

**MALAYSIAN ORGANISATIONAL EFFICIENCY –  
IMPLEMENTATION OF SIX SIGMA METHODOLOGY**  
(Kecekapan Organisasi di Malaysia – Pelaksanaan Tatakaedah Enam Sigma)

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*ABSTRACT*

The implementation of productivity tools in multinational companies is usually well documented. Two of the fundamental productivity methods used are waste elimination and variation reduction. The objective of this research is to identify the Critical Success Factors (CSFs) of six sigma methodology implementation in Malaysian Multinational Corporations (MNCs). This research used the method of exploratory survey conducted via online questionnaire. The survey was conducted among 22 MNCs in Malaysia which used six sigma methodology in their organisations. The list of 22 companies was retrieved from Internet search. Of the 22 companies surveyed, 20 returned their completed responses. The study concluded that Project/Process Assessment and Training/Awareness are the most significant factors in the successful implementation of six sigma. The results support the Null Hypothesis ( $H_0$ ) that the success of six sigma implementation in Malaysia is directly impacted on by the identified CSFs. This research finding provides the necessary foundation for local companies to adopt and to ensure the correct approach is used in implementing six sigma in their organisations.

*Keywords:* Multinational corporations (MNCs); six sigma; six sigma plus; critical success factors (CSFs); total quality management (TQM)

*ABSTRAK*

Pelaksanaan peralatan produktiviti di syarikat-syarikat multinasional biasanya didokumentasi dengan baik. Dua kaedah produktiviti asas yang digunakan ialah penghapusan pembaziran dan pengurangan variasi. Objektif penyelidikan ini adalah untuk mengenal pasti Faktor Kritikal Kejayaan (CSFs) dalam pelaksanaan tatakaedah Enam Sigma di Perbadanan Multinasional (MNCs), Malaysia. Kaedah tinjauan explorasi dengan soal selidik dalam talian telah digunakan. Tinjauan dijalankan di antara 22 MNCs di Malaysia yang menggunakan tatakaedah Enam Sigma di organisasi mereka. Senarai 22 syarikat ini dipetik daripada carian di Internet. Daripada senarai 22 syarikat yang ditinjau, 20 telah mengembalikan respons penuhnya. Kajian ini menyimpulkan bahawa Penilaian Projek/Proses dan Latihan/Kesedaran adalah faktor-faktor yang kritikal dalam menentukan kejayaan pelaksanaan Enam Sigma. Keputusan ini menyokong Hipotesis Nol ( $H_0$ ) yang merumuskan bahawa kejayaan pelaksanaan Enam Sigma di Malaysia dipengaruhi secara langsung oleh CSFs yang dikenal pasti. Keputusan ini menyediakan asas yang perlu bagi syarikat-syarikat tempatan untuk menerima pakai dan memastikan pendekatan yang betul digunakan dalam pelaksanaan Enam Sigma di organisasi mereka.

*Kata kunci:* Perbadanan multinasional (mncs); enam sigma; enam sigma tambahan; faktor kejayaan kritikal (csfs); pengurusan kualiti menyeluruh (tqm)

## 1. Introduction

Malaysia is envisioned to be a fully developed country by the year 2020. To achieve the planned progression, there is a fundamental need for business organisations operating in the country to deliver consistent and quality productivity outputs. This requirement is necessary to ensure our competitiveness in the business world, which has become more integrated and globalised. This drive towards globalisation effectively means inefficiency, long production time, high cost of operations, high defect and rejects will no longer be acceptable in the business system and thus, need to be sharply reduced or eliminated. Thus, there is an increasing need for companies in Malaysia to embrace global productivity methods and work cultures that have proven to bring success to MNCs in their operations around the world as shown by companies such as Motorola and Toyota.

This research is initiated to help bring more clarity on productivity methodologies and identify the key CSFs that are essential for successful implementation of the tools in local organisations. Six sigma methodology has been selected as the case study method for this research. This selection is due to its wide application in multiple industries and agencies in Malaysia.

### 1.1. Six Sigma Structure – an overview

Six sigma ( $6\sigma$ ) is defined as the region covered by the bell curve normal distribution which lies within Six Standard Deviations from the mean line ( $\sigma$ , Sigma is the Greek symbol used to represent standard deviation in statistics). This methodology provides the techniques and tools to improve the capability and reduce the defects in a process (Hoerl 2004; Dale 2001). It allows for only 3.4 defects per million opportunities for each product or service transaction (Basu & Wright 2003). A typical six sigma driven organisation will have six sigma experts or Black Belts to evaluate a business process and determine ways to improve the existing process (Ingle & Roe 2001). These experts guide employees who are to be certified as Green Belt to select and improve business processes at the workplace. The primary focus of a six sigma program is to improve the process performance, decrease variation and maintain the consistent quality of the process output (Antony & Banuelas 2002; Russell & Taylor 2003). Six sigma applications are widely applied in the business areas of project management, customer support, supply chain management, human resources and finance (Yasuo 1980; Juran 1986; Ricardo & Antony 2005).

### 1.2. Waste elimination or lean methodology

Developed at Toyota Motor Company by its former executive vice president, Taiichi Ohno, known as Toyota Production System (TPS) and eventually known as Lean due to its extended applications in non-production companies particularly in cost reduction mechanism (Taiichi 1995; Womack *et al.* 1991; Bicheno 2004). Lean methodology is a principle of applying standard practices in processes to ensure consistent throughput (Muthusamy & Noguchi 2004).

The fundamental idea behind the lean process is that for a process to function well, people and technology must integrate in the system, exploiting the strengths and minimizing the limitations of each component. Trist *et al.* (1997) called this as a Socio-Technical System. TPS emphasises the participation of all employees. It uses teams integrated with work cells for motivation, work management and problem solving. Work teams such as Quality Control Circles (QCC) are an important component of lean manufacturing as they enhance the performance of work cells and improve quality efforts.

According to Womack *et al.* (1991), elimination of Waste ("Muda" in Japanese) has many forms. Examples of "Muda" are material, time, idle equipment and inventory. TPS emphasises on the identification of wastes in processes and the use of specific tools and techniques to eliminate it. A further research conducted by Womack *et al.* (1991) concluded that there are three main principles of lean manufacturing as shown below:

- a) Improve flow of material and information across business functions.
  - (i) Product does not stop moving once launched in the process.
  - (ii) Interruptions to in-process work are minimised.
  - (iii) Vigorously respond to flow stoppages with dedicated support.
- b) Focus on pull factor or demand by customer.
  - (i) Product does not start until an order is placed by the customer.
  - (ii) In-process work does not move until needed by the next step.
- c) Commitment of organisation to Continuous Improvement (CI).
  - (i) Continuously evaluate and study the process.
  - (ii) Every incremental improvement uncovers the next opportunity.

### **1.3. Variation reduction or Six Sigma methodology**

Six sigma quality is a statistical measure that equates near-perfect quality and has become a recognised quality program based on the goal of virtually perfect quality (Russell & Taylor 2003). In philosophy, this tool helps companies to grow businesses by satisfying customer needs and requirements. Six sigma provides quality measurement that can be used throughout an organisation, not only in manufacturing but also in design, administrative and service areas (Bhuiyan & Baghel 2005).

Six sigma is also defined as an organised and systematic method for strategic process improvement for new product and service development. It relies on statistical and scientific methods to make dramatic reductions in defect rates (Linderman *et al.* 2003). Wyper & Harrison (2000) further interpreted six sigma as a useful management philosophy and problem-solving methodology which is a direct extension of total quality management (TQM). Further studies done by Bailey *et al.* (2001) concluded that six sigma has a better record of effectiveness than TQM, lean enterprise and re-engineering.

Developed at Motorola in the 1980s, this method allows users to fractionate and forecast miniature application defects to ensure the quality of products is sustainable at 99.99 percent accuracy or six sigma (Rancour & McCracken 2000; Devore 2000). The practical application of the six sigma methodology widely known as DMAIC is anchored to applying statistical tools in the Define, Measure, Analyse, Improve and Control stages of a process to ensure minimum variations in its repeatability and reproducibility (Hare 2005; Breyfogle 1999).

### **1.4. Six Sigma Plus**

Also known as lean six sigma, this is a combination of lean and six sigma methodologies to address waste eliminations and variation reduction (George 2002). Practical application of selected Lean tools such as Value Stream Mapping, Non Value Added (NVA), Value Added (VA), Rapid Problem Solving and etc. in the six sigma DMAIC environment help organisations to improve processes while maintaining very high quality results (Byrne 2003). The advantage of combining these methods are time reduction and increased efficiency, thus

allowing multiple applications at the same time with minimum variations and reduced time (Su *et al.* 2006). The lean six sigma implementation cycle is divided into three stages – Corporate Planning, Implementation and Assessment (Byrne 2003).

#### 1.4.1. Corporate planning

In order for the six sigma application to be successful, top-down management awareness and drive of the initiative are essential. The management will help to set a series of policies, guidelines and rules in organisations to ensure the workforce fully understand the nature of lean and six sigma and their implementation (Henderson & Evans 2000).

#### 1.4.2. Implementation

Having completed corporate planning, an organisation then employs the right full-time people and initiates projects and training. Each project clearly addresses one or more business goals to deliver core enterprise measures. Projects are continually tracked and updated for line management during existing business reviews to ensure successful completion (Eckes 2000; Paned *et al.* 2001).

#### 1.4.3. Assessment

Real-time assessment is exercised by applying selected six sigma and lean tools during the project phase to ensure quick elimination of wastages and continuous monitoring and reduction in process variations during and after execution of the project (Horst 2004; Ricardo & Antony 2005).

## 2. Problem Statement

Timothy (2001) in his paper on globalisation study entitled “How do we define value chains and production networks?” wrote, “the underlying hypothesis is that as more national economic systems come to resemble one another, the fewer barriers will exist to the flow of resources to their most efficient use, and the further the world economics will be integrated or globalised.”

The following is an extract of the Working Paper entitled “Malaysian Business Council – The Way Forward” presented by the fourth Prime Minister of Malaysia, Dr Mahathir Mohamad, at the Malaysian Business Council in 1991, which encapsulates the country’s drive towards becoming a fully developed nation by the year 2020 (Mahathir 1991):

*“Hopefully the Malaysian who is born today and in the years to come will be the last generation of our citizens who will be living in a country that is called 'developing'. The ultimate objective that we should aim for is a Malaysia that is a fully developed country by the year 2020. Since the early 1980s, we have stressed that this country will rely on the private sector as the primary engine of economic growth. In a way, we were ahead of the rest of the world, even the developed countries in entrusting economic growth to the private sector. The policy is now bearing fruit. The outcome: in 1988, we grew in real terms by 8.9 per cent; in 1989, by 8.8 per cent; in 1990, by 9.4 per cent without expansionary budgeting by the Government.”*

The vision calls for a self-sufficient industrial, Malaysian-centric developed nation, complete with an economy which in 2020 will be eightfold stronger than its economy in the early 1990s. This research finding is envisaged to serve as a contributing mechanism in the introduction of productivity and improvement methodologies in local organisations, thus

helping to lay out an appropriate foundation in the approach to be taken in applying such tools effectively to improve productivity and organisational effectiveness.

This research will also review how six sigma methodology can be implemented in Malaysian organisations to help facilitate the country's drive to become a fully developed nation by the year 2020. The results of the exploratory survey is then benchmarked to identify the Critical Success Factors (CSFs) which will help to ensure the successful implementation of such productivity tools in Malaysia (Chandra & Kumar 2006).

### **3. Scope and Limitation**

Six sigma plus methodology have been widely embedded in MNCs operating in Malaysia such as Motorola, General Electric, Citibank and Sony (Ricardo & Antony 2005). However, how the practices are modelled and applied within the Malaysian workforce and the successes and problems in applying these methods have never been documented. However, numerous papers have been produced on Total Quality Management (TQM) by scholars in Malaysia (Thiagaragan *et al.* 2001; Lau & Idris 2001). These papers will be reviewed to understand the reasons behind such studies, the conclusions reached and the issues open for future literature review.

This study will be carried out in MNCs. It is therefore hypothesised that by studying a Six sigma based improvement practiced by MNCs would then allow local businesses to apply such improvement as a whole or on selective basis when developed locally (Desai 2006; Hatice 2007). The other reason for this selection is the nature of the business which relies heavily on efficiency and standard work practices. As the global economy is moving towards a new structure of international interdependence due to MNCs' dominance and control, it is relevant for us to focus on work methods (Brinkman & Brinkman 2002).

### **4. Research Objective**

The primary objective of this research is to study companies implementing six sigma methodology in Malaysia and identify the CSFs required to make six sigma application in a MNC business a success. Similar studies conducted in other parts of the world have laid out a very concrete foundation path in their respective countries for scholars and decision makers alike for further understanding of six sigma's impact on the local business model (Desai 2006; Su *et al.* 2006). To achieve the research's primary goal, the following guidelines have been developed:

- a) To identify a pool of locally operating MNCs which employ six sigma methodology in their operations.
- b) To design a questionnaire and conduct exploratory survey on six sigma application at the MNCs.
- c) To use the questionnaire findings to develop the CSFs which make the implementation of six sigma a success in these companies.
- d) To publish the findings to ensure that a wider spectrum of local researchers and academics become aware of the tools.

## 5. Literature Review

Earlier studies in the field of productivity methodologies and tools in Malaysia touched on the application of Total Quality Management (TQM.) A literature review published on TQM implementation in Malaysia by Lau and Idris (2001) concluded that although TQM is a proven systematic approach to improvements in global business, the lack of information and data on critical success factors (CSFs) was hindering the implementation of an effective and successful TQM in organisations. In another literature review by Thiagaragan *et al.* (2001), they concluded that, “the construction of the TQM implementation framework is primarily based on findings representing the experiences of TQM organisations, the vast majority of which are two to three years into the implementation.”

It has been shown that the core elements (i.e. the critical success factors) used to construct the framework is too general and the framework is presented more as a guide for organisations planning for a TQM initiative. It is envisaged that the framework should provide useful advice in the critical first two to three years of TQM implementation as a practical and systematic tool for assessing, measuring and evaluating the progress made. The results of aforementioned works have contributed greatly in forming a conceptual idea of TQM on the Malaysian research front.

Wyper and Harrison (2000) further interpreted six sigma as a useful management philosophy and problem-solving methodology that is a direct extension of TQM. Further studies done by Bailey *et al.* (2001) concluded that in fact, six sigma has a much better record of effectiveness than TQM, lean enterprise and re-engineering. The researchers’ first reason for focusing this study on six sigma methodology is its relevance to the earlier studies.

In a research paper by Bhuiyan and Baghel (2005) on Continuous Improvement (CI) however, concluded that there is always a need for research in the field of hybrid CI methodologies (Juergensen 2000; Bessant *et al.* 1994). This will help determine these new CI methodologies’ applicability in various levels in an organisation. This is the second reason for this research to focus on six sigma methodology as to the methods’ link to future studies in which lean and six sigma tools are combined to give a new-look methodology called six sigma plus.

In Malaysia, there is a need for research in the field of six sigma application and implementation in order to facilitate the country’s drive becoming a fully developed nation by the year 2020. This will be the first documented research on the implementation of six sigma in MNC practices in Malaysia is envisaged to guide fellow researchers, academics and local practitioners in Malaysia. This will also help in future studies and how a localised concept of six sigma may be implemented in Malaysia.

## 6. Research Design

To ensure there is a structural approach to this research, the researchers set the foundation path to follow the concept of business research methods as this was an exploratory research for which a carefully laid plan would help in the attainment of the objectives (Zikmund 2003).

### 6.1. *Business research method (BRM) deployment*

BRM is an important management tool that is relevant in critical decision making in an organisation. It is a master plan for specifying the methods and procedures to be used to collect and analyse the data gathered. BRM is also a process that is relevant in obtaining necessary knowledge of organisations, the clients, the supply chain that feeding the process or any uncertainty. This process helps the decision makers to make decisions based on factual

data gathered through a systematic and objective method and reduce the tendency of making intuitive decisions.

The path of this research will be anchored to the method of exploratory study, focusing on the survey via e-mail corresponded questionnaire method (Henderson & Evans 2000). The reason for this is the method's ability to explore and interpret the known problem in this research for which a clear and precise statement is required. The questionnaire to be developed will look into two main aspects of MNCs:

- a) The company profile such as duration of operation, percentage of local content within its operations etc.
- b) Implementation of six sigma applications in these companies.

### **6.2. Cycle flow of BRM**

BRM's main objective in this research is to reduce uncertainty in the process and to allow decision making based on factual data. This process defines in a nutshell BRM functions by first identifying the problem in hand. The BRM will then be used to diagnose or identify the causes of the problem. After the problem is understood, the BRM tool will be employed to select and implement a suitable action plan that will be followed by evaluation of the results and action plan.

### **6.3. Methodology**

As a pioneer attempt to understand the correlation of six sigma implementation within MNC organisations in Malaysia, this research is embarked upon with limited knowledge of the subject. Therefore, a basic (pure) research method is used with the primary objective of expanding the limits of knowledge of the subject researched (Linderman *et al.* 2003).

In order to obtain a sample size large enough from the actual population size of MNCs operating in Malaysia and to have a more accurate reflection of six sigma implementation, the exploratory method is considered a suitable choice. Another point of consideration is the time constraint – it is not possible to complete the survey within the time available if it were done through interview or by post. Thus, e-mail correspondence will be used to ensure confirmation of survey acceptance by the participants. This method has a higher return in terms of response and consume less time and cost (Eisenhardt & Graebner 2007).

In ensuring a firm grip on the research path and its intended research objectives, scientific method procedures and techniques will be used for the entire research. As the study requires conclusions to be made based on systematic analysis and logical interpretation, this method will ensure the successful completion of the research.

The following guidelines will act as reference throughout the process:

- Assessment of the relevant existing knowledge
- Formulation of the concepts and proportions
- Statement of hypothesis
- Design of research to test the hypothesis
- Meaningful data collection
- Analysis and evaluation of the data
- Conclusion of the factual findings

The targeted respondents for the survey were pooled from the senior management of the companies, six sigma champions within the organisations, project managers and application engineers. The reason for this selection is their direct involvement in the application of six sigma tools in their organisations. The questionnaire for the survey is modelled on multiple choice close-ended questions to provide the researcher with better understanding of the demographic pattern of six sigma tools and their implementation. The received responses will then be fitted into a Measurement System Evaluation (MSE) tool to refine the responses received and provide calibrated and benchmarked results of the survey. The design will seek to address three linked purposes:

a) Identify pool of local MNCs

This first step will help this research to diagnose the problem in place and provide clear understanding of the objectives to be set. It will also help to prioritise the relevant variables of the problem.

b) Screening the alternatives

This stage will determine the best possible alternative to the application of six sigma practices in the local companies. This will help to identify new CSFs which might be relevant to the local model of implementation.

c) Discover and model new ideas

Summarisation of the CSFs will ensure the success of six sigma implementation in organisations. The critical factors will be defined based on solid findings and soft testing. The survey research concept will be used to ensure that any generalisation of the new discovered methods are flexible for multifunctional business applications.

This research will be guided by a theoretical framework captured in the following paragraph. It is gathered from previous concluded research studies (Coronado & Antony 2002). The hypothesis tested in this paper will be analysed as per the following framework (Motwani *et al.* 2004):

Five (5) known input variables identified from previous research as CSFs for successful six sigma implementation are grouped as the following (Motwani *et al.* 2004):

- a) Management commitment involvement.
- b) Workforce understanding of the six sigma methodology, tools and technique.
- c) Six sigma level of absorption into the organisation i.e. departments, clients and supplier involvements.
- d) Assessment process of all six sigma projects within the organisations i.e. project management and selection, reviews, tracking and after completion monitoring.
- e) Training structure for continuous awareness.

The final outcome of this research would be to conclude if the identified CSFs contribute to six sigma implementation within the organisation. The working hypothesis as such will be:

$H_o$ : Six sigma implementation successes in Malaysia are directly impacted by the above identified CSFs.

$H_a$ : At least one or more of the identified CSFs does not contribute to six sigma plus implementation success in Malaysia.



The abovementioned theoretical model will, however, be further enhanced if there are new changes as the research progresses to ensure the relevance of the model is consistently updated.

#### 6.4. Key assumptions

The research will be initiated with the assumption that the companies selected for the survey research have been implementing six sigma tools in their business structures. Another assumption will be that majority of local workforce employed to ensure the demographic behavioural requirements are fully captured.

### 7. Research Results

The results are presented in pie charts to facilitate easier understanding of the findings and the interpretation of the results.

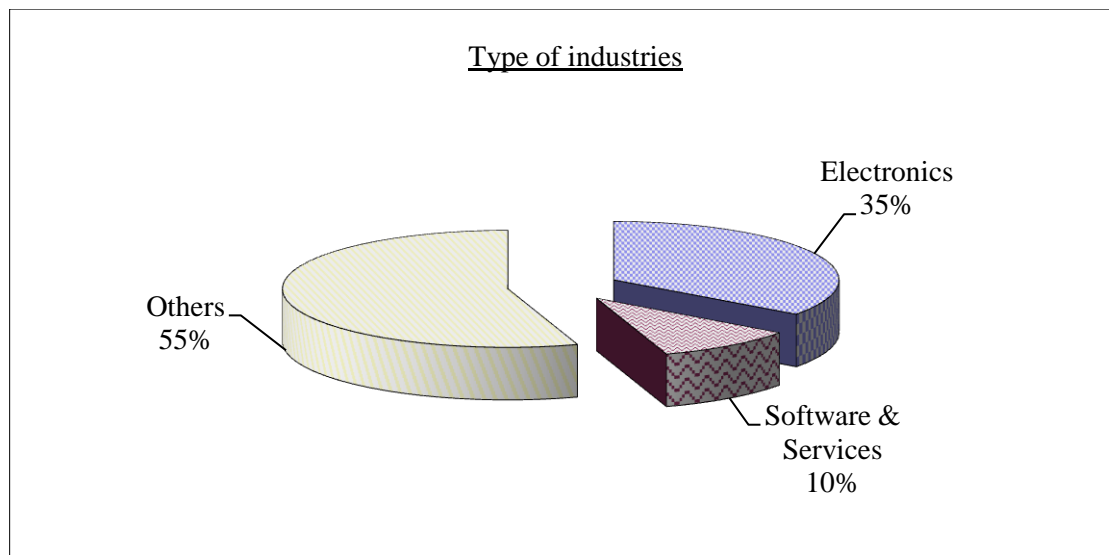


Figure 1: Breakdown of the major industries using Six Sigma in Malaysia

The above Figure 1, which contains information derived from the survey, indicates the major types of industries where six sigma is applied. The electronics industry is the single largest contributor with 35 percent of the pie. The interesting aspect of this finding is that 55 percent comprises other industries such as automation and control, building solutions, oil and gas, sales, services and government agencies.

This reinforces the literature findings that six sigma, unlike its earlier predecessor such as TQM, is widely accepted and applied in multiple business models. It reflects also the flexibility of adapting this method for use in various processes.

Next, we look into how long the companies interviewed have been operating in Malaysia as shown in Figure 2. These graphical results show that 95 percent of the companies

participating in this survey have been operating in Malaysia for more than eight years and have local workforce exceeding 90 percent in their organisations. It also found that 84 percent of the companies surveyed have been implementing six sigma for more than two years in this country.

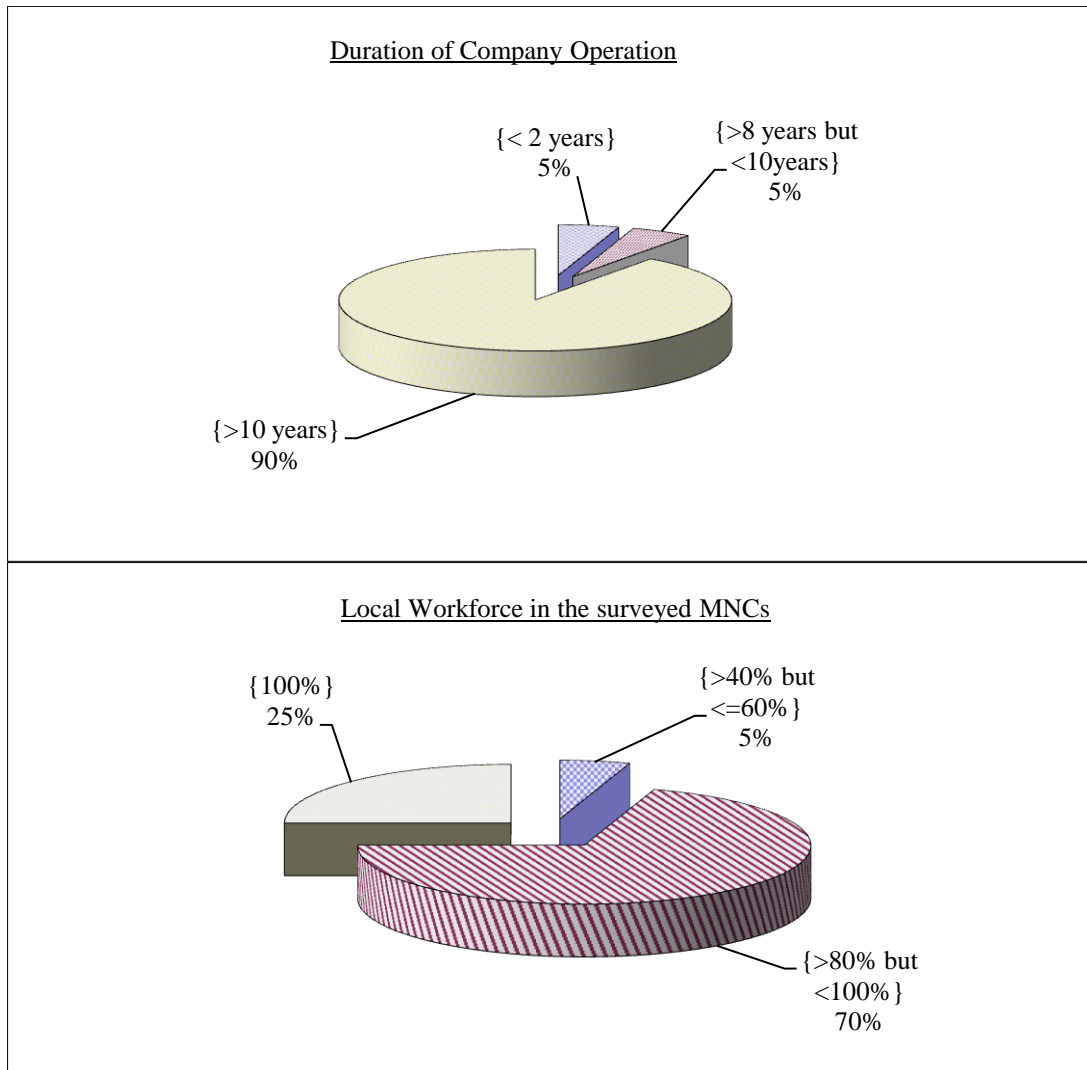


Figure 2: MNCs surveyed for employee composition

This will help us to form the hypothesis on cultural influences as one of the key CSFs in the six sigma implementation.

Figure 3 indicates the level of absorption and assessment of projects within the organisations surveyed. The results show that more than 90 percent of the design-related activities within the companies strictly pass through six sigma processes to ensure consistency and high quality production. Project assessments represent 100 percent feedback from the survey. This check is the most important process in ensuring that all projects produce consistent and timely project deliverables.

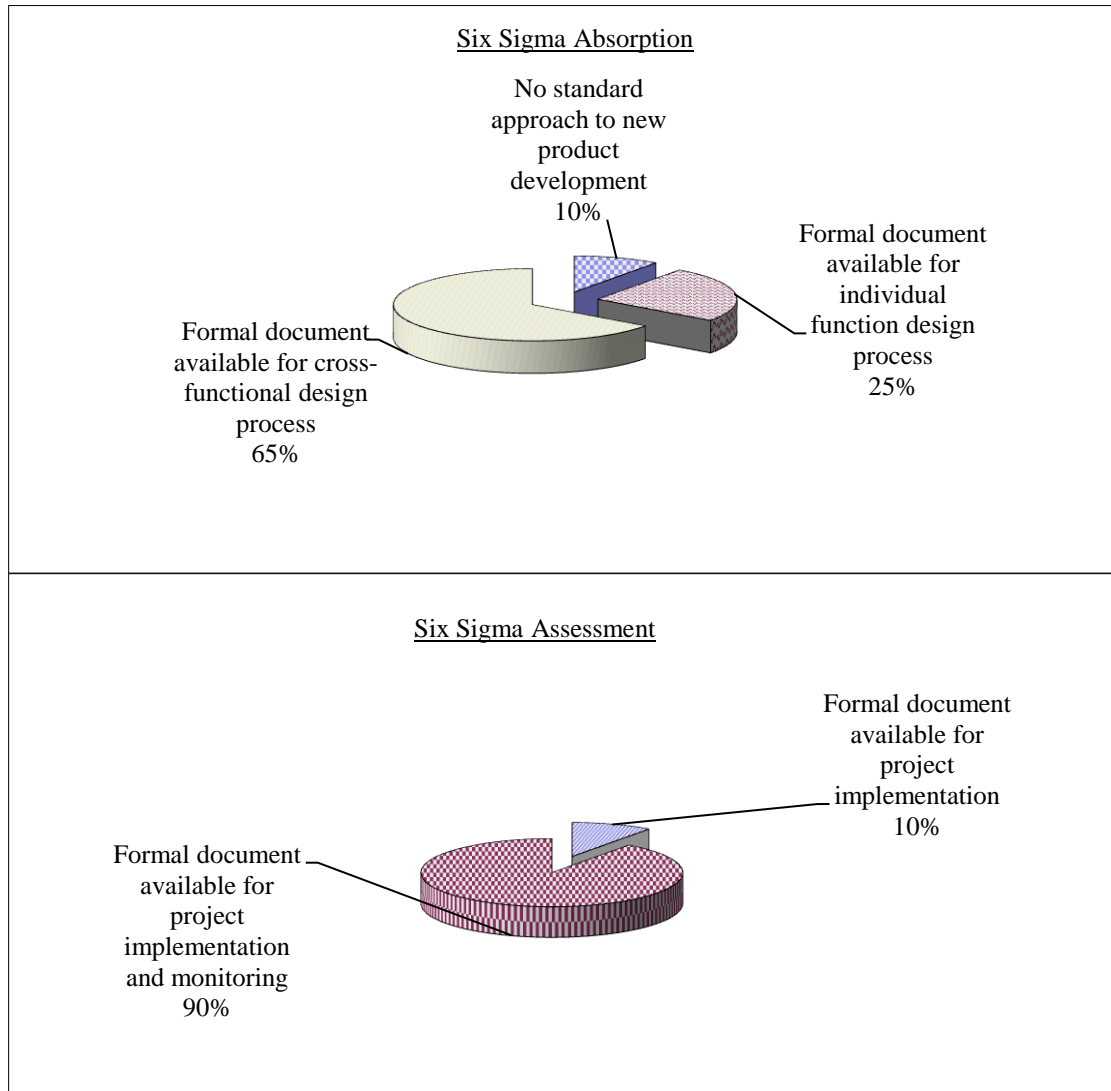


Figure 3: Six Sigma Implementation processes in MNCs surveyed

Figure 4 shows an overview of the key drivers of six sigma in these organisations revealed that 90 percent respondents indicated that the six sigma policy was driven as corporate initiative, while the 10 percent reflecting local initiative. This finding is further strengthened by the graph on key drivers which indicates that management represents 85 percent of the driver of the initiative within the organisation.

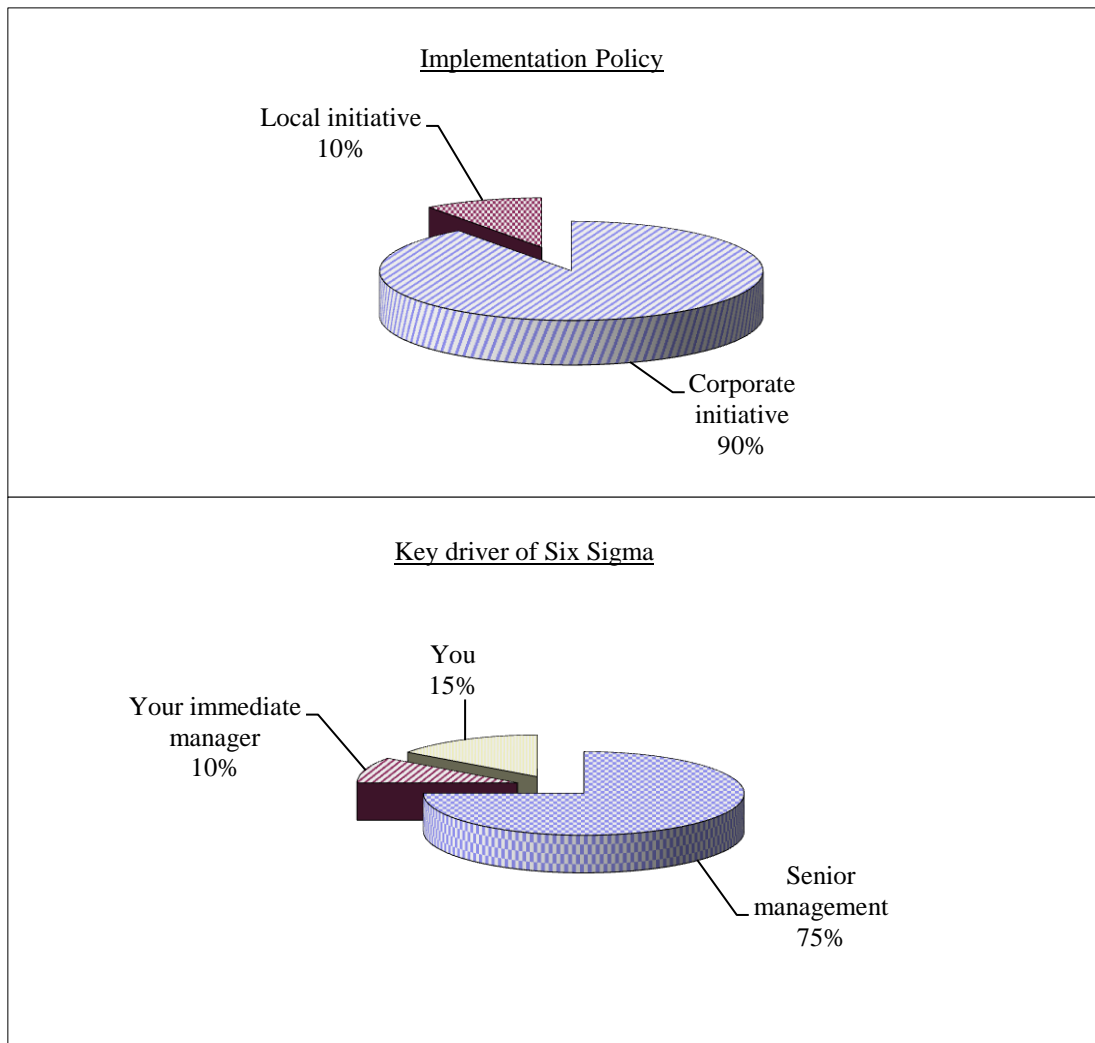


Figure 4: Key drivers in MNCs' Six Sigma implementation

Figure 5 represents training and awareness as a key critical factor for six sigma implementation. This element has returned 100 percent survey feedback, thus confirming that continuous education and embracement of the employees in the organisations is a CSF in six sigma implementation. 80 percent of the survey return indicated that an internal training structure headed by six sigma Black Belt personnel ensure that a consistent training plan was made for new employees and refresher courses was provided for existing employees. The 20 percent external training return was reflected by the new emerging local companies starting to implement six sigma in their organisations. Trainings for these companies are provided by external six sigma training companies as there is no internal training structure available.

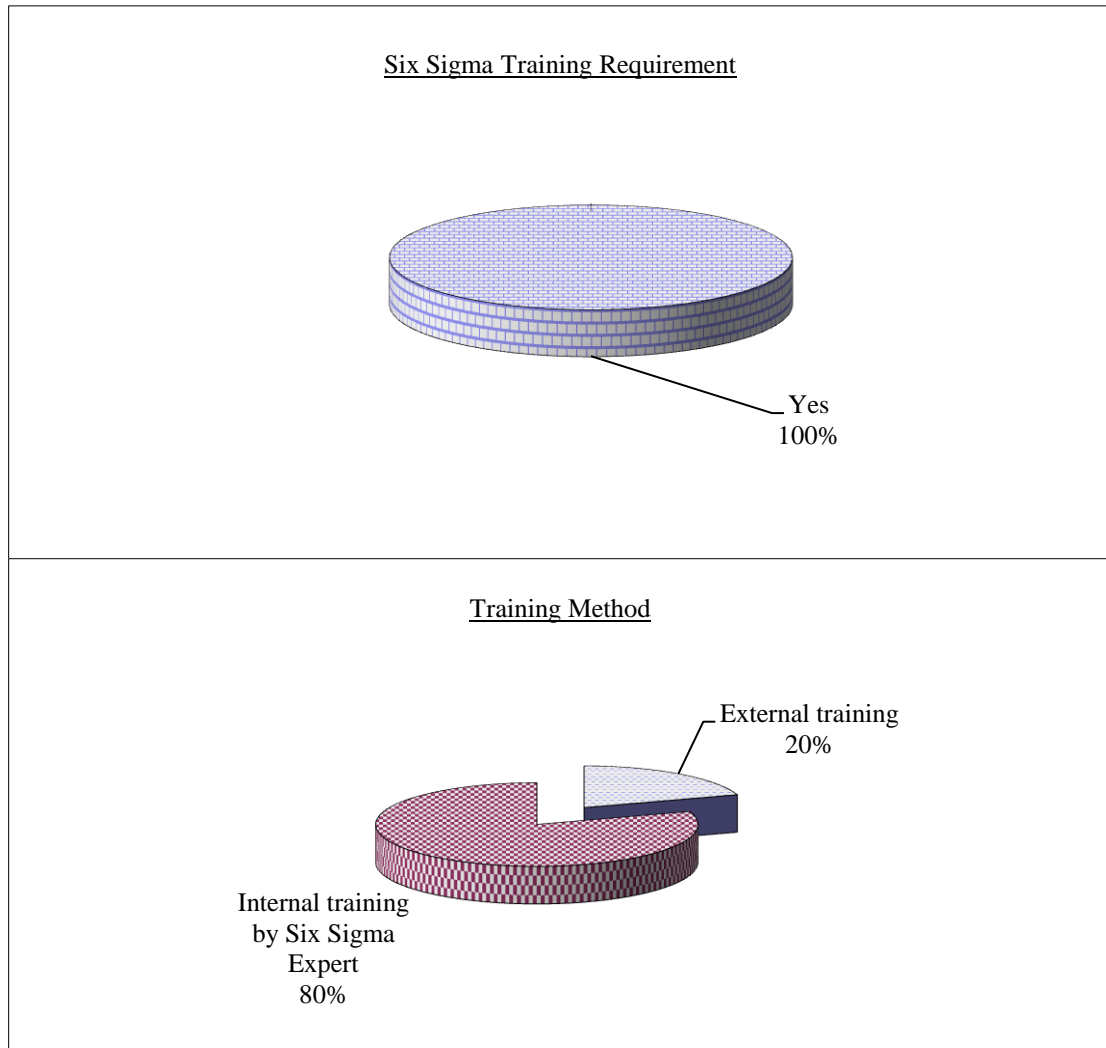


Figure 5: Six Sigma training needs in the MNCs surveyed

The final set of information contained in Figure 6 shows the results of the continuous embracement of the six sigma way of work as 85 percent of the individuals interviewed in this survey indicated that they used some of the six sigma tools in their daily lives such as in the arrangement of personal equipment used daily such as play toys, clothes, shopping checklist, vehicle checklist, etc.

The graphical review and findings have set us on the right path in our pursuit to understand the CSFs which are important in six sigma implementation in Malaysian MNCs. The findings support the Null Hypothesis of Ho: “Six sigma implementation successes in Malaysia are directly impacted on by the above identified CSFs”.

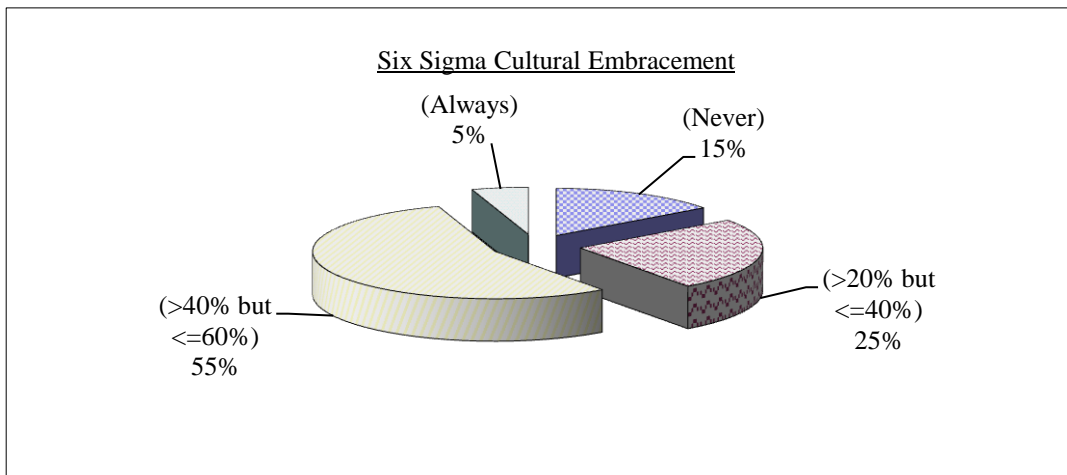


Figure 6: Six Sigma cultural embracement in the MNCs surveyed.

## 8. Conclusion

Six sigma methodology as reviewed and concluded by many researchers and peers will help to position a business into a prudent competitive model (Paned 2001). However, it is widely known that most productivity or business improvement models have failed mainly due to lack of understanding of the tools, cultural rejection of the idea or partial implementation for quick return of the bottom-line savings (Eckes 2000).

This research paper concludes that Project/Process Assessment and Training/Awareness are the most significant factors in the successful implementation of six sigma. Survey results supports the Null Hypothesis (Ho) where the success of six sigma implementation in Malaysia is directly impacted by the identified CSFs. It is envisaged that the results from this research will be used as a blueprint by Malaysian companies in applying the six sigma methodology and best practices in their business models. This will help to increase local competitiveness and product quality as well as lean and efficient processes. This will, in turn, make the businesses more profitable with prudent cost management (Desai 2006). Successful implementation of six sigma methodology by Malaysian companies will help to transform them into world-class businesses in line with the Vision 2020.

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