Developing of a Process Improvement Framework for Kimberly-Clark's Process Improvement Department

by

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Submitted in partial fulfilment of the requirements for
the degree of

BACHELORS OF INDUSTRIAL ENGINEERING

in the

FACULTY OF ENGINEERING, BUILD ENVIRONMENT & INFORMATION TECHNOLOGY

UNIVERSITY OF PRETORIA
PRETORIA

October 2010

Executive Summary

Kimberly-Clark is a leading health and hygiene tissue manufacturer with operations in 40 countries. Their wide range of products is sold over 150 countries worldwide. On a daily basis people are making Kimberly-Clark a trusted part of their lives by using their family care brands and personal care brands.

The project will focus on the Process Improvement Team from the manufacturing site of Kimberley-Clark Enstra Mill, in Springs. This Process Improvement Team has no specific structures and framework to operate effectively, and this causes their impact to be very limited. In order to have a significant impact, the Process Improvement Team needs a proper Process Improvement Framework.

The aim of the project is to develop a Process Improvement Framework that will include a structured approach to problem identification, problem analysis, change management and continuous improvement. Literature was gathered and analysed, followed by the selection of methods, tools and techniques to assist in developing the solution for the Process Improvement Department. A Process Improvement Framework is developed that will significantly improve this tissue manufacturer organization in the upcoming future.

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CHAPTER 1: Introduction

1.1 Background of Kimberly-Clark

Kimberly-Clark South Africa was founded in 1936 when they appointed agents to trade in and sell Kotex Napkins from the USA. They then developed into a local manufacturer of tissue in 1948 and in 1950 feminine care products. The manufacturing footprint of the company has increased over the years, with the addition of tissue manufacturing, diaper, facial tissue, roller towel and supplementary tissue converting infrastructure.

In 1960 Kimberly-Clark Corporation and Sappi began a business relationship, and started with a number of joint ventures, together with Malbak, Kohler, Holdains and finally Lion Match. The Companies products are sold over 150 countries worldwide, while manufacturing take place in 40 countries. Kimberly-Clark obtained the Carlton Paper Company in 1972.

Kimberly-Clark South Africa's Enstra Mill is located in Springs, Gauteng. At this manufacturing site the company commenced with its first creped wadding machine for the production of toilet and facial tissue. The mill soon became the major producer of the Company's toilet tissue, facial tissue and paper towel products. A de-inking plant (processing of waste paper), a diaper plant, and a variety of tissue converting equipment are also situated on this site.

On a daily basis, people are making Kimberly-Clark a trusted part of their lives throughout the world, by using:

- Family Care Brands: Baby Soft® Toilet tissue**,** Carlton® Toilet tissue**,** Kleenex® Facial tissues**,** Kleenex® Facial tissue innovations**,** Carlton® Roller Towels **,** Carlton®All Purpose Roller Towels **,** Carlton® Roller Towel Innovations
- Personal Care Brands: Huggies® Baby & Child care**,** Kotex® Feminine Care Range**,** and New Freedom® Feminine Care.

1.2 Problem Statement

Kimberly-Clark has a Process Improvement Team (PIT), with Process Improvement Engineers. This team currently consists of one Industrial Engineer, two Mechanical Engineers and a Technician. This newly formed PIT at Kimberly-Clark has no specific structures and framework to operate efficiently, and this causes their impact to be very limited. For them to have a significant impact, they need to get proper structures and a framework in place, to achieve continuous improvements on processes. This PIT's aim is to establish themselves as a Process Improvement Department within Kimberly-Clark South Africa.

1.3 Project Aim

The aim of this project is to develop a Process Improvement Framework for the Process Improvement Team of Kimberly-Clark.

In order to accomplish the aim, the following specific objectives must be addressed:

- To determine the PIT's current practice.
- Define methods, tools, and techniques in the industry for the development of the project's Process Improvement Framework.
- Develop a Process Improvement Framework that includes a structured approach to problem identification, problem analysis, change management and continuous improvement.

This can facilitate Kimberly-Clark's PIT to establish them as a separate Department within their company.

1.4 Project Scope

The intended scope of this project will be to understand the business of Kimberly-Clark South Africa and to identify tools, structures and frameworks within the industry. Benchmarking with Best Practices, structures and frameworks of other Process Departments, Process Improvement Departments and Continuous Improvement Departments will help with the development of a structured approach to problem identification, problem analysis, change management and continuous improvement.

1.5 Document methodology

A literature review is presented in Chapter 2 that is followed by Chapter 3 that includes the selection of appropriate methods, tools and techniques and the information regarding the PIT. Chapter 4 includes the design and problem solving of the Process Improvement Framework. The future recommendations and conclusion are presented in Chapter 5.

CHAPTER 2: Literature Review

The teamwork culture is a means to face the present unstable situations and to create an organization that achieve high performances to continuing change. Organizations tend to deliver more, thus constantly trying to improve performance in every area. Katzenbach and Smith (1993) states that teams outperform individuals, having their diverse skills, judgments and experience to improve results. The team's approach is capable to promote the attitudes and behavior for superior performance.

2.1 Nine Habits of Highly Effective Continuous Improvement Teams

The president of Parsec Automation Corporation, Eddy Azad, has major experience in the manufacturing facet, since the 1980's. Through Azad's (2006) experience and research he developed the foundation for success by the nine habits of highly effective continuous improvement teams, which are as follow:

1) The teams do not fall into the "high efficiencies" trap. When there is high efficiency, areas for improvement can be hidden. This cause that availability losses are not measured, allowing ineffective changeovers and unhygienic environment.
2) Cross-functional teams are assembled. This team discipline type, deliver exponentially value for manufacturers and produces significant results through their working ability.
3) The teams define focused and achievable goals. By first focusing on areas, lines, systems or disciplines that would dramatically improve the return on investment, before even attempting to undertake the whole factory.
4) The team's use of Key Performance Indicators (KPI) based metrics. Real-time and accurate information given to the workers on the floor and line managers will contribute to better performance that is important for the effectiveness.
5) Operators are selectively involved in data collection. The operators are able to see what happens and machines, meaning they provide valuable insight.
6) The teams determine the root cause analysis of the production losses. Accurate reports needs to be accessible that will make it possible for the team to swiftly and effectively identify the root causes.

7) The teams recommend and implement changes that deliver sustainable production improvement. Cross-functional team must have regular meetings to establish consensus that will improve their chances to success.
8) The teams consider proven programs for the increase in motivation of their people. The improvement speed is due to the people, the key to achieve the goals.
9) The teams benchmark themselves with Overall Equipment Effectiveness. This is a valuable way to measure the performance, and points out the areas to improve.

2.2 Benchmarking

2.2.1 What is Benchmarking?

Bhutta and Hug (1999) states, that benchmarking is a tool for improvement in business activity, in processes and in management, and that its conducted by means of comparison against familiar organizations within the area. However, benchmarking is widely used as a term. Commonly used definitions for benchmarking are:

- "A continuous search for, and application of, significantly better practices that lead to superior competitive performance" (Watson, 1993).
- "A continuous systematic process for evaluating the products, services and work of organizations that are recognized as representing best practices for the purpose of organizational improvement" (Spendolini, 1992).
- "Benchmarking is an external focus on internal activities, functions, or operations in order to achieve continuous improvement" (McNair & Leibfried, 1992).
- "A disciplined process that begins with a thorough search to identify best-practices and performance, progress through systematic site visits and interviews, and concludes with an analysis of results, development of recommendations and implementation" (Garvin, 1993).

The following principles can be summarized from these benchmarking definitions (Ahmed & Rafiq, 1998):

- Increased competitive performance
- Continually improve
- The benchmarking activity is achieved through a systematic procedure

Three ways (Figure 1) of capturing the key aspects of the benchmark concept are (Ahmed & Rafiq, 1998):

- An Enabling aspect: understanding the theory of high performing processes and understanding activities. The foundation is laid by a deeper level of learning and understanding which enables continuous improvement.
- An Assessment aspect: a firm's performance is measured through comparative assessment. Identifying the "gap" (an indicative size where there is indeed the need for progress) through Best Practice benchmarks.
- An Outcomes aspect: utilize the learning gained within the firm itself, achieved through completing the Enabling aspect.

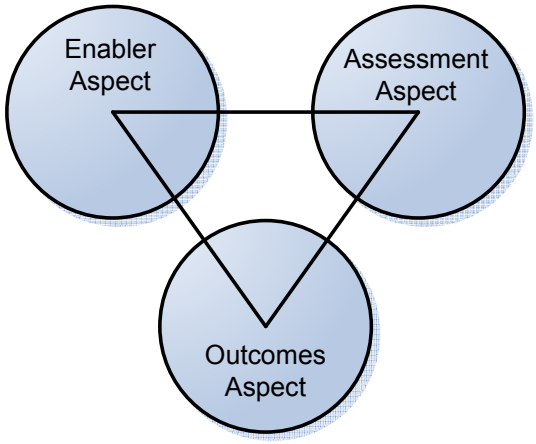

Figure 1 The benchmarking triangle (Ahmed & Rafiq, 1998)

2.2.2 Benchmarking timeline overview

Widely in business practices benchmarking is used as a tool for continuous improvement. In every industry, successful companies have achieved a high level of performance by engaging various benchmarking practices. Benchmarking is a recent methodology that has come forward to increase and continue competitive advantage. According to Ahmed and Rafiq (1998), a clear success indication or failure indication is provided by benchmarking. Bernowski (1991) states that regardless of benchmarking popularity, for a few it is just another management trend, thus within the management theory benchmarking have an uncomfortable seat.

Although benchmarking remains a relatively recent phenomenon, it has nowadays become a commonplace in businesses. The Japanese has been given credit for inventing the concept benchmarking, by learning and understanding from business that is the best within a practices. The benchmarking concept of developing and promoting are closely associated with Xerox. The popularity of benchmarking is due to Xerox's systematic approach of learning and codification of practices from its affiliate Fuji-Xerox (Ahmed & Rafiq, 1998).

Watson (1993) suggests that strategic benchmarking is a rare type of benchmarking, and that the benchmarking methodology is moving from an art to a science. A few companies have managed to make strategic and global approaches for the future. In Figure 2, distinct generations of development of benchmarking are shown. The different generations are (Ahmed & Rafiq, 1998):

Reverse benchmarking is associated with the first generation

- Reverse engineering of competitive product offerings for product orientation.
- Product characteristics comparison, functionality comparison, and performance of competitive offerings comparison.
- Tear-down and technical product analysis for reverse engineering initiatives.
- Competitive analysis on market-orientated features.

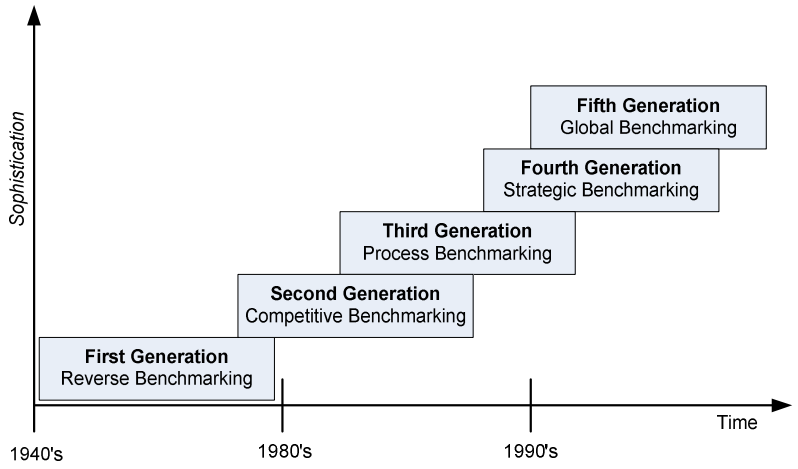

Figure 2 Benchmarking art Timeline (Watson, 1993)

Competitive benchmarking is associated with the second generation

- Xerox advanced into "science", throughout the period of 1976 - 1986.
- Comparison with competitors processes.

Process benchmarking is associated with the third generation

- Period of 1982 – 1988.
- Recognition of learning from companies outside competitive boundaries.
- Less restriction on sharing information.
- More in-dept knowledge and understanding similarities of widely different processes.

Strategic benchmarking is associated with the fourth generation

- Understanding external partners' strategies and adopting the endearing strategies for ongoing alliance. This necessitates systematic process that involves evaluating alternatives, implementing strategies and improving performance.
  - Perspectives of partnership
  - Continuous and long term
  - Have made fundamental shifts in processes

Global benchmarking is associated with the fifth generation

- Through globally learning and applying
  - Cross cultural barriers
  - Bridge international trade issues
  - Away with business process distinctions

2.2.3 Benchmarking Types

Numerous benchmarking types exist. The benchmarking types can be defined as what is compared against what and what the comparison is being made against (Ahmed & Rafiq, 1998).

- Competitive benchmarking: the comparison of direct competitors is made between functions and activities. This type of benchmarking will assist to level with competitors.
- External benchmarking: the comparison with external organizations of similar operations, systems, and processes.
- Internal benchmarking: to measure and compare with organizations' functions, processes, and activities.
- Generic benchmarking: comparison on a single function to improve the operation of that particular function regardless of industry or market.
- Functional benchmarking: comparison of the technology and process in one's own industry or technology to become the best in that technology and process.

- Process benchmarking: the comparisons made between the discrete processes and discrete systems. This is increasingly applied where outsourcing may be a consideration.
- Performance benchmarking: the comparison and inspection made of the performance attributes to assess competitive position with those of target firms.
- Strategic benchmarking: the strategic issues or processes are addressed with an advanced level than operational.

Figure 3 illustrate the combinations of the benchmarking types that can be applied to yield better company's process results, function results, or product level results.

	Internal benchmarking	Competitive benchmarking	Functional benchmarking	Generic benchmarking
Performance benchmarking	ψ	ϕ	ψ	θ
Process benchmarking	ψ	θ	ϕ	ϕ
Strategic benchmarking	θ	ϕ	θ	θ
Relevance / Value		High ϕ	Medium ψ	Low θ

Figure 3 The benchmarking matrix (Bhutta & Hug, 1999)

2.2.4 The process of benchmarking

According to Ahmed and Rafiq (1998), the process of benchmarking is by making comparison with other organizations and then to systematically incorporate the learning gained into one's own organization. Watson (1993) highlights the benchmarking process with asking four main questions:

I. What can we benchmark with others?
II. Against whom can we benchmark?
III. How do we execute the process we want to benchmark?
IV. How does other execute the similar process to achieve the competitive advantage?

Figure 4 is a schematically illustration of the benchmarking process.

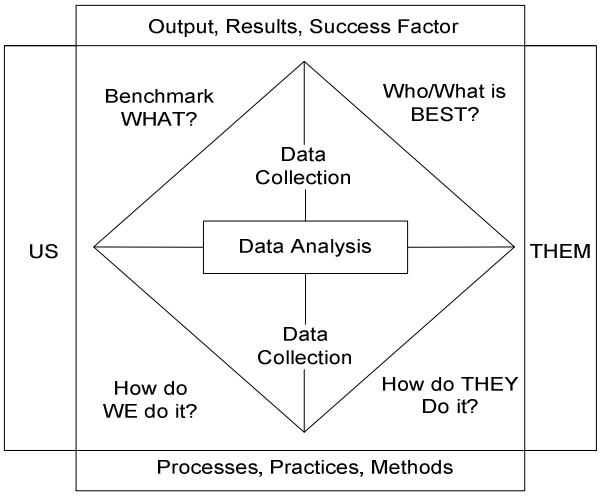

Figure 4 Benchmarking Process Diagram (Watson, 1993)

2.3 Continuous Improvement

2.3.1 Continuous Improvement methodologies

The present existing continuous improvement (CI) methodologies can offer significant benefits to an organization. The CI methodologies have developed rapidly over recent years from where the focal point was to minimize waste and improve product quality of a single production line, into a more advanced methodology where the focal point is on all the organization aspects (Bhuiyan, Baghel, & Wilson, 2006). Well known CI methodologies are as follow:

- Lean Production
- Lean Six Sigma
- Six Sigma
- Balanced Scorecard

Bhuiyan, Baghel, and Wilson (2006) also introduce a methodology that consists of a wide variety of improvement initiatives in their journal called Achieving Competitive Excellence, or ACE^{TM}. This ACE^{TM} have similarities and differences to Lean Production and Six Sigma, Table 1 points out these similarities and differences of the tools used between them.

All of these major CI methodologies serve different purposes, which have its benefits and drawbacks. The main CI methodologies are compared in Table 2 in terms of their objectives, principles, key performance indicators, tools, infrastructure and speed.

Table 1 CI methodologies similarities and differences (Bhuiyan, Baghel, & Wilson, 2006)

Major tool	Six Sigma	Lean production	ACE™	Description
Cp/Cpk	√		√	Process capability assessment
DOE	√		√	Design of experiments
SPC	√		√	Statistical process control
FMEA	√		√	Process/product risk assessment
Regression	√		√	Variable effect analysis
Process mapping	√	√	√	Map of process' detailed activities
5 Whys/2 How's	√	√	√	Root cause identification tools
Pareto	√	√	√	Column chart rank priority
Fishbone	√	√	√	Cause and effect diagram
5S		√	√	Waste elimination
Visual management	√	√	√	Implementation of visual controls
Poka-Yoke		√	√	Error proofing techniques
Spaghetti chart		√	√	Material flow or personal movements
Kanban		√	√	Automatic reordering process
TAKT time		√	√	Pace of a process
Standard work		√	√	Time required for activities in process
SMED		√	√	Quick machine setup
TPM		√	√	Equipment maintenance strategy
Cellular flow		√	√	Production techniques
Passport			√	Gated review in design process
QFD			√	Quality function deployment
MFA			√	Market feedback analysis
QCPC			√	Quality clinic process chart
RCCA			√	Root cause corrective action
Benchmark			√	Internal and external activities

Table 2 CI methodologies comparison (Bhuiyan, Baghel, & Wilson, 2006)

Methodology	Inception	Objective	Principles	KPI's	Tools	Infrastructure	Speed
Lean production	Early 1900s but modern Lean thinking introduced in early 1960's	To provide high value to the customer	To use the best practices and processes, to improve efficiency, reduce cost and speed up the process	The value provided to the customer	5S, mistake proofing, setup reduction and other TPS tools	*Ad hoc* resources can suffice, little formal training, on the job training	Quick initial returns and then incremental
Six Sigma	1986	Product and process improvement, minimization of variation	To keep the number of defects below 3.4 per million opportunities	Number of defects, customer satisfaction	DMAIC, DMADV, SPC	Dedicated resources, very specific skills	Quick initial returns and then incremental
Lean Six Sigma	2000	Reduce variation, speed up production and reduce waste	To use the best practices of Lean Production and Six Sigma, to increase the market share of the organization	Customer satisfaction, market share	Tools used in Six Sigma and Lean Production	Dedicated resources, very specific skills	Quick initial returns and then incremental
ACE™	1997	To improve customer satisfaction by maintaining high quality and delivery on time	Use the tools available to reduce waste, improve speed and do the "things right the first time"	Customer satisfaction	Passport process, MFA, RCCA, 5S, mistake proofing etc.	*Ad hoc* resources can suffice, little formal training, on the job training	Quick initial returns and then incremental

2.3.2 Continuous Improvement Process

Following certain structured guidelines for improvement initiatives through a team is of vital importance to achieve significant results. Figure 6 is a CI procedure proven by Neptune for solving team-based problems.

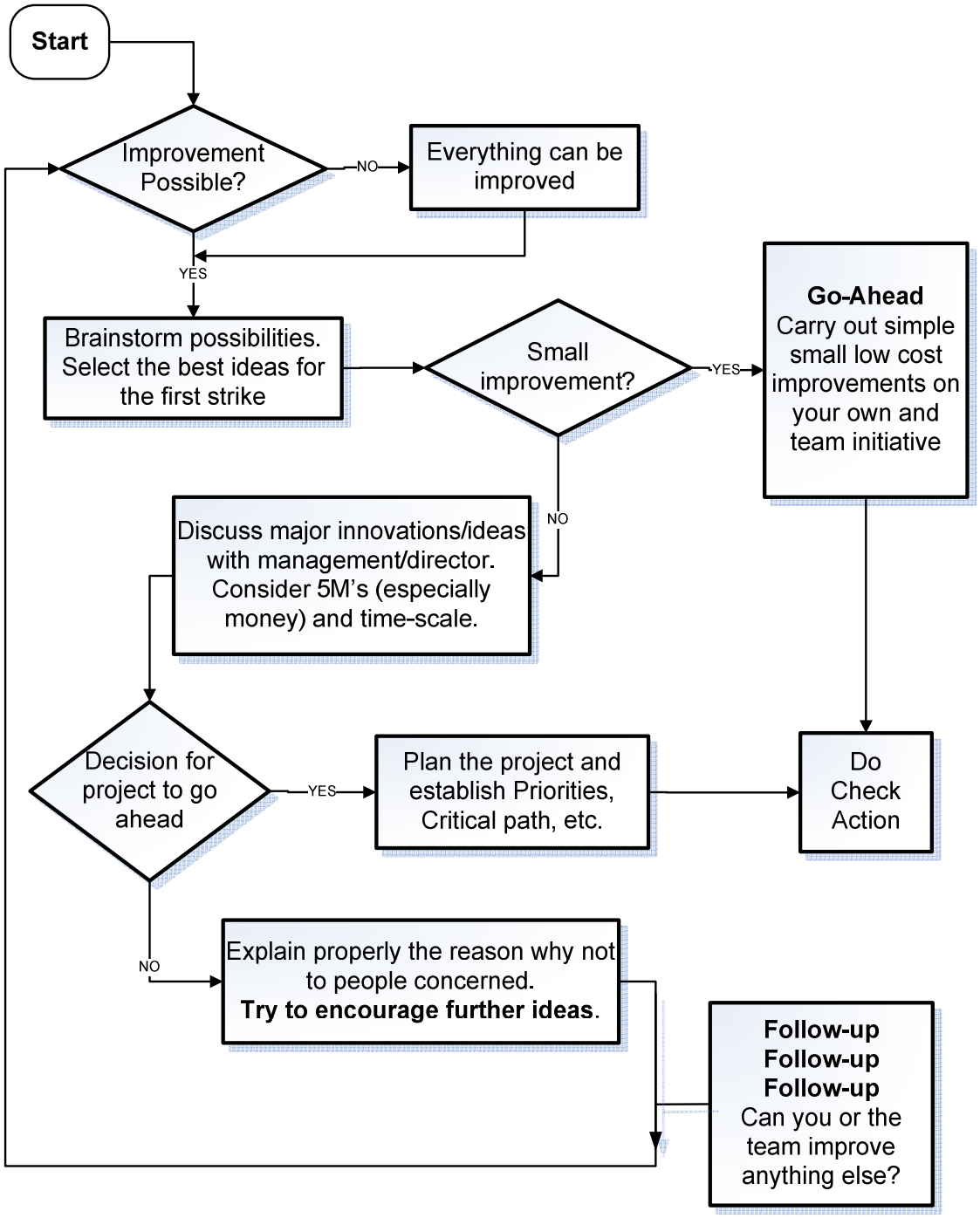

Figure 5 Neptune's CI process (Irani, Choudrie, Love, & Gunasekaran, 2002)

2.3.3 Deming's Cycle

Plan-Do-Check-Act (PDCA) is known as Deming's cycle, this cycle is a problem-solving procedure that consists of four stages (Wikipedia, PDCA, 2010). According to Bamber, Castka, Sharp, & Motara (2003), the PDCA (Figure 6) is an effective process for a cross-functional team to follow. This procudure is typically used in continouos improvement processes. The stages are defined by Wikipedia as:

- **Plan**: Determine initiatives to improve the processes that will deliver an enhanced outcome.
- **Do**: Implement new improvements to the current processes.
- **Check**: Follow up and measure the new improvements to determine if the outcome on the process were improved as they were before the new improvements were applied on the process.
- **Act**: Point out the differences on the process and analyze them to establish their cause. Continue to move through the PDCA cycle

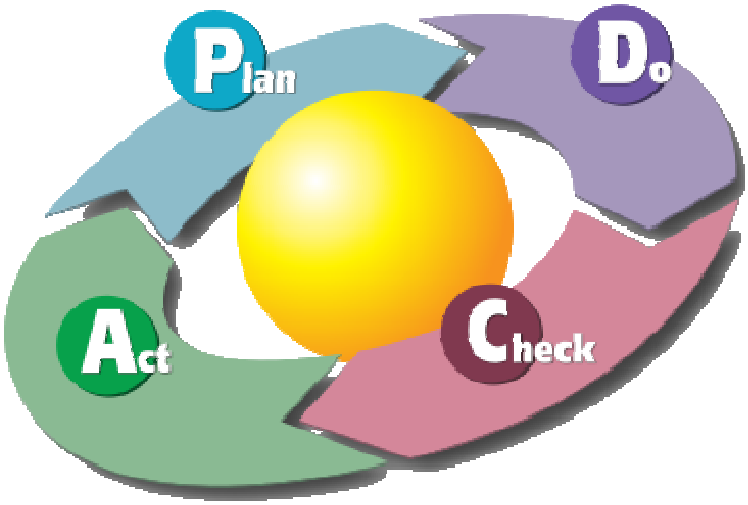

Figure 6 Deming's PDCA cycle (Wikipedia, 2010)

2.4 Change Management

Change management is defined by Van Rensburg (2006) as an approach to support people in a process to change themselves in order to fulfill with the organization's structural change.

Keller and Aiken (2009) have done research on change management recently; they conclude that from 1995 to 2005 the change programs were still only 30 percent successful, although there are much more change management information available nowadays. The McKinsey company have developed tested perspectives that deliver excellent results to businesses, by having applied research over a 4 year period to understand why change management fails and what they can do to successful enhance this matter.

Change programs will be successful when management behavior and employee attitudes are transformed. According to Lawson and Price (2003) people will change their behavior when certain conditions have been met, namely develop a compelling story, role modeling, reinforcement system, and required skills for change.

2.4.1 Develop a compelling story

The employees have to see, understand and agree with the purpose of transformation. According to Keller and Aiken (2009), they state that something may motivate an employee that would not necessarily motivate other employees. Through the research conducted by Keller and Aiken (2009), they conclude that for people at work there are five foundations of meaning: society's impact, themselves, the business, the customer, and the working team. The key to get the utmost of change is by telling these five stories on one time.

Keller and Aiken (2009) states that employees have to wrote their own story. Employees tend to be 83 percent more committed when they decide for themselves, and 17 percent committed when being told. A communicating strategy approach should be attempt by balancing the listen against to be told.

Power is generated with positive and negative together. Solve the problem approaches generate negatively (resistance and unproductive fatigue) power to change. To generate positive (enthusiasm and excitement) power to change, the capture the opportunity approaches are used. By applying both this approaches at the same time, the company can reduce the effect of weakness in change and maximize impact (Keller & Aiken, 2009).

2.4.2 Role modeling

The leaders of today think that they are the change within organization. Keller and Aiken (2009) states that the majority of leaders have the ability to role, but lack to change due to the leaders self-helping biases. This barrier can be overcome by the 360-degree behavioral feedback.

Powerful leaders can not be considered to be much influential. Attempts to catalyze preferred transformation through investing in powerful leaders are a waste of time. Influential leaders are important, but it is also important to not overinvest in them. Keller and Aiken (2009) states that "new research shows social contagion depend less on the persuasiveness of early adopters and more on how receptive the society is to the idea."

2.4.3 Reinforcement systems

Motivating people with money can be extremely costly. Employees should be rewarded for actively participating in the organization's change program. But there are other approaches that can be less costly, such as small surprising rewards throughout change programs. These less costly rewards also motivate them remarkably.

A reasonable process and a reasonable result are equally important. Cautious consideration should be given to transform a company's systems, structure, processes and encouragement, in order to achieve a reasonable process and a reasonable result (Keller & Aiken, 2009).

2.4.4 Required skills for change

The mindsets of employees drive their behaviors, and their behaviors drive the performance of their work. The employees' mindsets consist of feelings, thoughts, and attitude. Employees capability is build through placing the focus on technical skills and changing the employees' mindsets in order make the technical skills possible. Tools that can be utilized to asses the mindsets and capabilities are: Focus groups, shop floor surveys, and deep structure interviews.

Keller and Aiken (2009) explain that it would be insufficient with just good intentions. With good intentions and lowering the obstacle to practice the employee will feel the need to apply new skills and mindsets. The employees' capability can be improved through training them while doing their job, or through class room trainings (Keller & Aiken, 2009).

2.5 Team Enablers

The team enablers affecting the high performance are based on the factors listed in Table 3 for the successful implementation of Highly Performance Teams (Bamber, Castka, Sharp, & Motara, 2003).

Table 3 Factors affecting successful implementation of Highly Performance Teams (Castka, Bamber, & Sharp, 2004)

Critical factor	Description
Organizational impact	This factor covers the impact the organization has on a team development such as creation of organizational culture supporting teamwork, allocation of time, space, resources, team reward and appraisal.
Defined focus	This includes specification of tasks, promised level of performance, deadline, customer and how the ream deals with project management and future planning.
Alignment and interaction with external entities	Capability of team to maintain the alignment with other teams, managers, organizational structure, supplies, and customer.
Measure of performance	This factor covers the ability of the team to establish measures of performance that help to gauge the team's progress and task completion aligned to the customer requirements.
Knowledge and skills	This includes skills such as interpersonal and joint skills (dealing with conflict, dynamics of teamwork, how to conduct a meeting, effective decision making, communication skills, effective record keeping, leadership skills); analytical and statistical skills; improvement techniques and skills related to a particular job.
Needs of the individual	This factor deals with individual needs and different personal preference of team members in order to perform as a team member.
Group culture	Development of group culture based on empowerment, shared vision, creativity, participation, learning ability, trust and shared consensus.

2.6 Mean Time's

The mean time to repair (MTTR) is known as the average time it takes to repair a machine from its state of failure or stoppage (Wikipedia, MTTR, 2010). Figure 7 is the illustration of mean time between failures (MTBF), also known as the time the machine operates to produce the products between failures (Wikipedia, MTBF, 2010).

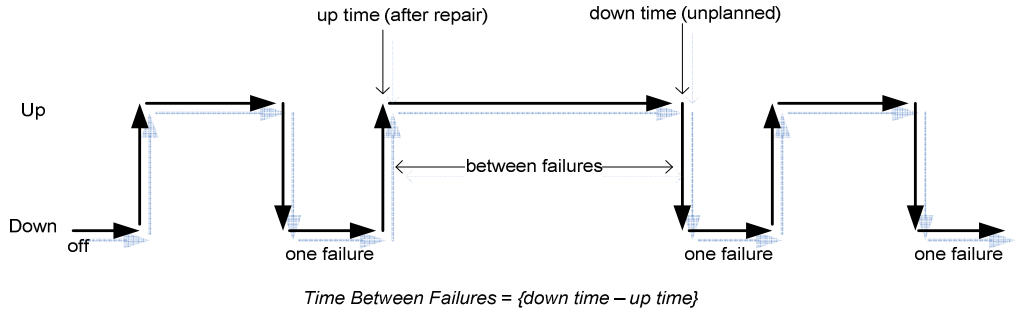

Figure 7 MTBF illustration

CHAPTER 3: Selection of appropriate methods, tools and techniques and Information Capturing

3.1 Benchmarking OEE

According to the Nine Habits of Highly Effective Continuous Improvement Teams of Eddy Azad (2006) in the literature above, he states that teams benchmark the Overall Equipment Effectiveness (OEE) with others in the same industry type. We can also conclude that the OEE benchmarking can be seen as the combination of Performance benchmarking and Competitive benchmarking type, which can yield high value results as shown in Figure 3's benchmarking matrix. This method will enable Kimberly-Clark to have a total measure of their performance, and enable them to benchmark their current performance against the OEE measures they already have access to of the worldwide tissue manufacturers.

Azad (2006), and Bamber, Castka, Sharp, & Motara (2003) explain that only cross-functional team's is necessary to improve OEE in a defined area of the organization. The OEE role involves the following (Bamber, Castka, Sharp, & Motara, 2003):

- Process improvement initiatives are taken into account.
- Provides a systematic method for establishing production targets.
- Prevents sub-optimisation of individual machines or product lines.
- Incorporate practical management tools and techniques in order to achieve a balanced view of process availability, quality, and performance rate.

It is of vital performance to conduct measurements of disturbances in the manufacturing process. Tajiri and Gotoh (1992) describe two categories of disturbances, namely chronic and sporadic (Figure 8). Chronic result of several concurrent causes that is usually hidden, small and complicated. With chronic disturbances occur repeatedly, that result in the low utilization of equipment and large cost; chronic can be seen as in normal state that makes it more difficult to identify. Sporadic occurs quickly and as large deviations from normal state. Through comparison of the theoretical capacity of the equipment with performance it is possible do identify chronic disturbances.

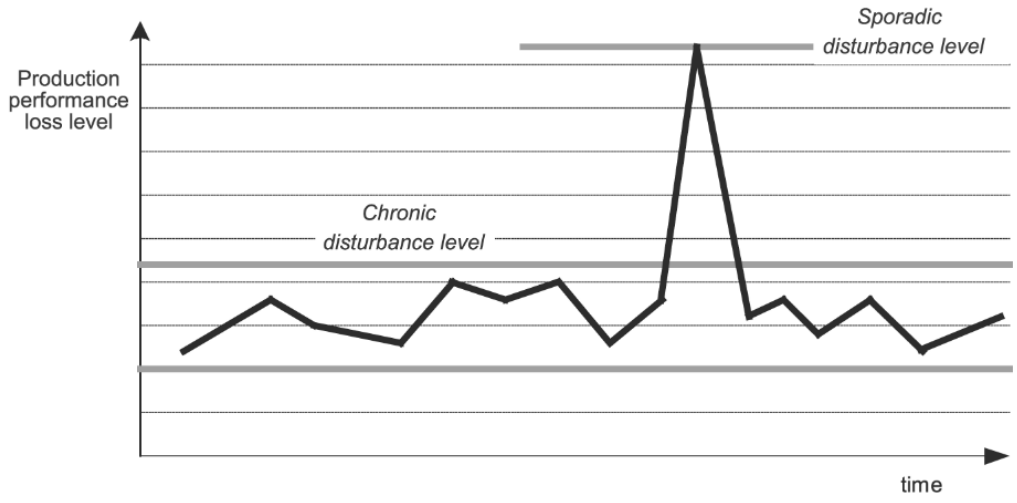

Figure 8 Production performance losses as result of chronic and sporadic disturbances

Chronic and sporadic disturbances result in different kinds of losses or waste. The OEE objective is to identify these losses, and then the workforce eliminates the six big losses. The three main categories of OEE losses are (Nakajima, 1988):

- Availability losses: takes machine down when it should be running.
  - Breakdown losses: Time losses when productivity is reduced and defective products cause quantity losses.
  - Set-up and adjustment losses: when production of one item ends and the equipment is adjusted to meet other item requirements, down time and defective products occur.
- Performance losses: the equipment run slower than what it should.
  - Idling and minor stoppage losses: machine idling or when production is interrupted by a temporary malfunction.
  - Reduced speed losses: difference between equipment design speed and actual operating speed.
- Quality losses: making bad products.
  - Malfunctioning of production equipment causes quality defects and rework losses.
  - Start-up losses: losses from machine start-up to stabilize during early stages of production.

It is important to know where the PIT stands with their OEE, to know where to excel at and if the PIT can continue to improve and create value. The goal will be to improve the OEE; this will necessitate measuring the three indicators of OEE, namely (Nakajima, 1988):

1) The availability indicator represents the percentage of schedule time that the operation is available to operate. The calculation of availability is:

$$Availability\ rate\ (A) = \frac{(Actual\ Operating\ Time)}{(Scheduled\ Production\ Time)} \quad \text{..... (1)}$$

2) The Performance indicator represents the speed at which the Department runs as a percentage of its designed speed. The calculation of performance is:

$$Performance\ rate\ (P) = \frac{((Output\ Operating\ Time)x(Ideal\ Cycle\ Time))}{(Operating\ Time)} \quad \text{..... (2)}$$

3) The Quality indicator represents the good units produced as a percentage of the total started units. The calculation of quality is:

$$Quality\ rate\ (Q) = \frac{((Input\ Units)-(Defective\ Units))}{(Input\ Units)} \quad \text{..... (3)}$$

Then the calculation of OEE is as follow (Nakajima, 1988):

$$OEE = Availability(\%) * Performance(\%) * Quality(\%) \quad \text{..... (4)}$$

Figure 9 is a simple explanation through a waterfall OEE graph of how the measurement of the OEE is done and how the losses can be determined. The OEE is an initiative to increase capacity gain.

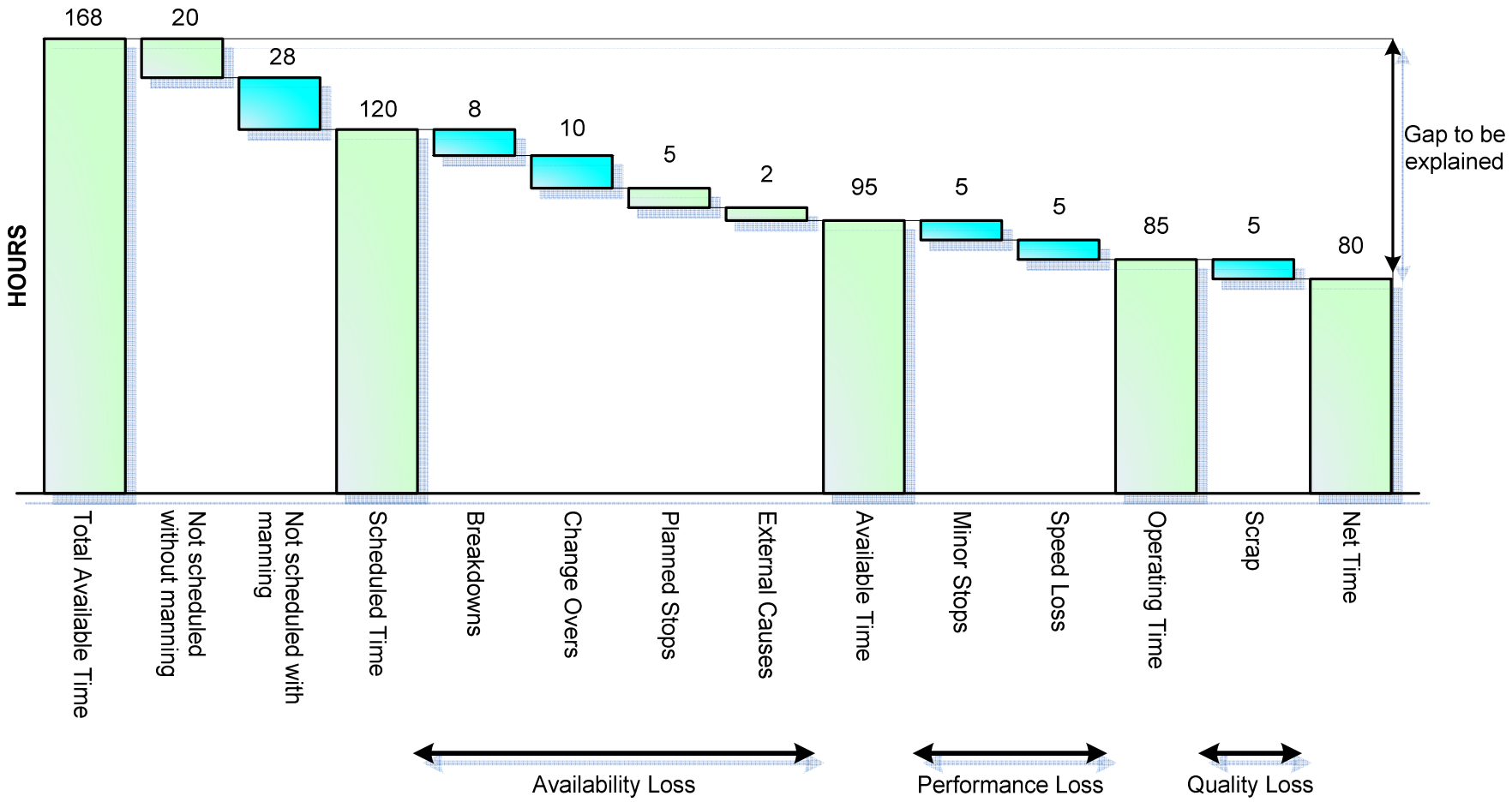

Figure 9 Waterfall OEE explanation graph

3.2 Lean Production

The Lean Production principle (Table 2) discussed in the literature is the most appropriate continuous improvement methodology for Kimberly-Clark due to the fact that its main principle is to use the best practices and processes, to improve efficiency, reduces cost and speed up the process by improving the OEE measures. The ACE is not considered as the best approach due to the focus is on the whole organization, although it is a combination of Lean Production, Six Sigma and Balance scorecard.

The following tools have been identified from Table 1 that would be utilized to find what the root cause of the problem is.

3.2.1 5 Why's

The 5-why's analysis is a tool that determines the root cause of problems, the main purpose of the tool is to reduce problems and eliminate problems. Murugaiah, Benjamin, Marathamuthu & Muthaiyah (2010) states that the 5-whys analysis benefits can be summarized as a manner to quickly finding the root cause of problems, make it possible to find the relationship between different problems, and it can also be learned easily by a person. Appendix A includes the 5 Why analysis sheet.

3.2.2 Pareto

The Pareto analysis is a tool that identifies the critical minority that are the minority causes for the major proportion of the process problems. The benefit of this tool that its points out the most important faults, thus making it much easier to observe. This tool is practically in every continuous improvement plan. Vilfredo Pareto is the developer of the Pareto analysis. Also none as the 80:20 rule, that are defined as 20 percent of sources cause 80 percent of the total number of problems (Gitlow, Oppenheim, Oppenheim, & Levine, 2005).

The Lean Production tools from Table 1 that can be used to develop solutions to improve OEE measure are as follow:

3.2.3 5S

5S is Lean Production's main element. This tool is used to arrange and maintain a place of work. The 5S consist of Sort, Straighten, Sweep, Standardize and Sustain; these are defined as follow (Bhuiyan, Baghel, & Wilson, 2006):

- Sort: Remove all excess items and place items back that are out of their place.
- Straighten: For visual identification, mark and position all equipment and products.

- Sweep: Cleaning the equipment and place of work. Maintenance can be done to equipment to avoid future breakdowns, after the equipment has been cleaned.
- Standardize: Maintain and monitor Sort, Straighten, and Sweep. This will allow an increase in speed, quality, and work area safety.
- Sustain: To harvest benefits, this process should continually be performed in the same order over a long period. Otherwise it would bring no benefits.

3.2.4 SMED

SMED is Shingo's methodology that is named the single minute exchange of die. This tool purpose is to improve operational set-up actions. Shingo also stated that SMED methodology can be applied to any machine in any factory. Figure 10 demonstrates Shingo's methodology; the internal set-up category can be carried out when a machine is not running, and the external set-up category can be performed when a machine is running (Moxham & Greatbanks, 2001).

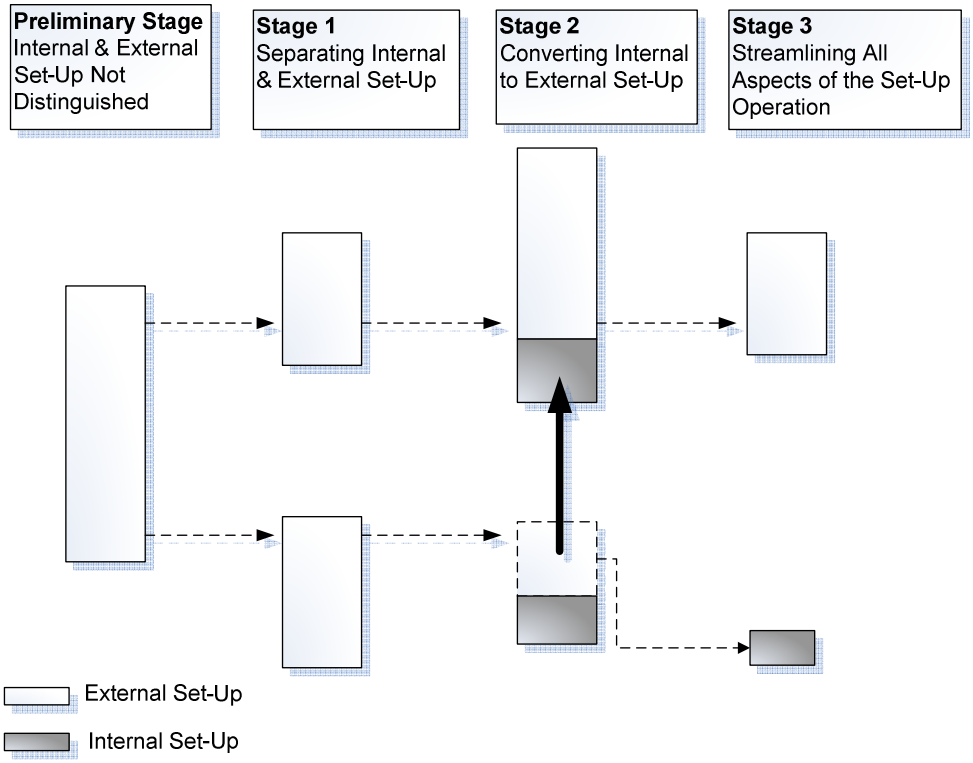

Figure 10 SMED conceptual stages (Moxham & Greatbanks, 2001)

3.2.5 Poka-Yoke

The Poka-Yoke methodology means mistake-proofing. This tool allows one to plan a process to prevent the possibility of mistakes, or help one to detect and correct mistakes without any difficulty. The Poka-Yoke can be divided into two categories, namely prevention and detection.

Prevention can be defined as engineering a process in a manner that will make a mistake impossible to happen. Detection can be defined as indicating the user to correct a mistake that has been made (Robinson & Packard, 1998).

3.2.6 TPM

Total productive maintenance (TPM) methodology is a process to include all employees to perform easy maintenance and fault-finding, that will improve the machine and operational reliability and efficiency (Wikipedia, TPM, 2010). This tool will reduce the losses and then significantly increase the OEE.

3.2.7 Visual management

Visual management is manner in which visual displays are set in a workplace environment to manage the Lean production and to eliminate all types of waste and losses. The eliminating of all types of waste and losses will then improve the OEE (Wroblewski, 2005).

3.3 Process of Continuous Improvement

Combining Deming's PDCA cycle (Figure 6) together with Neptune's Continuous Improvement Process (Figure 5) one can achieve continual movement of a process to follow and competitive excellence. But this will require the Neptune's method for solving team based problems to be adapted, and the PDCA cycle phases needs to be well defined in order to fit this projects Process Improvement Framework.

3.4 Mean Time's

Both MTTR and MTBF are alternative methods to see the improvement of the process. The purpose is to increase the MTBF and decrease the MTTR, to enhance the throughput of the process. This contributes to an improvement of the OEE measure. Figure 11 illustrates the combination of the MTTR and MTBF into one diagram.

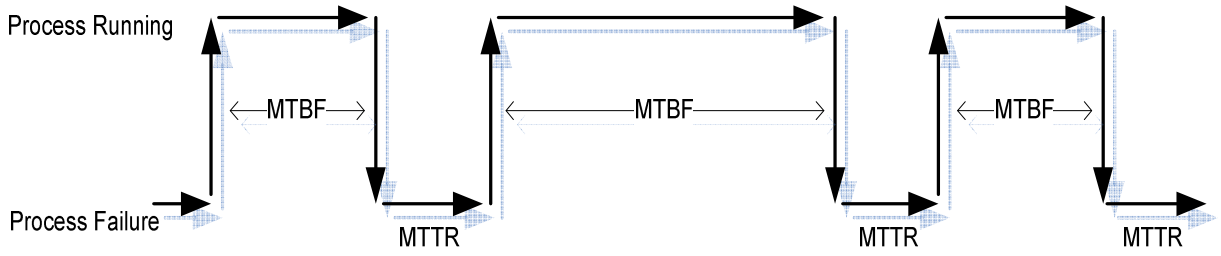

Figure 11 Mean Time's diagram

3.5 Approaching Change Management

There is a major lack in change management programs around the world; the research shows that only 30% is successful, this percentage was stated in 2008. McKinsey & Company did thorough research in determining why change management programs aren't working properly and what one can do to correct it. Thus the change management approach from McKinsey & Company is selected to be the most appropriate program for Kimberly-Clark, baring in mind their extensive and thorough research been done, and it's proven to delivers excellent results.

Keller and Aiken (2009) states that the change management approach encompass the following four conditions:

- Develop a compelling story
- Role modeling
- Reinforcement systems
- Required skills for change

3.6 Cross-Functional Team

From the literature above, Azad (2006) states, from his nine habits of highly effective continuous improvement teams, that cross-functional team is assembled. The Cross-functional Team is considered as the most appropriate team approach for Kimberly-Clark as it is the only team approach that will significantly improve the OEE, with the assemblage of employees from different functional areas of the business, ensuring the performance improves.

According to Proehl (1997) research done on 26 published articles, she underline five critical factors contributing to the success of a cross-functional team:

- It is critical to have the right team membership: members have to be extremely motivated, open-minded, and purposeful representation.
- The team leader needs to be skilled and have a powerful position within the organization.
- The team can complete their task when both power and accountability exists.
- The team needs support from management and needs sufficient resources.
- The existence of sufficient internal communication and external communication are crucial.

3.7 Process Improvement Team Configuration

3.7.1 Skills and size

The PIT consists of one Industrial Engineer, two Mechanical Engineers and a Technician.

3.7.2 Team strategy type

Every process engineer focuses on a production line or works area. With them a Process Specialist that typically has work beyond 5 years with the process, an Electrician, a Fitter, and a Team Leader to do all administration work, and Human Resources issues.

The purpose for the strategy is that the Process Improvement Engineer can learn about the process and try to add as must value to the process. Except for this approach, the PIT goes ahead with their other individual process improvement projects as usually.

3.7.3 Responsibility

The Process Improvement Engineer is responsible to take ownership, to research, to study, to refine, to propose solutions and to implement a range of initiatives and projects which have been identified. These could be related to improved processes and procedures, mechanical modifications or electrical modifications, process equipment modifications, HR-related changes, features or enhancements required by Marketing. Further identify such initiatives through their own observations and assessments, and report such to management for further consideration.

CHAPTER 4: Design and Problem Solving

4.1 Process Improvement Framework

The main barrier for the Kimberly-Clark for continuous improvement is mainly in the area of change management. All the personnel involved in the organization tend to feel insecure about transformation. This problem exists in many organizations and can have an impact on improvement.

Figure 12 is a graphic representation of the developed Process Improvement Framework. Continuous improvement is interdependent of change management and if change management is ignored, this framework can not be implemented successfully. This unique relationship will contribute to deliver significant results in any organization within this framework. The Continuous Improvement is also dependent on problem identification and problem analysis.

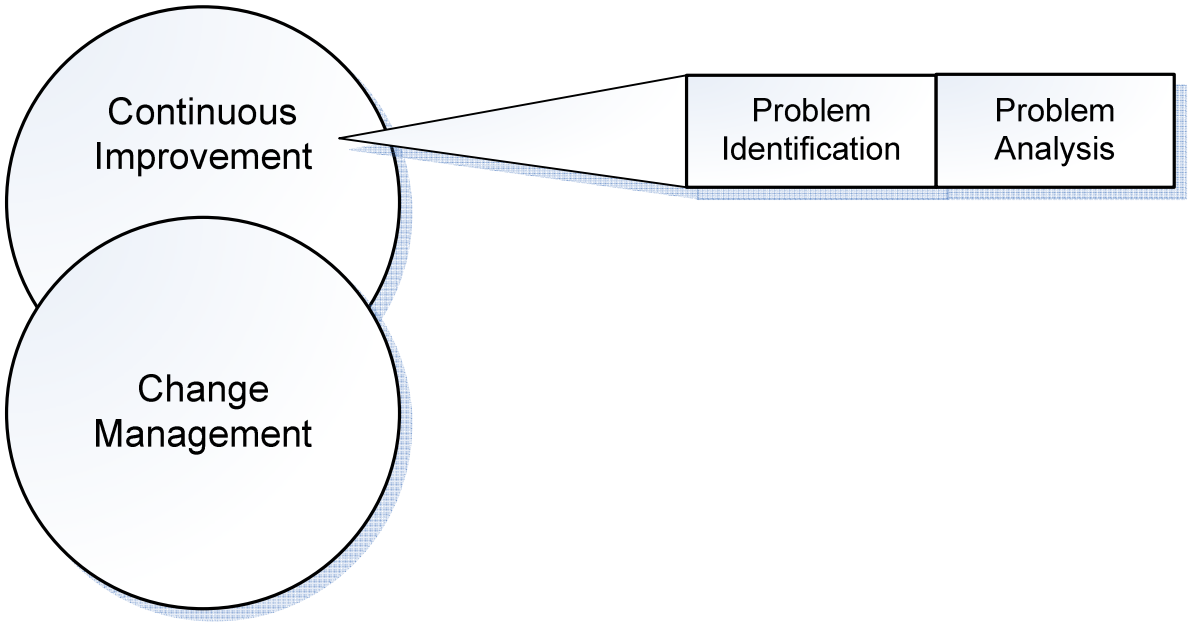

Figure 12 Process Improvement Framework drivers

4.1.1 Structured approach to Continuous Improvement

The structured approach to continuous improvement for the Process Improvement Team (PIT) at Kimberly-Clark will follow the well known continuous improvement process by Deming (Figure 13). The four stages that need to be followed can be defined as follows:

- **Plan**: Identify problems, construct a team, determine the root cause of the gaps, and find solutions to improve the performance.
- **Do**: Develop and implement the solutions to improve the performance.
- **Check**: Review if the performance has increased due to the solutions implemented.
- **Act**: If performance has increased, make sure it can be evaluated and maintained.

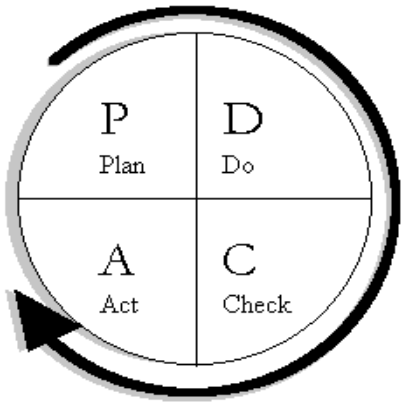

Figure 13 Deming's PDCA cycle

A more detail developed framework for continuous improvement are illustrated in Figure 14, which have a more structured approach to follow within the PDCA cycle. The Problem Identification and Problem Analysis phases will be discussed in more detail: the inputs and output to the phase, with physical examples of applying the tools on the processes at Kimberly-Clark.

Team Formulation

The research shows that a Cross-functional Team's approach is well known for achieving excellent results in a continuous improvement environment and that a team can improve the performance of the organization by managing it correctly. To give effect to this it will necessitate that:

- the team must consist of employees from different departments that has an influence on the process being addressed;
- the team must receive training for the improvement of their skills;

- the team must establish an organization structure to clarified project boundaries and effective communication channels among employees;
- a rewards system needs to be put in place;
- the necessary support from the management and adequate resources needs to be available to them;
- strong leadership needs to exist within the team; and
- regular meetings needs to take place;
    - meetings with operators just before change overs, in doing so the next shift will know where extra attention on the process needs to be given regarding the previous sessions results obtained.
    - regular meetings with operators to discuss where the management can help them to improve performance.
    - Cross-functional Team meetings regarding the daily results obtained.

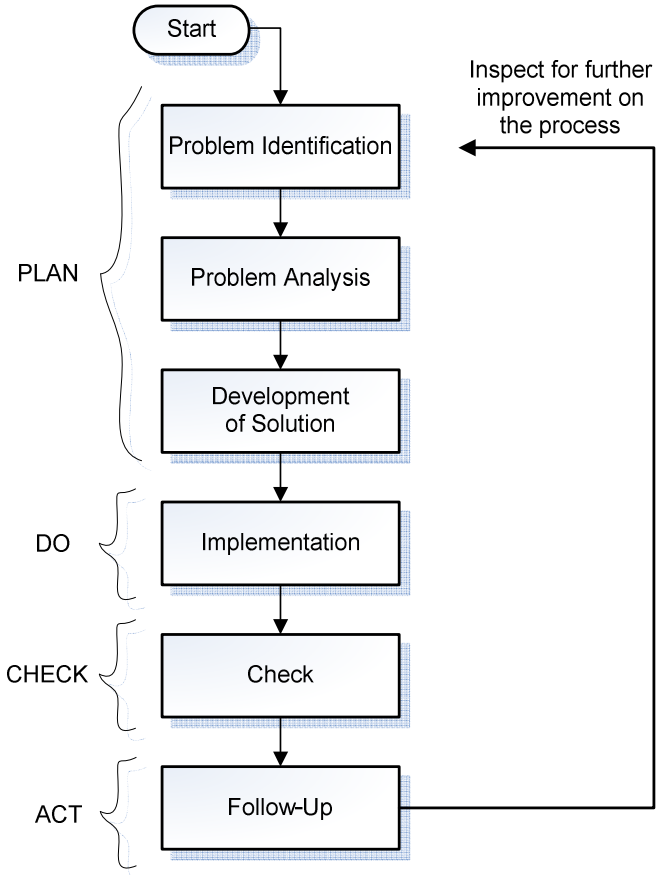

Figure 14 Framework for Continuous Improvement

4.1.1.1 Structured approach to Problem Identification

The structured approach to problem identification is further divided into the measure of OEE and pareto analysis phases (Figure 15).

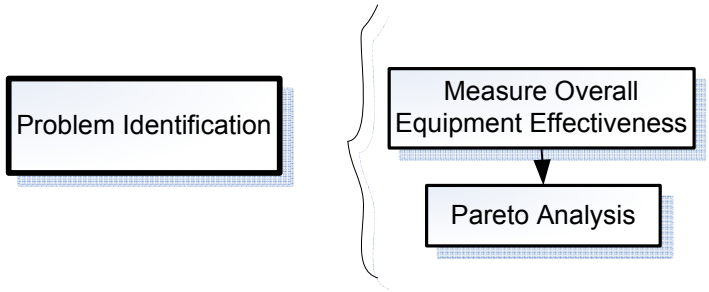

Figure 15 Phases of Problem Identification

Measure OEE

The measure of the Overall Equipment Effectiveness (OEE) needs to be done, this will place emphasizes on the areas that needs improvement. Through the OEE measurements of the processes the three major categories of losses are identified, namely:

- Availability Loss.
- Performance Loss.
- Quality Loss.

The purpose of the OEE measurements will be to identify losses to enable the Cross-functional Team to minimize these losses and to achieve capacity gains. This will assist the PIT to achieve an improved OEE measure, which will contribute to significant process performance.

Achieving competitive excellent will be the ultimate goal - being the benchmark for the tissue manufacturing organization. At present Kimberly-Clark already have access to all tissue manufacturing organization's OEE measures around the world, allowing them to benchmark themselves against the rest.

The company already did value stream mapping to identify the process that yields the most value to the company, thus the Bath Tissue process were selected. Figure 16 is the developed OEE waterfall for the Bath Tissue process at Kimberly-Clark.

From Figure 16 it can be concluded that Web breaks and Plug-ups and Speed Loss greatly decrease the value of the Bath Tissue process OEE. Thus the Cross-functional Team will place their focus on these areas for improvement, in order an increase the current OEE of 59.1 %.

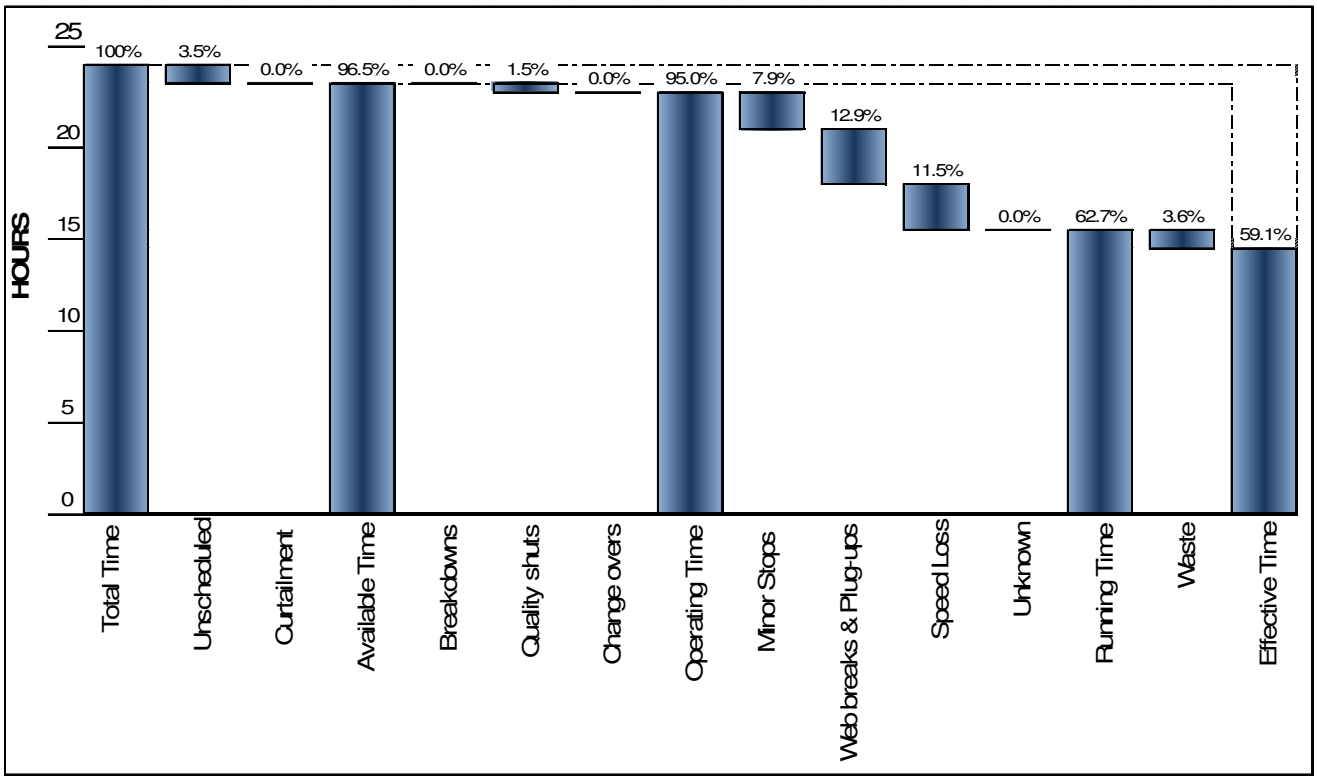

Figure 16 OEE Waterfall Report

Pareto Analysis

After the Waterfall OEE report, a pareto needs to be developed for the loss types. Figure 17 illustrates the pareto of the lose type identified by the OEE for the Bath Tissue process. The Web breaks and Plug-ups causes 34,4% of the total loss, and Speed Loss is 30,8% of the total loss, thus the improvement of these two areas will add the most value to improve the Bath Tissue process performance.

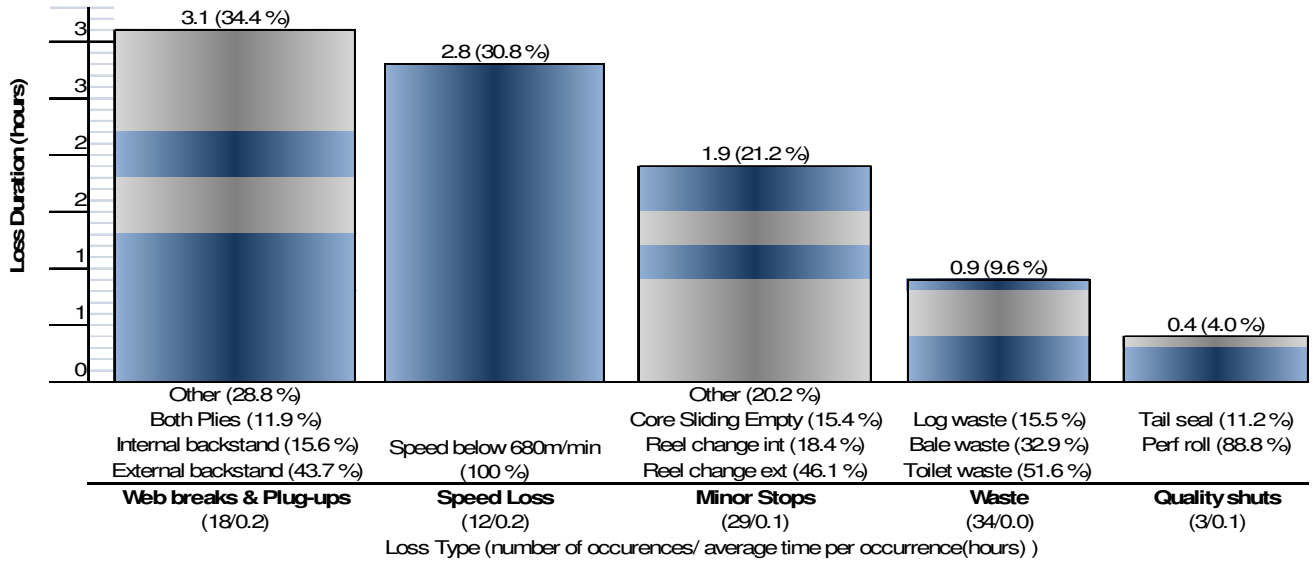

Figure 17 Loss Type Pareto

4.1.1.2 Structured approach to Problem Analysis

The main purpose for a structured approach to problem analysis is to find the root cause of the losses identified in the problem identification phase. To identify the root cause, firstly a pareto analysis needs to be done to determine the reasons for the loss type. Together with the loss reason pareto the average time per and between occurrences are determined.

The 5 Why's analysis have to be applied by the Cross-functional Team on the Bath Tissue process, after the loss reason have been identified.

Pareto Analysis

Figure 18 illustrates a pareto analysis of the reason of loss due to Web breaks and Plug-ups loss type. The Web breaks and Plug-up's external backstand has occurred 5 times, that sums up to a total of 81 minutes, thus has a percentage of 43.8% of the total time loss caused by the Web breaks and Plug-ups.

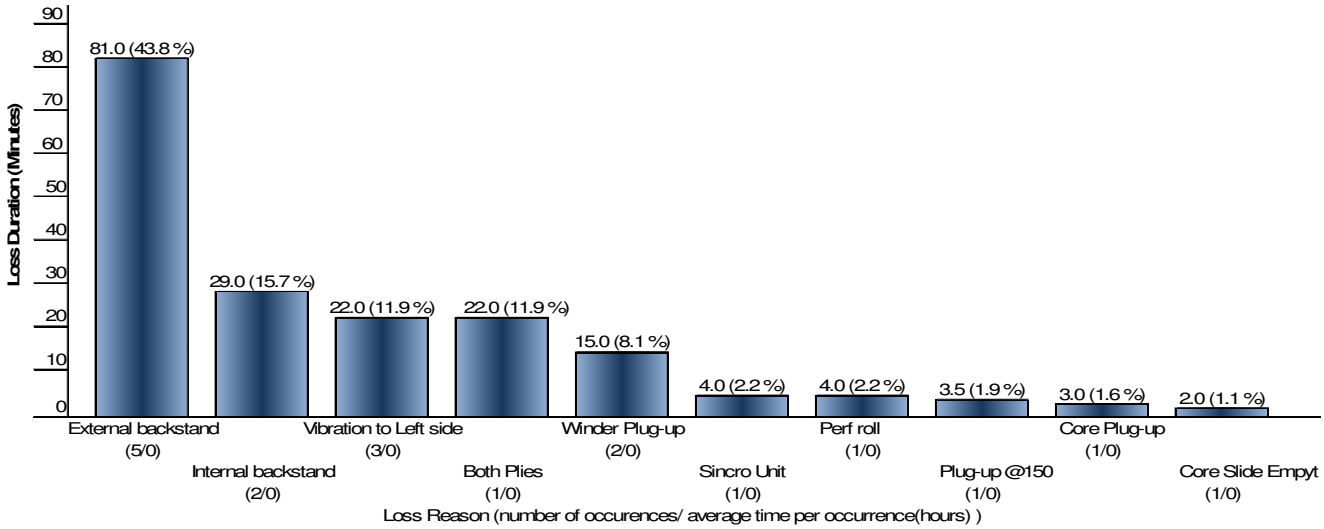

Figure 18 Loss Reason Pareto

The average time per occurrence is also known as MTTR (Mean Time To Repair). The purpose to also measure this is to rather try minimizing the time duration of the problem with some initiatives in the case where the root cause can not yet be solved. This allows one to improve the OEE measure for the short term duration, thus carrying out a containment action.

From Figure 19, the mean of Web breaks and Plug-ups are currently at 10.3 minutes, one needs to decrease this mean value in order to improve the OEE.

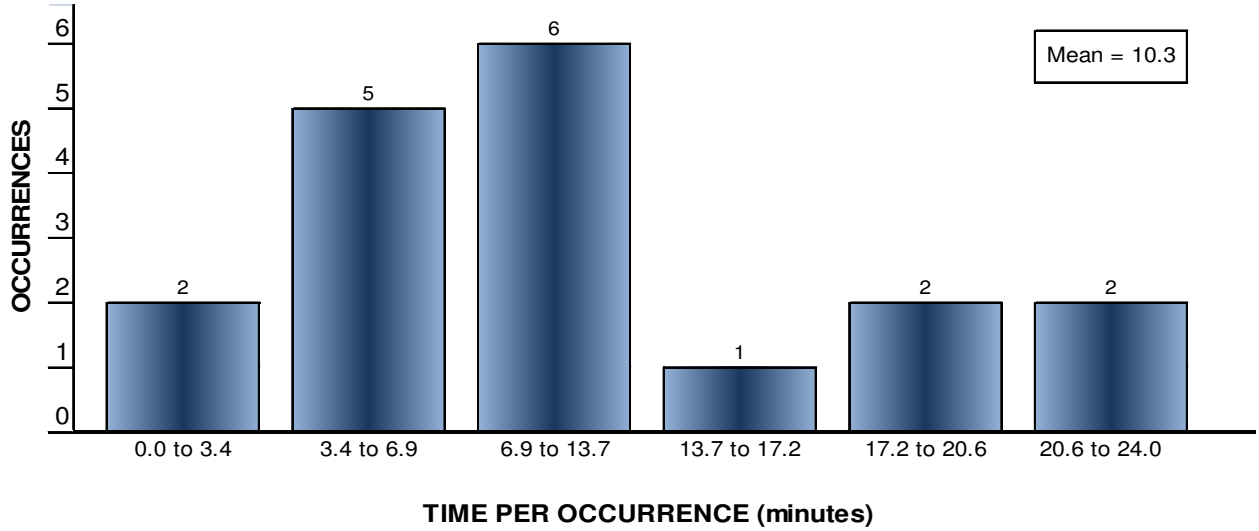

Figure 19 Average Time Per Occurrence

The average time between occurrences are also known as MTBF (Mean Time Between Failures). This is the time elapsed between failures of the process. Figure 20 illustrate that in 17 occurrences the time between failures were less than 2.1 hours. One needs to increase the mean value in order to improve the OEE measure.

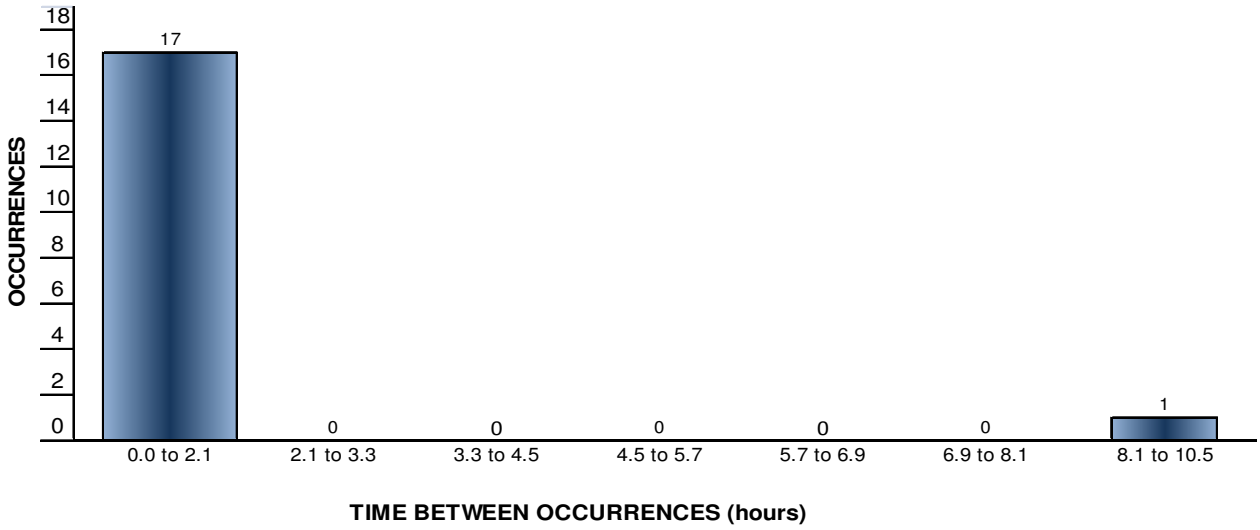

Figure 20 Average time between occurrences

5 Why's Analysis

The 5 Why's was applied on the Web breaks and Plug-ups, that causes 12.9% of the OEE loss. Figure 21 illustrates a 5 Why analysis applied to the core wind shaft breakdown. A possible containment action for the short term and possible permanent action for the long term is also included to address the problems of the 5 Why.

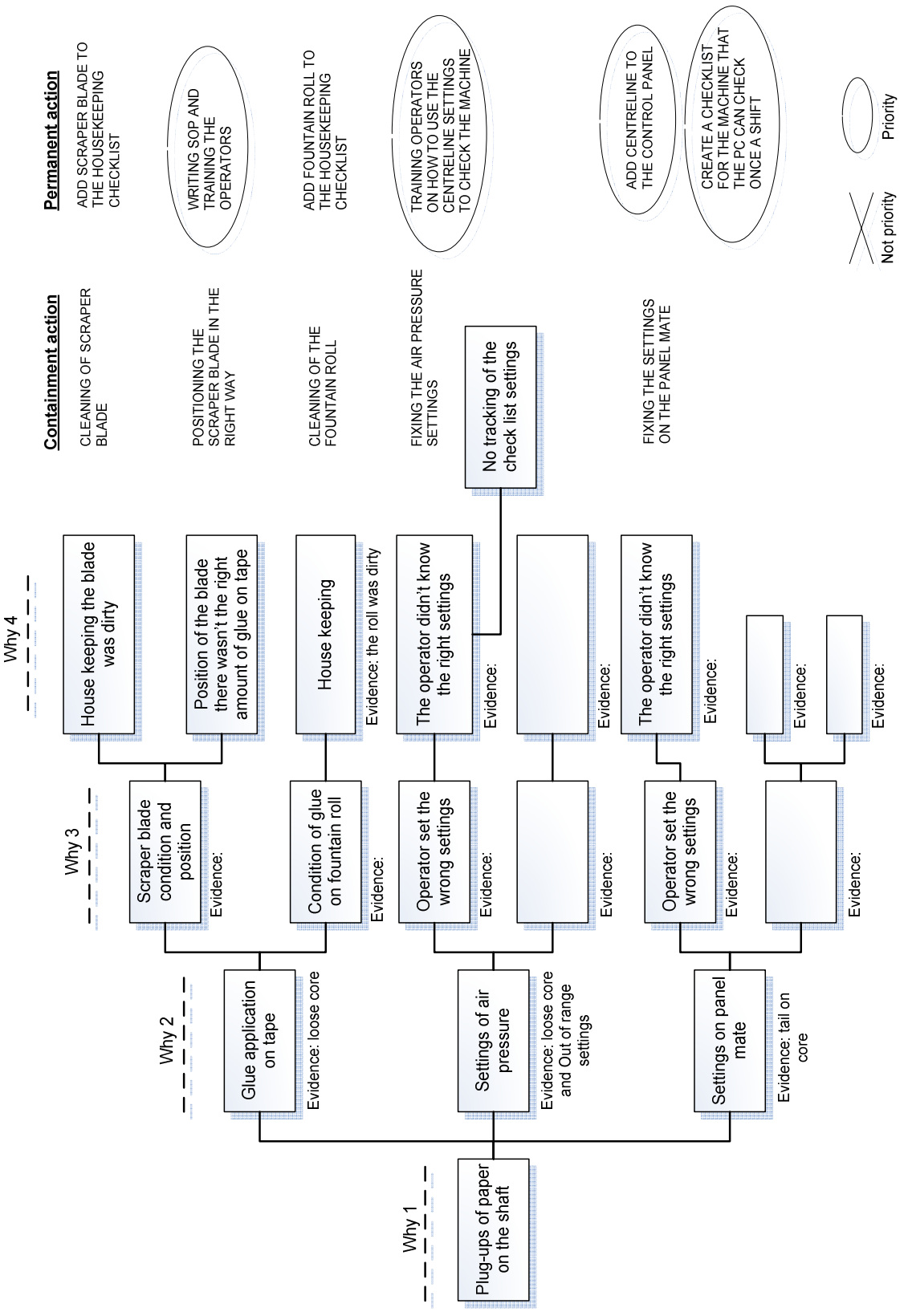

Figure 21 The Web breaks and Plug-ups 5 Why's

4.1.1.3 Development of Solution

The development of solution falls outside the scope of the project. From the problem analysis phase the Cross-functional Team needs to carry out the containment action or permanent action defined through their 5 Why's task.

The containment actions are applied when the root cause can not be solved yet. Thus for the short term rather minimizing the time duration of the problem and increasing the MTBF with some initiatives. This will contribute to improvement in the OEE measure. The permanent actions are applied when the root cause are properly identified.

Table 4 indicates the Lean Production tool that needs to be considered for Kimberly-Clark processes to develop a solution that will improve their overall performance, thus increasing the OEE measure. The 5S and Visual Management method can be applied from the start, making the process of identifying the root cause much easier.

Table 4 Development of Solution approach

Lean Production Tool	Purpose
5S	The method will arrange and maintain the workplace through sort, straighten, sweep, standardize, and sustain. The 5S will thus increase the speed, quality, and safety in the workplace. This can be done through marked areas for tools and equipment to be placed, keeping the area organized.
Visual Management	The method communicates relevant production information, highlights areas of waste for employees, and corrects a mistake proof. This provides a state of urgency amongst employees. This can be done through setting up performance boards.
SMED	Improves the operational set-up actions, causing less change over losses.
Poka-Yoke	Prevents and detects any mistakes of occurring, helping a decrease in breakdowns.
TPM	Improves the operational efficiency. But this method requires proper management support and commitment.

4.1.2 Structured approach to Change Management

Change management still occupies an uncomfortable place in today's environment. More thorough research needs to be done in order to manage the people-side of business change to achieve required business outcome.

Change management will ensure Kimberly-Clark that all changes and improvements are successfully executed and accepted by the employees. Through the research, for transformation it is shown that an employee's behavior affects his performance, hence his mindsets influences his behavior. An employee mindset consists of feelings, thoughts, and beliefs.

The proven change management program chosen for this project, have certain prerequisites for the transformation process, in order for employees to change their behaviors. The following prerequisites need to be taken into account:

- Developing a compelling story
- Role modeling
- Required skills for change
- Reinforcement systems

The Cross-functional Team is capable of achieving and sustaining continuous improvement in Kimberly-Clark, when all four of these prerequisites are effectively applied in Kimberly-Clark. This process needs to be done on a continual basis, thus Deming's PDCA cycle will be the most suitable approach to deliver results in change. It will be critical to take the following in consideration:

- On a regular basis inform all employees with the purpose of the transformation.
- Inform the employees about what the impact of transformation will be on:
  - the society
  - themselves
  - the business
  - the customer, and
  - the working team
- Management support and commitment are a vital important requirement, due to employees accept change if management beliefs in change.
- Employees need to feel that their efforts to change will be worthwhile, thus by giving them surprising rewards to show the appreciation to their efforts.
- Give the employees the necessary class room training and on job training that will improve their skills and capability.
- This change management approach needs to be carried out on a regular basis. To ensure that employees do not fall back to their old behaviors.

CHAPTER 5: Recommendations and Conclusion

5.1 Future Recommendation

The Process Improvement Team should consider the use of ShopWare's Visual Management system in the near future. This will take their improvement levels to greater heights. Allowing real-time and accurate performance measures to be available in a visual format throughout the organization. This system is designed to simplify the management of processes. The OEE is used by this system, pointing out the losses that are measured by the availability rate, quality rate and speed rate.

5.1.1 Management Information System (MIS)

- Generate graphical and tabular reports through information being modified by this flexible tool.
- Allow the user to scroll down from OEE charts to Pareto analysis of Availability, Speed and Quality.
- Supports user to generate charts.
- Can also create preferred lists for most generally used charts.

5.1.2 Enterprise Improvement Module

Deming's PDCA cycle for continuous improvement is supported by this MIS. Exact events can trigger the 5 Why problem solving technique. The key performance indicators are linked to action plans. Also a single sheet report with production metrics are automatically generated, that can be used in production meetings.

5.1.3 Benefits

Through the ShopWare system the competitiveness and continuous improvement of the organization are enhanced significantly. This tool's immediate advantages include that is not limited to:

- Improves the Overall Equipment Effectiveness.
- The traditional recording equipment and reporting systems are replaced by accurate real-time information, allowing information to be available when needed and problems can be solved quicker.
- Elimination of waste from analysis actions and data gathering.
- The employees' performance improves by making use of this uncomplicated, effective information technology.

5.2 Testing and Validation

The development of a Process Improvement Framework is a need identified by Kimberly-Clark. The need initiated this project, thus research were done to develop a solution to their need. The Process Improvement Team will further test and validate this solution, in order to adapt where needed to get the most effective impact on their processes.

5.3 Conclusion

The aim of this project was to develop a Process Improvement Framework for the Process Improvement Team of Kimberly-Clark. In order to have a significant impact on processes, through a structured approach to problem identification, problem analysis, continuous improvement and change management. Continuous improvement together with change management is a new trend that businesses nowadays tend to follow to improve their performance to achieve competitive excellence.

Through the analysis, the PIT finds it difficult to determine the root causes of problems and they were unable to proper measure if their improvements to a process have benefited the performance. There is also a lack in employees' behavior to change to accommodate the new improvement changes to a process.

Thus the OEE measurement used helps the PIT to easily emphasis the area of loss where the team needs to place their focus to quickly address the problem. Hence the Pareto analysis provides the Team with a much clearer observation of the loss type and the loss type reason.

Further the MTTR and MTBF are also measured in case the root cause can not yet be identified, in order to minimize the mean time duration of the problem through some initiatives, which will improve the OEE. The 5 Why's analysis determine the root cause of the problem and sets out a containment action for short term and permanent action for the long term. The selected Cross-functional Team approach enhances better communication between different departments and they also deliver exponential results through their ability.

The developed change management approach gives prerequisites that needs to be achieved, in order for employees to accept the change, sustain their performance, and not allowing them to fall back to their old behaviors that decrease the performance.

This project will provide Kimberly-Clark's Enstra Mill with a Process Improvement Framework that will facilitate the Process Improvement Team to achieve their main aim by establishing them as a Process Improvement Department.

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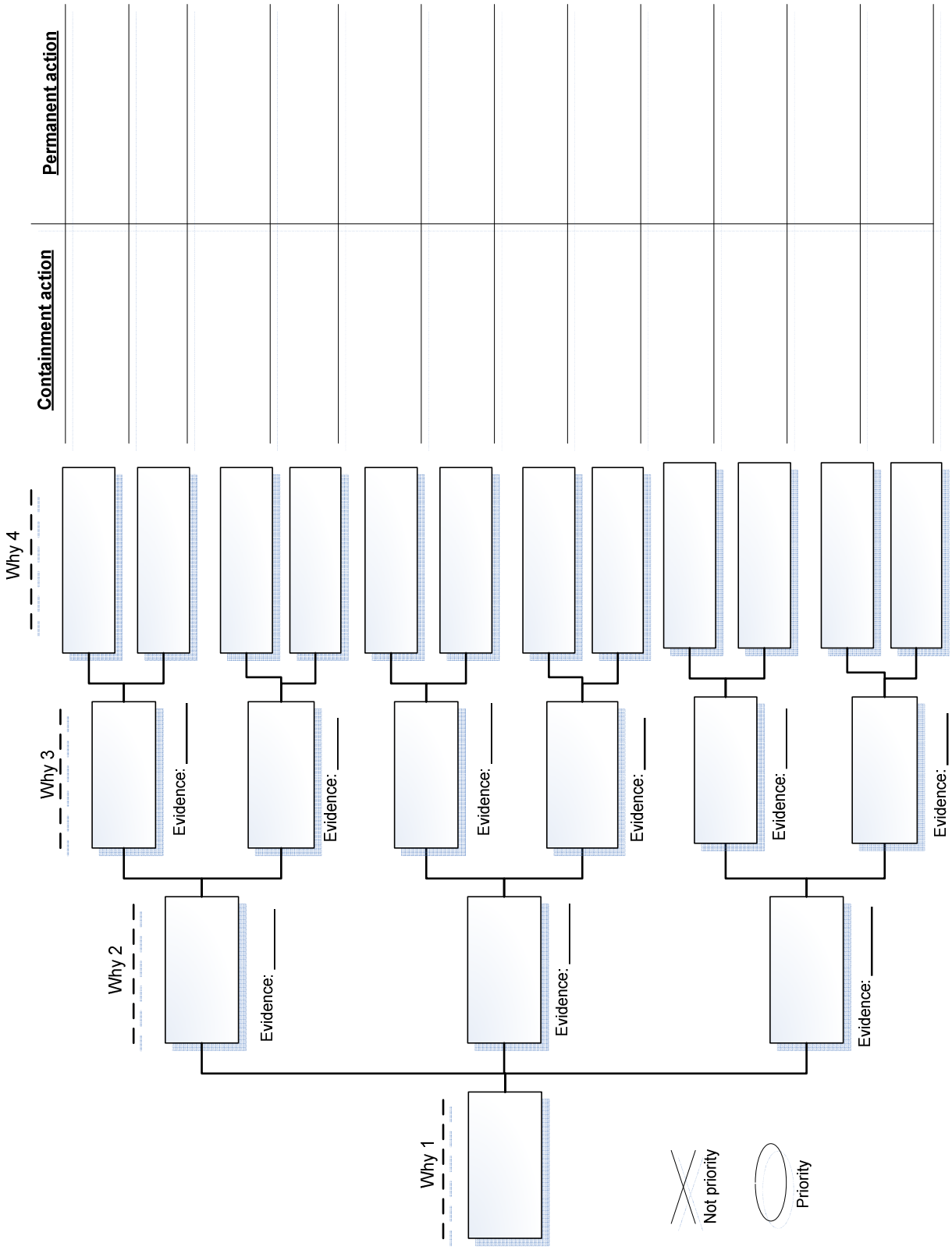
Appendix A


Permanent action
Containment action
Why 4
Why 3
Why 2
Why 1
Evidence:
Not priority
Priority