

DEVELOPMENT OF A COMPUTER AIDED DECISION SUPPORT TOOL FOR  
SELECTING ORGANISATIONAL IMPROVEMENT INITIATIVES

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## ABSTRACT

The objectives of this research are to: (1) Identify the main factors that should be considered in the selection of organisational improvement initiatives, (2) Develop a computer aided decision support tool (CADST) for selecting organisational improvement initiatives based on Malaysia context, as well as (3) Evaluate and refine the CADST for selecting organisational improvement initiatives . The main factors that should be considered in the selection of improvement initiatives have been identified based on literature review and questionnaire survey. The CADST was developed using Dreamweaver and PHP software. Two research phases were involved which are: (1) Development of CADST for selecting organisational improvement initiatives, and (2) Evaluation and refinement of CADST. Survey was the data collection method used in this research. This survey was conducted through email and face to face interview. Based on the result of the survey, two factors were rated as “Very high importance” (Median 5). The factors are: (1) Ability to gain top management commitment and support to introduce and implement the initiative successfully, and (2) The initiative is aligned to the vision, mission and/or purpose of the organisation. The CADST is evaluated during the survey and refined based on the feedback from the respondents. The refined CADST consists of four elements: (1) Identify possible area for improvement, (2) Select several relevant improvement initiatives, (3) Complete the decision matrix, and (4) Graphical representation of the decision rating. The proposed CADST can be considered as one of the first on-line decision support tool for selecting improvement initiatives based on Malaysia context.

## ABSTRAK

Objektif-objektif kajian ini dijalankan adalah untuk: (1) Mengenalpasti faktor-faktor utama yang perlu dipertimbangkan dalam pemilihan inisiatif-inisiatif penambahbaikan organisasi, (2) Membangunkan alat bantuan membuat keputusan berasaskan komputer (CADST) untuk memilih inisiatif penambahbaikan organisasi berdasarkan konteks di Malaysia, serta (3) Menilai dan menambahbaik CADST untuk memilih inisiatif penambahbaikan organisasi. Faktor-faktor utama yang perlu dipertimbangkan dalam pemilihan inisiatif penambahbaikan organisasi telah dikenalpasti berdasarkan kajian literasi dan soal-selidik. CADST telah dibangunkan menggunakan perisian Dreamweaver dan PHP. Kajian ini melibatkan dua fasa kerja iaitu: (1) Pembangunan CADST untuk memilih inisiatif penambahbaikan organisasi dan (2) Penilaian dan penambahbaikan CADST. Kajian ini menggunakan soal-selidik sebagai kaedah pengumpulan data. Soal-selidik ini dilaksanakan menerusi e-mel dan temuramah. Berdasarkan keputusan soal-selidik, dua faktor telah dinilai sebagai "Teramat penting" (Median 5). Faktor-faktornya berkenaan adalah: (1) Keupayaan untuk mendapat komitmen dan sokongan dari pengurusan atasan untuk memperkenalkan dan melaksanakan inisiatif dengan berjaya dan (2) Inisiatif adalah sejajar dengan visi, misi dan/atau tujuan organisasi. CADST telah dinilai semasa soal-selidik dijalankan dan ianya telah ditambahbaik berdasarkan maklumbalas daripada responden. CADST yang telah ditambahbaik terdiri daripada empat elemen iaitu: (1) Mengenal pasti peluang untuk penambahbaikan, (2) Memilih beberapa inisiatif penambahbaikan yang relevan, (3) Melengkapkan matriks membuat keputusan, (4) Persembahan grafik dalam menentukan kedudukan keputusan. CADST yang dicadangkan boleh dianggap sebagai salah satu alat sokongan membuat keputusan atas talian yang pertama untuk memilih inisiatif penambahbaikan organisasi berdasarkan konteks di Malaysia.

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## LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
BE	Business Excellent
BEF	Business Excellence Framework
BEMs	Business Excellence Models
BPR	Business Process Reengineering
CADST	Computer aided decision support tool
CI	Continuous Improvement
CPE	Criteria for Performance Excellence.
EFQM	European Foundation for Quality Management
FMEA	Failure Mode and Effect Analysis
ISO	International Organisation for Standardisation
MADM	Multiple Attribute Decision Making
MBEF	Malaysia Business Excellence Framework
MCDM	Multiple Criteria Decision Making
MODM	Multiple Objective Decision Making
QFD	Quality Function Deployment .
SPC	Statistical Process Control
SAW	Simple Additive Weighting
SPSS	Statistical Package for the Social Sciences
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
TQM	Total Quality Management
WPM	Weighted Product Method

# **CHAPTER 1**

## **INTRODUCTION TO THE RESEARCH**

### **1.1 Introduction to the chapter**

This chapter describe the research background, problem statement ,objectives, scope, and importance of the research.

### **1.2 Background to the research**

Decision support tools are information systems which help businesses make decisions by selecting the best decisions from a number of options. A computer aided decision support tool is therefore an information system or application which helps the organisation in making decisions. Generally, decision support tools support organisational management, operations and planning activities in organisations by making decisions in dynamic environments which may have many dynamics that need to be considered. A computer aided decision tool may be fully computerized or may include a combination of human & computer interaction in making decisions (Hughes, 2008).

A computer aided decisions tool which can help an organisation make decisions on the appropriate organisational improvement initiatives is of particular interest to this study. Organisational improvement initiatives are frameworks which are used by organisations to help improve the business by focusing on things such as; cost reduction, quality improvement, accreditation, strategic planning, organisational

development and process improvement. Since there are a number of such initiatives which can be used by businesses to improve operations, organisations are sometimes faced with challenges in selecting the most appropriate organisational improvement approach (Ana and Frada, , 2012 ).

Improvement initiatives swing in and out of fashion, similar to clothing style, car design and music trends (Clark, 2004). According to Cobb (2003), “Every time a new management technique comes into vogue, whatever was before is tossed out and forgotten and the new approach becomes a ‘paradigm’ for redefining how the business is managed.” An effect of this phenomenon is that organisations become the market for the latest management fashion, and managers tend to search for new initiatives (Mohammad 2012).

Today’s businesses operate very dynamically. There are numerous operations and initiatives which are usually being carried out in modern businesses which need the attention of managers (Gachet, 2004). Due to the nature of this working environment, the selection of an appropriate organisational improvement initiative may be confusing for managers amidst the numerous number of improvement platforms that exist. Notwithstanding these challenges, businesses are still expected to meet their purpose of incorporation and satisfy the needs of customers, partners, consultants, contractors and other stakeholders. Under such level of activity and pressure from many sources, businesses can face challenges in selecting the right improvement initiative because of the increasing number of initiatives that are available in the market.

Some of the most common improvement initiatives include Lean, Six Sigma, Business Community Management, Product Life Cycle and Business process Engineering. Additionally, the numbers of improvement initiatives continue to increase from time to time with each new approach, promising additional advantages over the currently existing ones. This makes it extremely tough for businesses to settle on one improvement platform over the others. Many professionals view the selection of improvement initiatives as a potential source of conflict between managers because different managers may prefer different improvement initiatives to select the right initiative, businesses need to focus on the bottom-line which is; the need for organisational improvement within the organisation (Biehl, 2008).

To select the right initiative amidst numerous solutions, a computer aided decision support tool would serve businesses well because it can be optimized to select the best for the business. This would also serve to eliminate potential points of conflict between managers because the tool would be impartial in selecting the most fitting initiative. Indeed, it is true that no single initiative can solve all the problems in the business but, the focus here is in the selection of the best initiative considering the circumstances (Gabriel & Fernando, 2010).

The right initiative can be chosen by considering the strengths and weaknesses of all the related initiatives and also by considering the critical business factors such as; maturity, financial factors, workforce size and organisational size. The computer aided decision tool would be better placed to make this selection since it can be used to assist in Malaysia decision.

### 1.3 Problem Statement

Organisations are required to improve their performance in order to meet the purpose of their existence, and to satisfy and exceed the expectations of customers, employees, shareholders and supply chain. (Mohammad, 2012). Presently, organisations operate in an environment that is dynamic. In this respect, numerous improvement initiatives and operations that require the attention of managers often emerge. Consequently, the choice of an appropriate improvement initiative for an organisation may end up as a hard task in the sense that, managers may get confused due to the numerous improvement initiatives that already exist.

Other than the challenges, organisations are also expected to meet their obligations to the community, contractors, partners, and other stakeholders within the context of an organisation or a business environment. Under such circumstances, business entities or organisations may fall prey to untested improvement initiative as a result of a hurry to satisfy the needs of the stakeholders whom they serve. Furthermore, additional improvement initiatives continue to emerge from time to time. As a result, it is not possible for an organisation or business entity to settle on a single improvement mechanism. On another note, professionals seem to view improvement initiatives as resulting in conflict between managers. This results in managers settling on different improvement initiatives.

Organisations are facing problems in selecting appropriate improvement initiatives due to a plethora of initiatives currently available in the market. The problem lies not only with new improvement ideas but, rather with some managers becoming a victim of the process, where some new idea will entirely displace whatever went before. (Mohammad, 2012).

To address this issue, a CADST for selecting organisational improvement initiatives will be developed. A computer aided decision support tool which helps the organisation to make decision from a number of options and to reduce the time to decide upon the initiatives.



## **1.4 Objectives of The Research**

The objectives of this research are as listed below:

1. Identify the main factors that should be considered in the selection of organisational improvement initiatives.
2. Develop a prototype of a computer aided decision tool for selecting the organisational improvement initiatives.
3. Evaluate and refine the proposed computer aided decision support tool for selecting the appropriate organisational improvement initiatives.

## **1.5 Scope of the research**

The main focus of this research is on the decision making process which is being followed while selecting an appropriate organisational improvement process. The research do not cover the detailed process of the adoption, implementation and the maintenance or evaluation of such initiatives. The scope of the research ends when the right organisational improvement tool is selected and further details of its implementation, support and evaluation will not be covered in this research. To sum it up, this research is only focused on the utilization of a rational and structured approach which can be used for the selection of improvement initiatives.

## **1.6 Importance of the research**

The significance of this research can be established from the challenges that are currently being faced by businesses in selecting the right initiative for organisational improvement. Since there are numerous organisational improvement initiative, it is quite challenging for businesses to select the right initiative without a rational and structured approach which can guide the decision Malaysia. Previous literature highlighted the importance of selecting the right initiative for a given context or situation, such as; Basu (2004b), Francis (2010), Hendra (2010) and Rigby and Bilodeau (2005). Selection processes will help organisations to do the right thing. As stated by Ackoff (1999), “It is better to do the right thing wrong than to do the wrong thing right. When we do the right thing wrong, we make mistakes that can be corrected; hence we learn how to be more effective”. Therefore, selection and adoption of the most appropriate improvement initiative according to the situation are really crucial to the organisations in selecting the right initiative (Ray, 2012).

The outcome of this research will be a structured approach which can be used by businesses in selecting the right initiative. Additionally, the ability to avail an automated or computer based decision support tool will also be a useful form for many businesses in making their selection. It will allow businesses to concentrate on their core business once management is aware that the right framework for business improvement has been selected. Additionally, this decision tool could eliminate potential sources of disputes between managers on the selection of the right improvement initiative (Power, 2002).

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction to the chapter**

This chapter examines information regarding computer aided decision support tool for selecting appropriate organisational improvement initiative. At the beginning of the chapter, the definition of “Organisational Improvement Initiatives” is explained. After that, the Total Quality Management (TQM) principles and Business Excellence (BE) concepts that are considered in the process selection are discussed. This chapter also explores the main concept or theories related to the selection of organisational improvement initiative. Additional items to be considered in this chapter include the rational in terms of decision making related to the selection of the appropriate improvement initiative. Also, this chapter discusses related literature on the existing computer aided decision support tool for selecting organisational improvement initiatives

#### **2.2 Organisational Improvement Initiatives**

When we say organisational improvement we mean the various techniques and interventions that are planned and implemented in order to assist or facilitate the implementation of certain planned and consequential changes in the structure, processes and human resources within the organisation. Organisational development process is planned, as it requires systematic diagnosis, program improvement and mobilization of resources (financial, technical, human) in a separate structural unit or

the entire organisation. It is described as a process that includes efforts to improve various activities in the organisation. Organisational development involves the analysis of strategy, structure and culture of the organisation. Organisational development analyzes formal and informal parts of the organisation.

In general, organisational improvement is used to classify two terms which are; Continuous Improvement and Breakthrough Improvement (Imai, 1986; Slack et al., 2009). “Continuous Improvement” also known as “Kaizen” is a never-ending, small and incremental performance improvement involving everyone in the organisation (Imai, 1986, 1997; Slack et al., 2009). Continuous Improvement (CI) can be employed in a broad context of organisational excellence and business development. A continuous improvement program is “an evolutionary ongoing process which leads to a better way to compete and add value to existing processes and encompasses the entire workforce of the organisation” (McAdam et al., 2000). In contrast, the ‘breakthrough’ or ‘innovation-based’ improvement is a major and dramatic non-incremental performance improvement based on technological breakthrough and/or new inventions (Imai, 1986, 1997; Slack et al., 2009). According to Slack et al. (2009, p. 439), this type of improvement: “can be expensive, often disrupting the ongoing workings of the operation, and frequently involving changes in the product/service or process technology”.

The improvement initiatives include the approaches, management system, tools and techniques that can be used to improve the organisation performance. Table 2.1 depicts the definitions and examples of these terms.

Table 2.1: Definitions and examples of an approach, system, tool and technique for improving organisational performance (Adopted from Mohammad, 2012, p.13)

No	Item	Definition	Example
1	Approach	An approach needs resources (e.g. training hiring additional and specific personnel), senior management commitment, strategic planning and an “intellectual effort in terms of its deployment and adoption” (Van der Wiele et. Al., 2007,p 561)	TQM, BPR, Six Sigma, Lean
2	Management System	It is the framework of processes and procedures used to direct and control some forms of the operation”	Quality Management System (ISO 9000), Environmental Management System (ISO 14000),..
3	Tool	A tool can be “described as a device which has a clear role and defined application. It is often on its own” (Van der Wiele et. Al., 2007,p 562)	Cause and Effect Diagram, Pareto Diagram, Control Chart, Histogram, Relationship diagram, Flowchart.
4	Technique	A technique “has a wider application than a tool”. It requires “more thought, skill, knowledge, understanding and training in order to use them effectively. A technique may even be viewed as a collection of tools” (Van der Wiele et. Al., 2007,p 562)	SPC, Benchmarking, QFD, FMEA,

The implementation of an organisational improvement initiatives are believed to bring several expected benefits (Mohammad, 2012) , which include but are not limited to:

- Quality Improvement (For example, reduce the number of faults in products , reduce complaints about services.)
- Dependability Improvement (For example, reduce percentage of orders delivered late, better schedule adherence).
- Speed Improvement (For example, improve order lead time, improve cycle time).
- Better Flexibility ( For example, reduce time needed to develop new products / services).
- Cost Reduction (For example, reduce cost per operation hour).

### **2.3 Main concepts and/or theories that can be used for the selection of organisational improvement initiatives**

This section explains three main concepts and/or theories that can be used for the selection of organisational improvement initiatives:

(1) TQM and Business Excellent (BE).

(2) Rational decision making.

These two strategies are significant in categorizing the best practices. In terms of analysing the strategies, this should be done using indicators for time, cost, quality and flexibility.

#### **2.3.1 Total Quality Management and Business Excellence as a guiding framework for selecting organisational improvement initiatives.**

Quality is a continuous quality improvement process towards a predictable degree of uniformity and dependability. Deming also identified 14 principles of quality management to improve productivity and performance of the organisation. Juran defined quality as “fitness for use.” According to him, every person in the organisation must be involved in the effort to make products or services that are fit for use.

Total Quality Management (TQM) is defined as an approach to improve the quality and performance of business and encompasses the entire organisation, from supplier to customer. It aims to meet the requirements of the customer by continuous improvement in the whole activity of the organisation (Powell, 1995). Its success depends on harnessing strong coalitions, partnerships and collaboration between key stakeholders (Nwabueze, 2011). The concepts of the TQM (Reid and Sanders, 2010) are summarised in Table 2.2.

Table 2.2: The concepts of the TQM (Reid and Sanders, 2010)

No.	Concept	Main Idea
1	Customer focus	Goal is to identify and meet customer needs.
2	Continuous improvement	A philosophy of never-ending improvement.
3	Employee empowerment	Employees are expected to seek out, identify, and correct quality problems.
4	Use of quality tool	Train the employee to know well and master the quality control tools such as; cause-effect diagram, flowchart, pareto chart, etc.
5	Product design	Products need to be designed to meet customer's expectations.
6	Process management	Quality should be built into the process; sources of quality problems should be identified and corrected.
7	Managing supplier quality	Quality concepts must extend to a company's suppliers.

The Business Excellence (BE) can be defined as 'Excellence in strategies, business practices, and stakeholder-related performance results that have been validated by assessments using proven business excellence models' (Adebanjo & Mann, 2008a, p. 1).

The BE can also be defined as an initiative to help organisations to know where they are on the excellence journey and what they need to do to achieve a higher level of performance. This is done through an assessment of an organisation's performance against the requirements of an internationally benchmarked business excellence framework. It also recognises organisations for their performance in the business excellence journey.

Business Excellence Models (BEMs) were first called Total Quality Management models. Today, they are usually referred to as Business Excellence Models – this term helps to communicate the importance of "excellence" in all aspects of a business; not only product and process quality. The models are used to assess how well BE core values and concepts (the ingredients of success) are embedded in an organisation.

Business Excellence models entail deploying integrated leadership and organisational management system of elements vital for sustainability of organisational excellence. Business Excellence models are vital in improving different aspects organisations that relate to leadership, people, service delivery, planning, product quality, strategizing and bottom-line outcomes. BEMs also recognize the unique features of enterprises. With regard to selecting and managing multiple organisational improvement initiatives, BEMs addresses key questions that include “how the organisation is performing”, “in what areas the organisation is good at?” and “what is needed to improve the organisation?” (Gabriel and Fernando, 2010. p.15). Further BEMs ensure that organisational review of all the factors that influence performance. In essence, BEMs ensure how organisations deal with factors that inhibit or propel advancement by providing improvement initiatives for implementing targeted strategies.

Two most widely used BEMs are European Foundation for Quality Management (EFQM). Excellence Model and Baldrige Criteria for Performance Excellence (CPE) Model. Mohammad, Mann, Grigg & Wagner (2011) stated that: “The EFQM Excellence Model is used in 30 countries on two continents – Europe (e.g. Austria, Northern Ireland, Sweden, Italy, and Portugal) and Asia (India, Turkey, and United Arab Emirates). Meanwhile, the Baldrige CPE is used in eight countries on four continents; including Northern America (USA), Asia (Hong Kong, Indonesia, Philippines, Thailand, and Sri Lanka), Oceania (New Zealand), and Europe (Sweden). Many countries are also using their own national bespoke model. Interestingly, most of these bespoke models are based on EFQM Excellence Model or Baldrige CPE”.

The Malcolm Baldrige Criteria for Performance Excellence (CPE) is an evolutionary business management framework designed to increase competitiveness through assessment and identification of organisational strengths and opportunities for improvement. (CPE) which is used in the United States but has been adopted in many countries in Asia (in some countries, small revisions have been made to it). In Baldrige CPE model, it identifies seven criteria as an indicator Business Excellence. Six of the criteria are grouped into “Process”, which is labelled 1 – 6 in the Figure 2.1 . The remaining criterion is grouped into “Result”, which is labelled 7 in the



figure below. The figure below shows the interrelationship between each indicator. (Mann, Mohammad and Agustin, 2012).

Figure 2.1: Interrelationship between each criteria in Baldrige CPE Model



The BEM in Malaysia is known as Malaysia BE Framework. The Malaysia BE Framework adopted the main concept from Baldrige CPE. It was used as a guideline for executives of organisations to review and assess their companies' affairs and performances. The aim of Malaysia BE Framework is to provide an optimistic prospect of the organisation with a continuous improvement that will lead to sustainable business success. It is used to improve any part of the organisation (MPC, 2011).

The Business Excellence Framework (BEF) has seven dimensions of excellence namely; Leadership, Strategic Planning, Data & Information, People Development, Customers Focus, Process Management and Business Results. The description of seven excellence indicators is shown in the Table 2.3 :

Table 2.3: Description of seven excellence indicators in Malaysia BE Framework  
(Adopted from MPC, 2011).

No	Excellence Indicator	Description
1	Leadership	The leader addresses how the leader develops and facilitates the achievement of the mission, envisions and develops values required for long term success.
2	Planning	Planning addresses the organisation's establishment of strategic objective and action plan, deployment of plans and plans changed if circumstances require a change; and how progress is measured and sustained.
3	Information	Information of management is gathered and analysed to improve the organisation and create unique values and knowledge. The knowledge is used to compare and support decision-making and improve all levels of the organisation.
4	Customer	How the organisation emphasizes in customer's voice, communicates with the customer and determines the customer's expectations and uses the information as an outcome of overall learning and performance of excellent strategy.
5	People	How organisation manages, develops and trains an individual / team based on organisation-wide level to support its policy and strategy and the effective operation of its process.
6	Process	How the organisation designs, manages and improves its process to achieve its aims and objective and satisfaction of the customer and the stakeholder.
7	Result	These criteria are concerned with what an organisation has achieved and is achieving. An organisation uses a number of key parameters to measure its performance.

The Figure 2.2 shows the interrelationship between the seven excellence indicators and its basic elements in Business Excellence Framework which are driver, system and results.



Figure 2.2: Malaysia BE Framework (Adopted from MPC, 2010)

In general, BEM is used in the following situations:

- An internal organisational assessment tool. (Mann, Mohammad & Agustin, 2012)
- An assessment to provide an outsider's view on the health of an organisation and enable the organisation to be considered for quality / BE award (Eriksson & Garvare, 2005; Grigg & Mann, 2008; Mann, Mohammad & Agustin, 2012)
- As a benchmarking to compare the organisations performance against others, both domestically and globally (Adebanjo & Mann, 2008; Mann & Grigg, 2004; Mann, Mohammad & Agustin, 2012).
- Provides a common framework for learning and sharing 'best practices' both within and between organisations. (Adebanjo & Mann, 2008; Mann & Grigg, 2004; Mann, Mohammad & Agustin, 2012).
- Overarching framework for managing/aligning multiple improvement initiatives. (Brown & Pemberton Planning Group Ltd., 2008; Consortium for Excellence in Higher Education [CEHE], 2003; Saunders & Mann, 2007).

### **2.3.2 Rational decision making in selecting appropriate improvement initiatives**

The choice of appropriate improvement initiatives are based on the systematic assessment and minimal irrational influences such as; culture or power. According to Bazerman and Moore (2009, p. 4), a rational decision making is “logically expected to lead to the optimal result, given an accurate assessment of the decision maker’s values and risk preferences”. The idea of rational decision making revolves around two theories. First, there is the view which speculates that diffusion related to ideas tend to fluctuate. On the other hand, preference for an idea is influenced by the power of decision setters such as; consultants or academic gurus. There are key elements that can be related to diffusion. This includes innovation, a social system, time and channels used for communication.

Rational decision making with regard to appropriate organisational initiatives require systematic and structured process of decision making. New ideas require critical analysis as per their foundations. Guidelines need to be implemented prior to adoption of new ideas for organisational improvement. Further, rational decision in relation to improvement initiative requires a clear process of evaluating the identified initiatives (Sturdy, 2004).

Facilitating rational decision making entails the utilization of numerous information detailing diverse viewpoint. This would assist in terms of developing collective intuition, maintaining time pacing, propagating constructive conflict and discarding politics. A strategic decision making entails two key questions: first, “where an organisation wants to go?” and second, “how the organisation can get there?” (Greatbatch and Clark, 2005, p. 105). In essence, appropriate strategy in terms of decisions relating to the choice of improvement initiatives involves identifying gaps both from internal and external environment. In addition, there is the need to develop objectives and criteria identification prior to making choices .

Decision making involves many available alternatives and evaluation criteria. When making decisions, it is always difficult to choose the most appropriate alternative among the available alternatives. There is a need for simple, systematic and logical methods or mathematical tools to guide decision makers in considering a number of selection criteria and their interrelations. Depending upon the domain of alternatives, Multiple Attribute Decision Making (MCDM) problems are usually subdivided into continuous and discrete types. MCDM problems have two classifications: Multiple Objective Decision -making (MODM) and Multiple Attribute Decision-making. MODM methods have decision variables values that are determined in a continuous or integer domain, with a large number of alternative choices. MADM methods are generally discrete, with limited number of pre-specified alternatives (Gayatri and Chetan, 2013). MADM can be defined as “making preferential decisions, the example is evaluation, prioritization and selection over the available alternative that are characterized by multiple, usually conflicting, attributes. There are many MADM methods that can be used, but these five methods are the most commonly used(Gayatri and Chetan, 2013) :

- Simple Additive Weighting (SAW)
- Weighted Product Method (WPM)
- Analytic Hierarchy Process (AHP)
- Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
- Compromise Ranking Method (VIKOR)

However, the SAW method is perhaps the most commonly used and well known method, particularly in single dimensional cases (Triantaphyllou, 2000). This method has been incorporated in the decision matrix. It helps decision makers in choosing the most appropriate improvement.

#### **2.4 Simple Additive Weighting (SAW) for evaluating alternatives.**

This is also called the weighted sum method (WSM) (Fishburn, 1967) and is the simplest and still the widest used MADM method. According to Zanakis (1998), the performance of SAW and AHP is almost similar to each other than the other methods. The difference of both methods is that SAW is a traditional method,

whereas AHP is a new method. One of the most popular analytical techniques for complex decision-making problems is the analytical hierarchy process. Saaty (1980, 2000) developed AHP, which decomposes a decision-making problem into a system of hierarchies of objectives, attributes and alternatives (Gayatri and Chetan, 2013).

The WSM or SAW method can be applied to a group decision making technique in the field of quality management and operations management such as; the decision matrix is Quality Function Deployment (QFD) (Akao, 1990) and it is the selected concept in any product development project (Thawesaengskulthai, 2007). Simple Additive Weighting (SAW) is simpler than AHP in terms of evaluation (Triantaphyllou 2000; Zanakis et al. 1998). Many researchers and authors in strategic decision-making prefer to use the WSM as the standard for comparisons, as it gives the most acceptable results for the majority of single-dimensional problems. This means that the units of multiple criteria are similar, and the results are the most acceptable (Triantaphyllou, 2000).

Table (2.4) Strength and weakness for SAW, AHP and WPM (adopted from Gayatri and Chetan, 2013).

Method	Strength	Weakness
1. SAW	Strong in single dimensional problems.	Difficulty emerges on multi-dimensional problems.
2. AHP	Appropriate for Group Decision Matrix Handles multiple criteria Doesn't involve complex mathematics. A certain value of consistency is allowed Easy to capture and convenient	Perfect consistency is very difficult. Time consuming with large numbers. Doesn't take into account the uncertainty.
3. WPM	Can be used in single and multi-dimensional MCDM. Instead of actual values, it can use relative ones.	No solution with equal weight of decision matrices.

To determine the most appropriate alternative or initiative, the common structure of a Multi Criteria (MCDA) and SAW is drawn in a matrix form. The matrix form is shown in Figure 2.3. At is alternative t (also known as initiative),  $V_j$  and  $W_i$  are the important weights of the selection's criteria (criteria also known as selection's view / main criteria), and sub-criteria respectively, j is criteria (also known as selection view or main criteria) and i is the sub-criteria. The consequence of action  $A_t$  on criteria j and sub-criteria i is expressed as score  $S_{tj, i}$ .

Criteria (j)	Sub-criteria (i)	Weight		Rating score for Alternatives				
		level 1 ( $V_j$ )	level 2 ( $W_i$ )	A1	A2	A3	A4	$A_t$
1	1							
	2							
2	1	$V_2$	$W_1$	→		$S_{2,1}^j$		
	2		$W_2$					
	3		$W_3$			$S_{j,i}^t$		
...	1							
	2							

Figure 2.3: Structure of SAW based on Thawesaengskulthai (2007).

To select the initiatives, it may be useful to employ two columns of criteria, as shown in Figure 2.3. The first column holds the main criteria. The importance of the second column is the weight of each main criterion. The first column is to select an organisational improvement initiative that might include the company's objectives, pay-offs, fashion and so on; while under each main criterion, there might be a number of sub-criteria such as; cost and quality under the main criterion of the company's objectives. The decision-making managers need to agree upon the relevant criteria and their sub-criteria as objectives to select the most appropriate actions.

#### 2.4.1 Calculation of total score and ranking SAW method.

According to the WSM or SAW, which is based on the additive utility assumption, the total value of each initiative and the overall weighted score of initiative can be calculated by using this formula as shown in Figure 2.4:

$$T_j(t) = \sum_{i=1}^n W_i S_{j,i}^t$$

The overall weighted score (t) =  $\sum_{j=1}^m V_j T_j(t)$

Where:

$T(t)$  = Total value of the initiative t in the  $j^{\text{th}}$  selection's view.  
 $W_i$  = Relative weight or importance of the  $i^{\text{th}}$  sub-criteria.  
 $S_{j,i}^t$  = Rating score of the initiative t to the  $i^{\text{th}}$  sub-criteria.  
 $n$  = Number of sub-criteria in the  $j^{\text{th}}$  selection's view.  
 $V_j$  = Relative weight of the  $j^{\text{th}}$  selection view.  
 $M$  = Number of selections' views.

Figure 2.4 : Formula to calculate the overall weighted score.

## 2.5 Existing computer aided decision support tool for selecting the organisations improvement initiatives.

The existing computer aided decision support tools for selecting improvement initiatives available on the internet and in previous literature are listed below:

- 1) Thawesaengkulthai (2007) – Selecting quality management and improvement initiatives: Case studies of industries in Thailand
- 2) Wieleman (2011) – Selecting Business Improvement Methods: Towards a technique for consultants to support the selection of methods in an improvement project.
- 3) Mohammad (2012) – Development of a guidance model for the selection organisational improvement initiatives.
- 4) Nazar (2013) – A decision aid for the selection of organisational improvement initiatives.

Table (2.5) explains the characteristics of each one; Thawesaengkulthai (2007), Wieleman (2011), Mohammad (2012) and Nazar (2013).



Table 2.5: The characteristics of Thawesaengskulthai (2007), Wieleman (2011), Mohammad (2012) and Nazar (2013).

No	Authors	Characteristics of CADST
1-	Thawesaengskulthai (2007)	<ul style="list-style-type: none"> <li>➤ Use Microsoft Excel.</li> <li>➤ Include two phases: decision matrix and graphical display.</li> <li>➤ The matrix is required to fill the name of organisation, weightage, importance and score</li> <li>➤ Four selected views (strategic fit, pay off, organisation fit and fashion)</li> <li>➤ Weightage value of the main criteria is (0-1)</li> <li>➤ Weightage value of the importance of the sub-criteria (0-100)</li> <li>➤ Initiative score used likert scale (1-5)</li> <li>➤ Indicator placed below decision matrix</li> <li>➤ Result displayed on the bar and tabular graph</li> </ul>
2-	Wieleman (2011)	<ul style="list-style-type: none"> <li>➤ Use Microsoft Excel</li> <li>➤ Have three phases,</li> <li>➤ First phase : Elimination based</li> <li>➤ Second phase: Score input by decision maker, score determination.</li> <li>➤ Third phase: Graphical display on the bar and radar graph</li> <li>➤ The range of weight of criteria from 0 to 100.</li> </ul>
3-	Mohammad (2013)	<ul style="list-style-type: none"> <li>➤ Use Microsoft Excel</li> <li>➤ Have one phase only: decision matrix.</li> <li>➤ Three main criteria / selection view: Feasibility, organisation fit and value / benefit.</li> <li>➤ The scale of the weightage value of the main criteria is (0-1)</li> <li>➤ The scale of the Weightage value of the sub-criteria is (0-100)</li> <li>➤ Initiative score use likert scale (1-5)</li> <li>➤ Doesn't have any graph to show the result</li> </ul>
4-	Nazar (2013)	<ul style="list-style-type: none"> <li>➤ Use Microsoft Excel</li> <li>➤ Have two phases decision matrix and graphical display</li> <li>➤ Three main criteria / selection view: Feasibility, organisation fit and value / benefit.</li> <li>➤ The matrix required to fill the name of organisation, weightage, importance and score</li> <li>➤ The scale of the weightage value of the main criteria is (0-1)</li> <li>➤ The scale of the Weightage value of the sub-criteria is (1-5)</li> <li>➤ Initiative score use likert scale (1-5)</li> </ul>

Thawesaengkulthai (2007) developed the matrix by using Microsoft excel (see Figure 2.4). The five point likert scale was employed in the matrix because it is a simple, effective and widely used method (Yoon & Hwang 1995). He applied the SAW method technique in the decision matrix because it is simple, an accepted standard and suitable for practical (Daellenbach & McNickle 2005). Other than that, SAW method can also reduce the evaluation time and provide a clear method to manage or compare with others under stable calculation. In research Thawesaengkulthai (2007), the decision matrix consists of two phases. The first phase requires decision maker to fill the company's name, information of the organisation's selection view or criteria, sub-criteria, weightage, importance of sub-criteria, and score of initiative. The result is displayed on the bar and tabular graph in the second phase, (as depicted in Figure 2.5 and Figure 2.6).

### Selection matrix of management tools

Company's name: .....Essilor Manufacturing (Phillipines)

Date:....30 March 2006.....

Type of industry: Manufacturing or Service, Type of product/ service:....Contact Lenses.....

Selection's views	Area Weight	No.	Sub-Criteria	Company's Importance	Rate Initiatives							
					TQM		ISO		Lean		Six Sigma	
					Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Strategic Fit (Direction/ vision, KPI, OW/OQ)	0.35	1	Cost	25	4	100	4	100	3	75	5	125
		2	Quality	25	5	125	5	125	3	75	4	100
		3	Speed	25	3	75	3	75	5	125	4	100
		4	Dependability	15	3	45	2	30	3	45	4	60
		5	Flexibility	10	2	20	0	0	3	30	3	30
Pay-Offs	0.35	1	Shareholder benefits	10	0	0	0	0	1	10	5	50
		2	Company performance	10	4	40	0	0	3	30	4	40
		3	Marketing performance	10	1	10	0	0	1	10	2	20
		4	Customer satisfaction	40	5	200	5	200	1	40	5	200
		5	Human resources	10	3	30	0	0	1	10	3	30
		6	Process improvement	10	4	40	4	40	4	40	5	50
		7	Organisational benefits	10	4	40	0	0	4	40	2	20
Organisation Fit	0.20	1	Company capability and readiness	30	4	120	3	90	3	90	3	90
		2	Achievement possibility	20	4	80	3	60	4	80	4	80
		3	National and organisation's culture	15	3	45	0	0	1	15	1	15
		4	Commitment from top	20	4	80	5	100	4	80	5	100
		5	Infrastructure	15	3	45	4	60	3	45	3	45
Fashion	0.10	1	Follow best practices, competitors, books, journal	50	3	150	0	0	4	200	3	150
		2	Suggested by consultant, experts	0	2	0	0	0	2	0	4	0
		3	Follow trends	50	2	100	0	0	4	200	3	150
EVALUATION	Strategic fit score					365		330		350		415
	Pay-offs score					360		240		180		410
	Organisation fit score					370		310		310		330
	Fashion score					250		0		400		300
	Overall score					353		262		288		385
	Rank					2		4		3		1
Area weight		0-1.00		Total = 1.00								
Sub-criteria weight according to		0-100		Total = 100								
Rating Score		1-5		1 = Very low to 5 = Very high, See Profoma for rating								

Result

Figure 2.5 : Decision matrix developed by Thawesaengskulthai (2007)

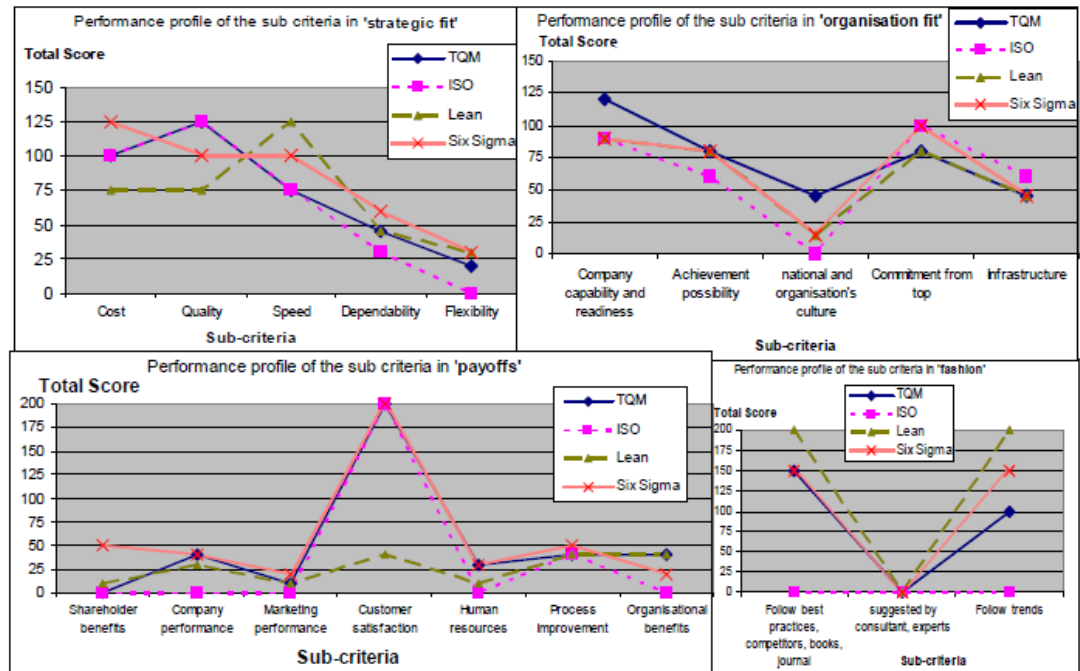


Figure 2.6 : The performance of the graph developed by Thawesaengskulthai (2007)

Wieleman (2011) has also developed a decision matrix by using Microsoft Excel. He applied the WPA method technique in the decision matrix because the criteria are in different dimensions / units. The matrix has three phases which are: elimination based, score input by decision maker and score determination. Refer to Figure 2.7 (a-b) & Figure (2.8 -a), and the score robustness (see Figure 2.9-b). The first phase consists of the information of an organisation and the evaluation criteria of the initial improvement method. The last phase, Graphical display on the bar and radar graph, (see Figure 2.9 a and Figure 2.9 b ). Finally, Wieleman (2011) applied indicator in decision matrix by using the insert comment which helped and provided extra guidance to the user as to what is required to be filled (see Figure 2.10).

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