ratio stability
↘ Ratio decrease

* For indicator resulting from Budget-Q & Budget-HR, Month Target is equal to Semester Target.
** MPM JIT Budget/Target is 0