# INTEGRATION OF DMAIC METHODOLOGY AND CAPA CONCEPT FOR QUALITY IMPROVEMENT IN SEMICONDUCTOR INDUSTRY

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# INTEGRATION OF DMAIC METHODOLOGY AND CAPA CONCEPT FOR QUALITY IMPROVEMENT IN SEMICONDUCTOR INDUSTRY

**by**

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| CA | Corrective Action |
| CAPA | Corrective and Preventive Action |
| CN | Change Notice |
| DMAIC | Define, Measure, Analyze, Improve, Control |
| DFSS | Design for Six Sigma |
| DOE | Design of Experiment |
| ET | Electrical Test Department |
| FPC | Flexible Printed Circuit |
| FPCA | Flexible Printed Circuit Assembly |
| FR4 | Fire Resistance Type 4 (support material) |
| ICA | Interim Containment Action |
| ISO | International Organization for Standardization |
| OQA | Outgoing Quality Assurance (basically for data purpose) |
| OQC | Outgoing Quality Control Department |
| PA | Preventive Action |
| PCB | Printed Circuit Board |
| PDCA | Plan-do-check-act |
| QER | Quality Enhancement Rating |
| QC | Quality Control |
| QFD | Quality Function Deployment |
| QI | Quality Improvement |

| | |
|---|---|
| QP | Quality Planning |
| QT | Quality Tools |
| RCA | Root Cause Analysis |
| SMT | Surface-Mount Technology |
| TP | Target Punch Department |
| TQM | Total Quality Management |

**INTEGRASI METODOLOGI DMAIC DAN KONSEP CAPA BAGI PENAMBAHBAIKAN KUALITI DALAM INDUSTRI SEMIKONDUKTOR**

## ABSTRAK

Terma kualiti di dalam industri menjadi faktor utama bagi mengukur kebolehsaingan suatu firma. Konsep, kaedah dan alat telah digunakan secara meluas dalam menambahbaik serta mengawal kualiti produk. Dengan itu, industri berusaha bagi menghasilkan produk yang baik. Bagi memastikan tindakan kualiti lebih teratur, laporan kualiti yang tersusun adalah sangat penting. Tujuan kajian ini adalah untuk menghasilkan rangka kerja penyelesaian masalah yang baru di mana metodologi DMAIC (*Define-Measure-Analyze-Improve-Control*) menjadi pendekatan utama untuk gabungan konsep CAPA (*Corrective and Preventive Action*). Metodologi DMAIC sering diterangkan sebagai suatu pendekatan dalam penyelesaian masalah dan suatu strategi kualiti berasaskan data kerana ia adalah sebahagian daripada inisiatif kualiti Six Sigma. Manakala konsep CAPA merupakan siasatan sistematik pada punca masalah yang dihadapi. Dalam kajian ini, dua pendekatan tersebut digabungkan dalam penghasilan Laporan *Quality Enhancement Action* (QEA), di mana laporan ini bertujuan untuk membawa pengurusan industri ke arah tindakan yang lebih jitu berkenaan isu kualiti dalam sektor elektronik. Laporan ini telah disahkan melalui kajian kes dan kajian soal selidik. Hasilnya telah menunjukkan laporan dan juga rangka kerja baru tersebut adalah praktikal. Selain itu, laporan kualiti ini bukan sahaja focus kepada penyelesaian masalah, malah boleh memecahkan jurang sesebuah organisasi. Menerusi penambahbaikan proses and kualiti, industri dapat lebih berdaya saing bagi menghasilkan produk yang lebih baik di masa hadapan.

**INTEGRATION OF DMAIC METHODOLOGY AND CAPA CONCEPT FOR QUALITY IMPROVEMENT IN SEMICONDUCTOR INDUSTRY**

## ABSTRACT

The term quality in industry has been a key factor in measuring a firm competitiveness. Tools, methods, and concepts have been massively applied in improving and controlling product quality. Thus, industries urge themselves to cope with the needs of complete goods. In order to get a structured quality action, an organized framework is highly reliable. The purpose of this research is to develop a new problem solving framework where DMAIC (Define-Measure-Analyze-Improve-Control) is the main approach, with infusion of CAPA (Corrective and Preventive Action) concept. The DMAIC method is often described as an approach to problem-solving and a data-driven quality strategy as it is an integral part of the Six Sigma quality initiatives. Meanwhile, the CAPA concept is the systematic investigation of the root cause of identified risks or problems, widely implemented in industries. In this research, these two approaches are merged in designing a new quality reporting document named as the Quality Enhancement Action (QEA) report. The report presents the structured quality action in a more efficient way conducted in the electronics sector. The report has been validated through case studies and a survey through questionnaire. The outcomes confirmed the application and the practicality of the report as well as the new framework to improve quality issues. On the other hand, the quality report is not only focus on problem solving and decision making, but can break down organizational barriers. Through process and quality improvement, industries will have the capability in producing better goods in future.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Overview

This chapter consists of five sections, beginning with the research background. This section briefly discusses on the research field and scope. Next, the second section discussed on problem statement. While the following sections are research objectives and scope of research. Lastly, this chapter ends with thesis layout.

## 1.2 Research Background

Over a decade there has been a significant increase in high quality awareness among manufacturing industries. Evolution of technologies is expected to bring more effectiveness to mass production along with better product quality. This evolution also comes along with high expectations from customer. Thus, industry improves themselves to cope with customer needs. Various actions, quality tools, quality improvement are adapted into the process. Malaysia is also not lagging behind. Our industries are facing the same challenges too. Thus, we need to learn and cope with other global company to build a dynamic and strong stake to elongate good manufacturing practices.

An organization with strong and continuous improvement system tend to withstand barriers and can rapidly grow. The improvement can be said as a crucial thing to do. Lots of questions have to be asked to industry “Why the profit is down?” or “What is the problem?” The answer will bring many potential causes. Most of the barriers lie in their manufacturing process. Necessary guidance or solution are

needed to solve the problem. Here, production issues are mostly cause by quality problem. So now, industry needs a guide for effective problem solving. Here, quality is the major stake while the improvement action definitely will support the objectives. So, proper guide is essential to gain the desired quality results.

In order to survive in this growing industries, companies have to compete to promote high-end products. Competitive environment will lead to continuous process improvement. How do we want employees to embark in a successful process improvement program? Would they get through the problems? Or just making the problem unsolved and get even worse? One of the possible cause of this situation is understanding. So now, "How to make employees understand and able to carry process improvement?" The answer lies in finding the correct medium which assist the implementer in an effective way through the project completion.

Now, the suitable medium to ignite the understanding is the adaptation of quality tools incorporate with necessary methodology and guidance. Implementer now is to lead their process improvements through detailed description of problem solving techniques. The framework of all the methods or techniques is to monitor the implementer to be in a right path towards best quality improvement actions. The guidance must be a systematic, focus, controlled and timely manner.

### 1.3 Problem Statements

Process improvement needs a proper guide to possibly eliminate defects. Thus, there must be a focused method to achieve the goal. But somehow, industries are stranded with lots of methods or tools and the methods sometime being misused. The solutions become lengthy when they try to cope with the methods and end up mixing the tools but then there is no correct root causes are found. Practitioners must

be clear on what tools they want to adapt to, unless there are systematic guidance to successfully do the process improvement. Here, DMAIC methodology is introduced to manage the problem solving issues with the aid of CAPA concept. Later on in Chapter 2 and 3, this two methods will be further discussed where DMAIC and CAPA are merged to develop a new framework.

Next, the crucial problem would be implementers have lack of understanding and skills. Sometimes, mistakes are made from the very beginning since they do not even know how to cope problems with the problem solving tools. "What the next step is and fail to find the answer (Rohleder and Silver, 1997). When this happen, later on the problem is not going to find the best solution. They tend to solve the problem based on their past experience (Lee and Chuah, 2001).

The third problem is the most common issues in industry. It is the experience based issues. Actually this problem does correlate with the above problem when implementers do not have thorough understanding on the methods used, then they rely on their seniors on what they are experience before. This can bring about a bigger problem once it becomes a "culture". Let say a major defect is reported then practitioners do the process improvements by all means, but at the end the defect still occur. The company will rely on the most independent senior to solve the issues once again instead of seniors guiding to a proper problem solving.

In addition, another problem is poor documentation for problem solving analysis. Data is scattered, not focused, incorrect method and many more. We do have plenty of problem solving documentation or so called "quality report" and we can simply use it. But, is the report can really match to our situation? Would that be effective enough to reach best solution? So now, this research will design a new

quality report accordingly to the new methodology to cope with all this improper documentation and guide practitioner to successful analysis. Later on the new quality report will be discussed in upcoming chapters.

## 1.4 Research Objectives

The objectives of this research are explained below:

1. To develop a structured framework for quality improvement. Through a combination of process improvement framework to cover various aspects of problem solving procedures;

2. To improve the current quality report. A proper reporting document for solving quality issues will be generated.

3. To validate effective problem solving analyses and promote wide industrial applications for the proposed new framework together with the new designed quality reporting document.

## 1.5 Scope of Research

This research is test directly in industries where two case studies are done practically. Thus, the scope of this research is to develop a new framework. Then later on, a new quality report will be designed as a contribution to the industry and some tests will be done through the two case studies. Each case study took about a month to be monitored and each of them is solving different quality issue. New practitioners will be included as implementer in the case study validations since one the mission of the new report is to guide everyone including new practitioners to the process improvement. Therefore, through the tests, the effectiveness of the report can be validated.

## 1.6 Layout of Thesis

This thesis consists of six chapters. Chapter 1 briefly provides an overview of the whole research. Beginning with the current quality issues, some explanation is included to discover the issues of quality in manufacturing industries. Then comes the problem statements to strengthen the needs of this project and we will go through the scope of research and objectives of the research are discussed as well.

While Chapter 2 covers the literature review related to this research. Then the chapter also focus on DMAIC methodology, how the framework is and the history of it. Then, the literature review of CAPA concept is discussed. The last part being the most important of this research where literature findings for both quality tools is discussed.

Next, Chapter 3 bring us to the closer look on how the DMAIC and CAPA correlate in building the QEA report. Here the framework of DMAIC methodology and CAPA concept will be merged and a new framework will be developed. Lastly, the new framework will then converted into a document, namely QEA report specifically to guide process improvement.

Chapter 4 includes presentation, analysis and discussion of the case studies done in real industry. Results for the case studies are documented and discussed for the reliability and effectiveness of the QEA report. The result of the pilot run is then discussed in the next chapter to validate the effectiveness of the report.

Chapter 5 will further validate the report through a survey of questionnaire. Here, the result from the questionnaire will reflect the practicality and the effectiveness of the report to solve quality issues.

Lastly, Chapter 6 will conclude important findings and recommendations for further developments of the QEA report. All results and findings are concluded in this chapter.