IMPLEMENTATION OF 7 QC TOOLS BY USING KAIZEN APPROACH FOR SME MANUFACTURING INDUSTRY

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ABSTRACT

Kaizen is a critical tool for to eliminate or reduce waste from production processes. Seven quality control (7 QC) tools are one of the common methods and techniques of the kaizen. The objective of this thesis is to improve product quality and performance of production using kaizen process approach by reduce or elimination of scrap with the aid of using appropriate 7 QC tools and Standard Operation Procedure (SOP) to improve process efficiency. The methodology use are the kaizen flow by establish a team, identify the waste with the concept of 7 MUDA and reducing the rework waste in the X Company with the aid of 7 QC tools. The flow chart, Ishikawa diagram, Pareto diagram and histogram are used to record data, identify possible cause of problem, visualize the frequencies of the rework waste and show the causal relationship between the two and the frequency distribution of a set of measurement. The improvement action of kaizen by having SOP in order to increase workers understanding on their duty, reduce scrap, increase productivity, reduce rework problem and hence save the manufacturing cost as well as increase the overall performance of the attached company. Consequently, this thesis will guide the users in the correct and effective way to reduce the rework by utilizes the SOP, 7 QC tools and kaizen flow.

ABSTRAK

Kaizen bermakna peningkatan berterusan dalam setiap aspek kehidupan termasuk perniagaan, pembuatan, pentadbiran dan sebagainya. Kaizen adalah alat yang penting untuk menghapuskan atau mengurangkan pembaziran dalam proses-proses pembuatan. Tujuh alat kawalan kualiti (7 QC) ialah salah satu kaedah dari teknik kaizen yang biasa digunakan. Objektif tesis ini adalah untuk meningkatkan kualiti produck dan prestasi pengeluaran menggunakan pendekatan kaizen untuk mengurangkan atau menghapuskan scrap dengan menggunakan alat-alat 7 QC yang sesuai dan tatacara pengendalian piawaian (SOP) untuk meningkatkan kecekapan proses. Cara pelaksanaan ialah dengan penubuhan satu pasukan kaizen, mengenal pasti pembaziran menggunakan konsep 7 MUDA dan mengurangkan pengerjakan semula dalam syarikat X dengan bantuan alat 7 QC. Carta aliran, gambar rajah Ishikawa, gambar rajah Pareto dan histogram adalah digunakan untuk merekod data, mengenal pasti punca masalah, menggambarkan kekerapan kerja semula dan menunjukkan kaitan punca di antara kedua-duanya selain mengambarkan kekerapan taburan satu set ukuran. Tindakan pembaikan kaizen dengan penggunaan SOP dalam syarikat adalah untuk meningkatkan kefahaman pekerja kepada tanggungjawab meraka tentanf tugas mereka, mengurangkan bahan buangan, meningkatkan kualiti produk dan produktiviti dan mengurangkan masalah kerja semula. Seterusnya ini menjimatkan kos pembuatan serta meningkatkan prestasi keseluruhan syarikat. Tesis ini akan memberi petunjuk kepada pengguna dengan cara yang betul dan berkesan untuk mengurangkan kerja semula dengan menggunakan SOP, alat 7 QC dan kaizen.

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LIST OF ABBREVIATIONS

UMP	University Malaysia Pahang
PDCA	Plan Do Check Act
TPS	Toyota Production System
TQM	Total Quality Management
TPM	Total Productive Maintenance
7 QC	Seven Quality Control
SME	Small and Medium Enterprise
JIT	Just In Time
CIM	Continuous Improvement Manufacturing
SPC	Statistical Process Control
SMED	Single Minute Exchange of Die
JICA	Japan International Co-operation Agency
UCL	Upper Control Limit
LCL	Lower Control Limit
FG	Finish Good
WIP	Work In Progress
SOP	Standard Operating Procedure

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Quality, since the beginning of the 1980s, the large or small business had used this as a key management concern and has become important to the success. The origin of quality is mean of *qualis* as "how constituted", traces its basis in human needs and wants (Schultz, 1994). The definition of quality was "fitness for use; customer satisfaction" (Juran, 1974) and another definition of the quality by Crosby was "quality is conformance to requirements" (Tsai, 1996). However, general definition of the quality in most organization refers to the ability of a product or service directly interconnected to meet or exceed the requirements and expectations of the customer.

Quality is broadly supposed that a manufacturing organization's operation or production with a successful quality management system is able to fabricate good quality products and therefore achieve good business results. One of the methods to solve quality issues is Kaizen. Kaizen is a common problem-solving tool and may be applied to any improvement process especially quality. The good quality product or service means that it has the ability to satisfy the customer's needs and expectations (Bergman and Klefsjo, 2003). There are five factors as the key drive for improving quality in the 20^{th} century. Juran concluded that the 20^{th} century was the century for productivity. According to Juran, the forces that drove quality consist of:

1. greater complexity and precision of products
2. threats to human safety and health, and to the environment
3. government regulations of quality
4. the rise of the consumerism movement
5. intensified international competition on quality

1.2 BACKGROUND OF STUDY

The term kaizen from Japan has generally been translated in western form as continuous improvement (CI) (Imai, 1986). The first applied of kaizen was in several Japanese businesses after the Second World War (WWII), affected partly by who visited the nation such as American businessman and quality management teachers. Kaizen means continually improving in every aspect of life including business, manufacturing, administration, commerce and international relations, and so on. Therefore, it is not only a philosophy of the workplace but also the foundation of all activities if it is completely executed in the organizations.

Kaizen is a critical tool for implementing lean production to eliminate waste from production processes. The lean production is originated on the idea of kaizen which is the small, gradual, incremental change applied over a long period of time that combines to a major effect on business result. It is also addressed in the general workforce. For example, Womack and Jones (1996) referred the kaizen as lean thinking and came out a systematic method to helping organizations reduce waste, or Muda. The Muda described by Womack and Jones (1996) as any human activity that adsorbs resources but produces or adds no value to the process.

Besides, the kaizen is defined as an essential tool for inclusion in industrial technology curricula (Lee *et al.*, 1999). The kaizen has a strong demand for many top management especially managers because it is fast, effective and dramatic. The kaizen principle is identified and solved the work-based problems by application of assorted problem-solving tools to implement in work cells, reduce setups and also for 5S. Moreover, the kaizen may turn a profitless company into a profitable one without a huge investment in equipment with the methods such as quality circles (plan-do-check-

act). The kaizen strategy involving all levels of management including managers, engineers, technician and production supervisors where they are assigned as team leaders for continuous effort and obligation (Ortiz, 2008).

Kaizen starts with a problem or with the detection that a problem exists. A problem in an organization is anything that inconveniences people downstream, either people in the nest process or ultimate customers. The difficulty of problem solving is that the people who create the problem are not directly inconvenienced by it. Thus, they are not sensitive to the problem. Subsequently, the kaizen techniques are valuable instrument that can be used to solve the existing problem such as building a small kaizen group, brainstorming or people-oriented thinking, gemba and so on.

The kaizen approaches and techniques are valuable tools that can be used to increase productivity, to obtain the competitive advantage and to raise the overall business performance on a tough competitive market by reducing the manufacturing or production cost. For easier and more effective solving the problems or managing the events of the kaizen, the right and suitable methods should be used. There are some common methods and techniques of kaizen that integrate and drive quality improvement which are listed as below.

1. Japanese 5S
2. Six Sigma
3. PDCA
4. Toyota Production System (TPS)
5. Total Quality Management (TQM)
6. Seven quality control (7 QC) tools

A focused kaizen that is designed to address a particular issue over the course of a week is referred to as a "kaizen blitz" or "kaizen event". The kaizen blitz is a team activity aimed at rapid use of lean methods to eliminate production waste in particular areas of the shop floor. It is well planned and highly structured to enable quick, focused, intense, short-term project to improve a particular process or activity (Productivity Press, 2002).Kaizen events can focus on starting 5S or other goals limited to reducing or eliminating waste in a single area or operation(Lee, 2003).

According to W. Edwards Deming, "The system improvement of the production and service is not a one-time effort. Management is obligated to continually look for ways to reduce waste and improve quality." Consequently, a standard such as SOP needs to be implementing by organization to make sure the improvement is ongoing. The continuous improvement and support of the higher standards can be implemented by providing the training, materials and supervision that is needed for employees to achieve and maintain their ability to meet those standards on an ongoing basic.

1.3 PROBLEM STATEMENT

Problem solving of quality issue is critical in current manufacturing area. 7 MUDA is a serious quality issue happens in the manufacturing. In order to solve the problem, a kaizen team establishes and having adequate training and knowledge of basic problem solving tools such as SOP and 7 QC tools will lead to solve the quality problems efficiently and effectively.

1.4 OBJECTIVES

There are three objectives in this thesis which are listed as below.

1. To use appropriate 7 quality control (7 QC) tools to analysis data.
2. To improve product quality and performance of production using kaizen approach by reduce or elimination of scrap.

1.5 SCOPES OF THESIS

The scopes of thesis are

1. Use 7 QC tools to identify, analyze and control the major problems exist.
2. Create SOP for kaizen improvement.
3. To reduce or eliminate the waste of scrap.
4. Implement in the plastic Small and Medium (SME) industry.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this section literature review was categorized into six sections. The first section studies the quality improvement history. This provides a guideline of how the quality improvement was moved on during the last decade and learned about the techniques and tools that have been used to study case. The second section would review on kaizen philosophy. This could give some ideas on how to improve the quality by using various kaizen tools and techniques such as 7 wastes and 7 QC tools.

The third section discusses about the Standard Operating Procedure (SOP). There were some description of SOP about who is going to write the SOP, what is the purpose of SOP and methods to create it. The fourth section reviews the description of 7 wastes and rework issue in some organizations. The 7 quality control (7 QC) tools are discussed in section five. The descriptions and examples of 7 QC tools were shown in this section. The last section is the quality improvement in Malaysian Small and Medium Enterprises (SME's) industries. Method is discussed and reviewed to give reader a better understanding on Malaysian industries improvement movement.

2.2 QUALITY IMPROVEMENT HISTORY

According to Juran (1974), quality was defined as freedom from lacks-freedom from defects that need rework or consumer dissatisfaction or claim and so on. He also assumed that quality is a necessary requirement of products that they meet the wants of the consumers. Besides, he also described quality management in terms of trilogy or tools which are quality planning, quality control and quality improvement

Additionally, Giffi *et al.* (1990) described that to sustain competitiveness cannot be created overnight and will never be reached if manufacturers focus only on some of the elements in the manufacturing equations. In the quest for quality, organizations have sought formalized alteration programs such as Kaizen (Hamel and Prahalad, 1994).

Stevenson (2009) described TQM as a philosophy that involves everybody in an organization in a constant effort and enlarges the traditional understanding of quality from focus only the quality of the final product or service to focus at the quality of every phase of the production process or service. Table 2.1 below shows the summarization of contributions by contributors (Stevenson, 2009).

Table 2.1: Summarization of contributions by contributors. Source: Stevenson (2009)

CONTRIBUTOR	KEY CONTRIBUTIONS
Shewhart	Control charts; variance reduction
Deming	14 points; special versus common causes of variation
Juran	Quality is fitness for use; quality trilogy
Feigenbaum	Quality is total field; the customer defines quality
Crosby	Quality is free; zero defects
Ishikawa	Cause & effect diagrams; quality circles
Taguchi	Taguchi loss function
Ohno& Shingo	Continuous improvement-kaizen

2.3 KAIZEN PHILOSOPHY

Imai (1986), who introduced kaizen as an umbrella concept for a great amount of Japanese practices which in his book, *Kaizen: the Key to Japan's Competitive success*. Moreover, he defined kaizen means continuous improvement that involves every employee.

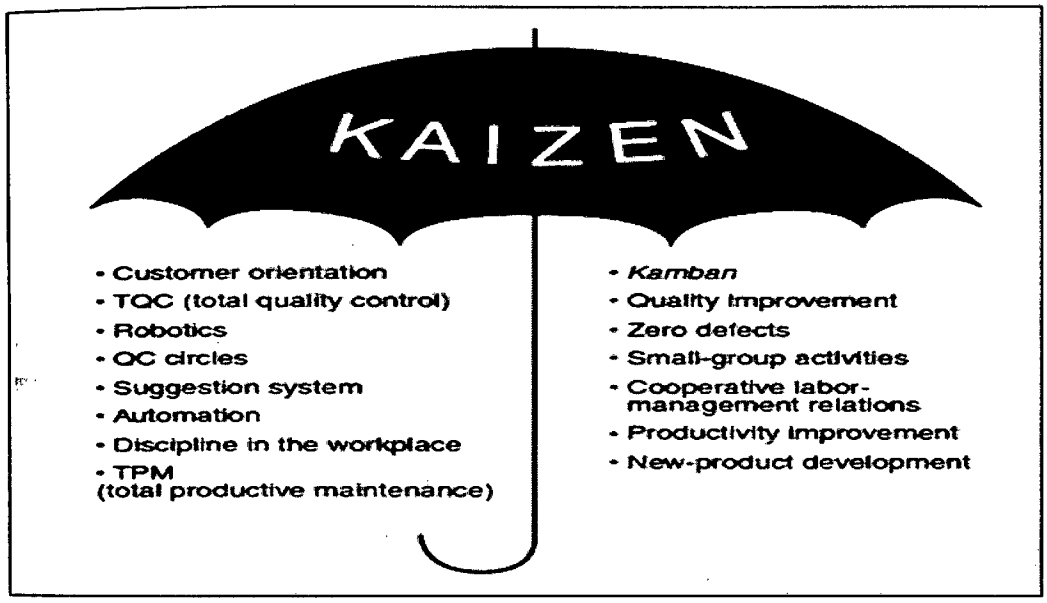

Figure 2.1: The kaizen umbrella. Source: (Imai, 1986)

Kaizen initiatives in Japan had one key practice in common which is overwhelming workers' resistance to adjustment. However, there are some differences between Japanese and Western management method. For the Japanese method, kaizen focus on human basics and human's process-oriented efforts while the Western method tends to studying performance from results-based standards (Imai, 1986 and 1997).

Ashmore (2001) found that kaizen approach especially the role of 5S by eliminating waste and Just In time (JIT) in making continuous improvement increasing the competition and costs. This is because after executive of this approach, the sale increased more than 69% and its profit by 54 times in an economic year.

According to Environmental Protection Agency (2007), the SOP should be written by person knowledgeable and experienced with the activity and the internal structure of organization. These persons are essentially subject-matter experts who actually perform the task or use the process. However, if the multi-task processes perform is critical, buy in the SOP from potential users is encouraged.

Iowa State University (2008) explained that there are some purposes of preparing the SOP such as serve as frame work for organizational policy by providing direction and structure, written documentation of best practice and tells what, how, when, why, where and who to perform the task. Besides, it provides foundation for job descriptions, employee training, corrective action and discipline as well as performance review.

David (2010) mentioned that there are a number of different methods to developing SOP. It depends on the business, complexity of the SOP and the amount of people involved in the development. The steps procedure below may be valuable and effective in most situations.

1. Use description action words to name the SOP.
2. Write the SOP scope by answering which operations or tasks will be covers, which are not covered and who is the SOP written for.
3. Overall task description developing including the number of people and their skill levels required for the task, the equipment and supplies required, any personal protective equipment required and how the finished thing should look.
4. Detail descriptions of task by specific order of the activities, timing sequences and time allowed, materials and tools used and techniques and safety considerations.
5. Involved everyone on board that who is affected by SOP.
6. Set up a system to monitor, evaluate and update it regularly.

2.5 7 WASTES AND REWORK

The seven wastes originated in Japan, where the waste is called "Muda". It is a tool to further categorize "Muda". Toyota's Chief Engineer Taiichi Ohno who is the core of the TPS, also known as lean manufacturing. In order to reduce and eliminate the waste, one of the most vitally important ways is to identify and understand exactly what waste is and where it exists. Table 2.2 depicts the brief description of 7 wastes.

Table 2.2: Brief descriptions of each 7 wastes

Wastes	Descriptions
Overproduction	Producing more than is needed for immediate use.
Inventory	Any raw material, WIP or FG that exceed what customer needs.
Waiting	Non activity period for operator and machine.
Motion	Unnecessary movement of people such as reaching and walking.
Logistic/Transportation	Unnecessary movement of products, materials or information.
Rework/Defect	Any production that results in rework.
Over processing	Adding more value than the agreed standard.

Hawken (2000) clarified that in almost all modern manufacturing today, the common goals to attain is to have no stops, no delays, no backflows, no bottlenecks, no expediting, no buffer stocks and especially no Muda. In order to do so, some of the advantages will achieve. There are lower the capital investment, greater flexibility, often higher reliability, lower inventory cost, lower shipping cost and more localized production equipment.

David (2003) expressed the quality defects resulting in rework are a tremendous cost to organizations. The correlated cost included quarantining inventory, re-inspecting, rescheduling and capacity loss. The total cost of reworks is often a

significant percentage of total manufacturing cost in many organizations. With the purpose of eliminating the rework, the employees' involvement and kaizen is the effective way that must be focus on.

According to Sutherland and Bennett (2007), elimination of rework is a significant task in TPS. TPS strives for the total elimination of rework through where managers work cross-functionally to develop and sustain strong business processes (process focus) by collecting facts and actual data (genchi genbutsu) and continuous improvement (kaizen) between management and employees (mutual respect).

2.6 7 QC TOOLS AND TECHNIQUES

Lyu (1996) explained the kaizen becomes continuous improvement manufacturing (CIM) when it is applied to manufacturing. CIM uses seven basic quality tools (7 QC tools) to execute problem-solving activities in factory. From his research, he found that kaizen has been verified useful in new product and safety improvement.

Yung (1996) described the Statistical process control, SPC is a useful tool for controlling and improving process quality and productivity and the 7 QC tools are powerful for problem solving. From his research, he summarized the relationship between the some elements of the process improved model such as SPC, TQM, kaizen and 7 QC tools as the figure 2.3.

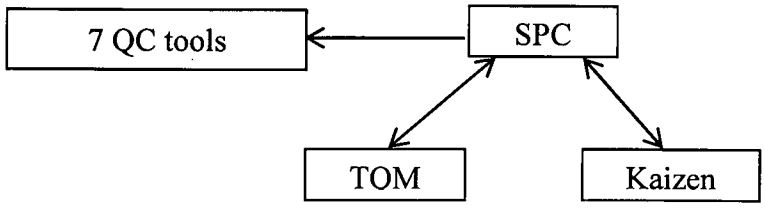

Figure 2.3: Relationship between some elements of the process improved model. Single arrow indicates unidirectional relationship of the element while a double arrow indicates inter-dependency of elements

For a kaizen to work, Mirko *et al.* (2007) mentioned edit is needed to have 7 QC tools as improvement tools to solve graphical problem-solving methods. Some of the seven tools used in process identification and process analysis. The figure 2.4 below shows the use of 7 QC tools in process identification and analysis.

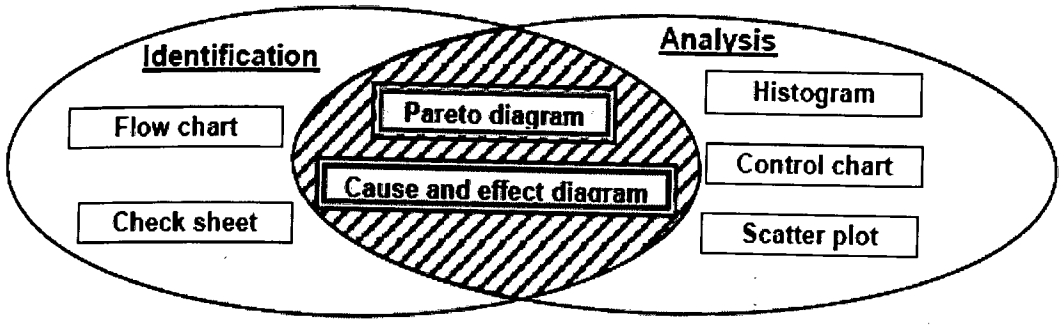

Figure 2.4: Kaizen guiding principles. Source: Suarez-Barraza, (2007)

Suarez and Ramis (2008) explained the techniques and tools of kaizen that use for quality improvement referred to "kaizen building blocks". The techniques and tools such as the 5S, kaizen teams, elimination of Muda, kanban, poka-yoke, 7 QC tools, andon, single minute exchange of die (SMED), total productive maintenance (TPM) and heijunka (leveling batch size).

Rahman *et al.* (2009) have given a new sign about the waste minimization has higher level of significance for SME industries compared with large industries. According to organized approach based on the work and contribution of the workers, the kaizen techniques, tools and guiding principles must be used gradually (Barraza *et al.*, 2011).

The 7 QC tools are engineering quality tools. These tools are easy to learn and handle. Moreover, they are used to analyze the solution to an existing problem. They defined the 7 QC tools are the basic for all other tools. The descriptions of 7 QC tool as below (Ratchanok and Kongkiti, 2011).

2.6.1 Check Sheet

A structured and prepare form for manually collecting and analyzing data in a reliable, organized way. They are design based on the type of data to be collected and aid in systematic collection of data. This is a general tool that can be modified for a wide variety of purpose. Figure 2.5 is an example of the check sheet for pin diameter.

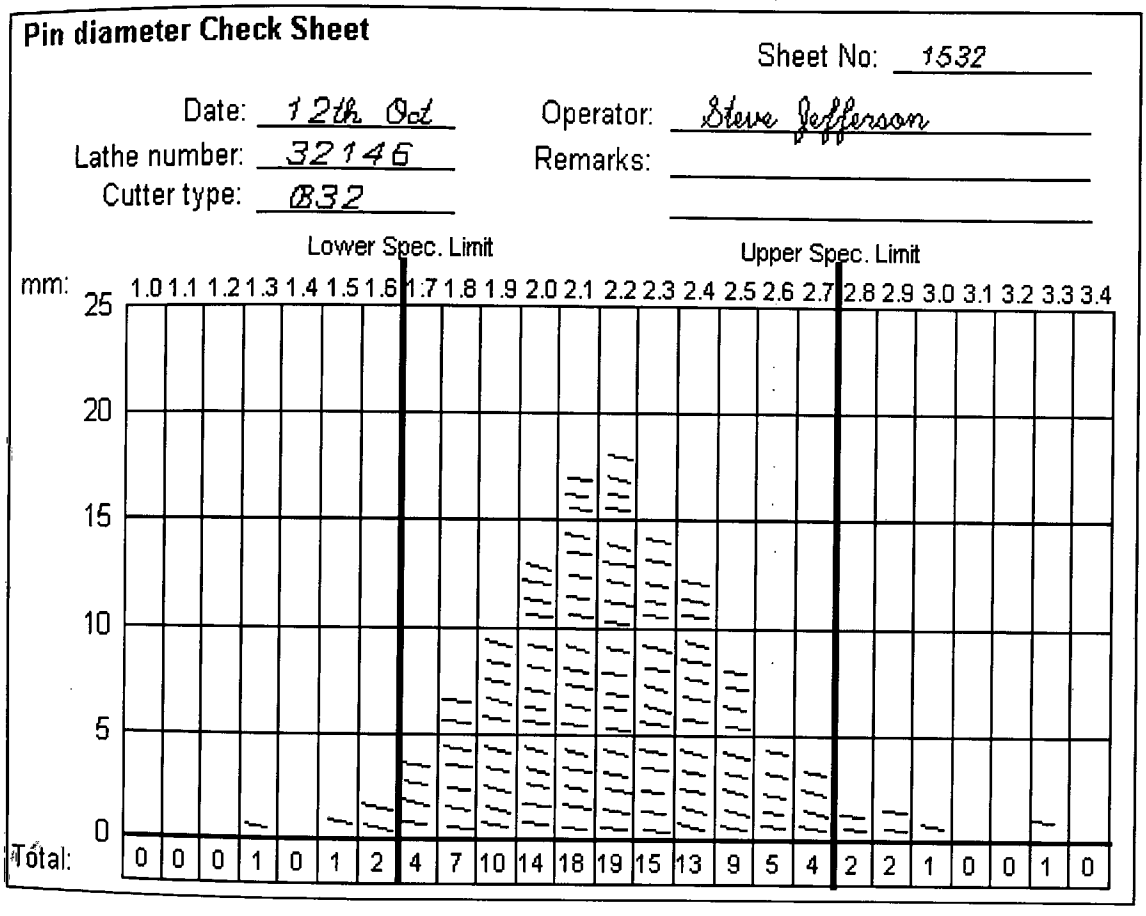

Figure 2.5: Example of check sheet

2.6.2 Ishikawa Diagram

A tool also called cause and effect diagram or fishbone diagram. It shows and identifies systematic relationships between an effect and its possible causes. Besides, it can be used to structure a brainstorming session. This is because it is an effective tool to immediately sort ideas about the causes for problems into useful categories as it displaying the hierarchy of causes. Figure 2.6 illustrate an example of Ishikawa diagram.

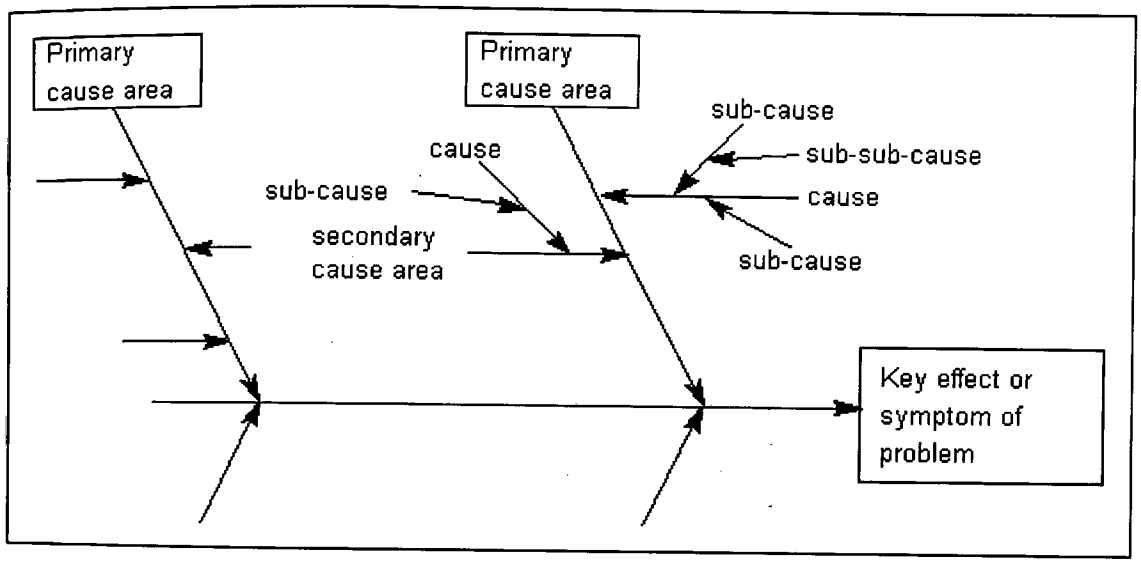

Figure 2.6: Example of Ishikawa diagram

2.6.3 Histogram

A frequency distribution shows the how often different value in a set of data occurs in physical bar. The width of each bar is constant and represents a fixed range of measurement. Histogram is useful in studying distribution pattern and in drawing conclusions about the process based on the pattern. Figure 2.7 show the number of business claim as an example of histogram.