

Strategic Implementation of Six Sigma Project Management for Quality Improvement and Performance Enhancement

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Abstract

With increasing focus on the quality of product or service in recent years, researchers have launched several investigations into the cause of quality and customer satisfaction. However, quality in an organization is a measure of the extent to which the product or service delivered meets the customer's expectations. Many studies have developed measurement tools and techniques for assessing quality of product or service and consumer satisfaction levels. The six-sigma quality management system is a breakthrough approach that reduces product prices substantially, improves quality, creates services, reduces delivery times and ultimately improves profits. It aims at achieving customer satisfaction and preventing product defects or errors, and improving business performance significantly.

The purpose of this study is to investigate the implementation of the six-sigma strategy in businesses and performance. Through relevant literatures review, this study establishes three aspects of the implementation process: methods of implementation, corporate decision making, and project management. Statistic analyses are conducted using the correlation and multiple-regression analysis. The results indicate positive correlations between all three aspects of the implementation process and such six-sigma performance indices as product defect rate reduction, customer satisfaction improvement, profit increase, lead-time reduction, performance growth, and cost reduction. The study may also provide the basis and some reference for businesses advocating and implementing the six-sigma theory. Finally, future studies can either focus on certain industries and their current situations or extend the scope by including researches from both home and abroad. This may further help the understanding and advocacy of six-sigma implementations.

Keywords: six-sigma, methods of implementation, six-sigma performance, project management

Introduction

Continuous improvement with regard to the quality of product or service has stressed the strategic importance of customer satisfaction and performance for maintaining sustainable competitive advantages in the marketing literature. However, quality in an organization is a measure of the extent to which the product or service delivered meets the customer's expectations. In the highly competitive market, firms need to deliver high-quality products or services in a timely manner and must understand customers' needs and expectations. They must offer products which meet the desires, requests and demands of the customers. They

need a set of processes for creating, communicating, enhancing the quality of product or service delivery, and increasing the added value of each product to customers throughout the value chain.

By facing the global competition, an excellent quality management is the only condition for establishing business continuity; therefore, companies continue to enhance enterprise quality by continually implementing a variety of quality management activities, in order to maintain sustainable operation competitiveness. Among them, the six sigma quality management system is a breakthrough in order to achieve a substantial low product prices, quality improvement, provide service and reduce process time and ultimately enhance companies' profit in order to achieve a full range of customer satisfaction and to prevent fake products and error, and significantly improve the business performance (Goldstein, 2001).

The purpose of this study is to investigate the Six Sigma's strategic implementation and performance evaluation, through the literature review of the Six Sigma, compile the way for building Six Sigma into companies and conduct performance evaluation, in order to understand the efficiency and effectiveness of Six Sigma, and as the reference for the management business strategy planning in the future. The data analysis for this study is conducted mainly by correlation analysis, multiple regression analysis, etc. The results show that the impact of implementation of the Six Sigma is positively related to the performance of the low products' defect rate, upgrade of customer satisfaction, increased operating profit, and shortened workflow time, performance growth and a low cost index. The study is hoped to be provide reference and a foundation theory for enterprise which will implement the Six Sigma. Finally, the future researchers focus on the current state of individual industries to explore and expand to the conduct of the study area at home and abroad in order to understand further the implementation and drive of the Six Sigma strategies.

Literature Review

Nowadays enterprisers have been aware that customers' demand for product quality has been increasing. The knew that, in the past, the industry's practice of using the Three Sigma quality management as the quality control standard to make the defect rate under 2.7×10^{-3} , but now it has been unable to meet the customer demands for high quality (Harmon, 2007). Today, they use Six Sigma as the control level, and even a "Zero defects" as self-requirements in order to win the customer's fully satisfaction as a business strategy to help minimizing operating errors, improving customer satisfaction and shaping the organizational culture to enhance competitiveness (Taho & Chiung, 2009).

The six sigma quality management system has become a system for today's global pursuit of high-quality. Motorola profited by the six sigma quality management systems, not only to save the previous bad quality, but also was recognized in The Malcolm Baldrige National Quality Award. The most important thing is that with six sigma as the target quality activity makes the performance of the company to grow five times per year and net profit growth of nearly 20%, also the competitiveness is significantly enhanced (Pande, 2000).

The Six Sigma quality management system is a breakthrough in order to achieve a substantial low product prices, quality improvement, provide service and reduce the process time and ultimately enhance enterprisers' profit in order to achieve a full range of customer satisfaction and to prevent fake products and error, and significantly improve the business performance (Goldstein, 2001).

The concept of the Six Sigma was developed by Harry (1987) as a quality management system, which means the quality of our products of a company is necessary to follow the Six Sigma as the standard. Later it is gradually extended to all domains in the organization, and becomes the indicators of pursuit of high-quality and high standard. The

aim of the Six Sigma is to enable every employee to understand their own workflow, and also use a variety of statistical tools for continued pursuit of improvement. In combination of statistical quality control methods, the target for quality below the 3.4 parts per million defect rate, which is to control as ideal as the "Zero defects" target by an effective scientific method (Tadikamalla, 1994; Hahn and Hill, 1999).

In the global logistics system of the operational centre for Taiwanese enterprises is how to meet future customer demand by low cost, high quality and fast delivery in the market. With the successful derivation of some foreign big companies and achieve a good corporate performance, which gradually paid attention by domestic enterprises, and continued to introduce the Six Sigma, such as Rong Steel, Kim Po Electronics, Aerospace, Dupont etc, has been successfully implemented. Therefore, this study will review the Six Sigma related literature, and enterprises which built in successfully and implemented the Six Sigma and its strategy focus on discussing and operating performance (Antony and Banuelas, 2002; Su and Chou, 2007). It also focuses on the questionnaire survey for companies with implementation of Six Sigma to understand the quality and standards of practice and operating performance of the domestic enterprises with Six Sigma in order to provide a reference for the domestic enterprises in the future.

Usage of Six Sigma tools

The focus of Six Sigma is to enable an efficient production business process, so as to eliminate errors, boost morale, as well as save cost. Hahn and Hill (1999) think that the Six Sigma improvement approach can be summarized in four steps (MAIC): measurement, analysis, improvement and control. According to Pande (2000) which emphasis on customer satisfaction, thus it is defined as the 5 steps (DMAIC) of the implementation of Six Sigma: define, measure, analyze, improve and control. The above DMAIC cycle can improve the products for fulfilling customers' demands, and performance. However, companies cannot fulfill the Six Sigma standard if there are not Six Sigma DMAIC methods in the companies . Therefore, Simon (2002) then suggests another DMADV replacement cycle. The DMADV steps are define, measure, analyze, design, and verify.

The Six Sigma programs implemented by major companies, based on their business background and style, adopted a different problem management process model, including the above presented MAIC, DMAIC, DMADV etc. However, they seem to be different issues management process model, but in fact they are very similar. They have a high degree of commonality and are used to guide participants to solve all types of problem effectively, so this study will be focused on the most common one DMAIC and illustrate every stage of its purpose and task. (SatyaS, 2009)

There is the most appropriate problem management process in different areas and types of problems. In the field of quality management, the operation and management approach of Six Sigma is based on DMAIC's five-stage problem-solving process to conduct quality improvement activities and also a good way to solve the problem of management process of Six Sigma. However, it is neither solely nor necessarily the best. The key to the success of Six Sigma does not only depend on the problem management process but the surrounding management systems and even tools which play an important function and role. Therefore, we can say that the reason for Six Sigma to be so successful should be a comprehensive business management strategy equipped with a series of supporting measures (Yah, Cheng, & Chi, 2007).

Commitment of top management

The most important part of Six Sigma process improvement is the commitment from top management. The commitment refers to their willingness to participate in the whole

process of improvement. Top management involvement indicates significantly to the success because the improvement process would necessarily involve every department (Brue, 2002). When the top management is involved, it will reduce the resistance from various sectors and resources can be reallocated, thus the power of Six Sigma will be created.

The implementation of Six Sigma needs more resources and training than implementation of the other management systems, and also the need for inter-departmental teamwork. Moreover, it requires significant improvements in business performance. Hence, it's more difficult to implement it. So management will not only have a high degree of determination and insistence, but also to enhance communication among all members to form a consensus in order to achieve their support and action (Ferguson & Dickinson, 1982). Top management is found to take the important role in the activities of Six Sigma according to the above literature review, in particular the members of the Six Sigma organization, such as the champion, and master black belts and black belt also need to take the role as important reform leaders (change leader) and lead the organizations in the reform of the Six Sigma.

Customer-oriented

The ultimate goal of Six Sigma is customer-oriented and to establish an idea "customer's need is always in my heart" and focus on the customer value process. Therefore, companies must begin with the customer's ideas, commit to give service and support to customers, listen to customer feedback and reaction until customer satisfy for the products and services. Customer's reaction for the products and services is the key factor. It helps to fulfill customer's satisfaction on the products and services. Besides reaching the expectations of current customers, it continues to satisfy customers more and with their higher requirements and meet their higher expectations of customers (Ferguson & Dickinson, 1982).

Training

A company must provide education and training in order to make Six Sigma team members, regardless area s of expertise, in the right direction to carry out process improvement, and make employees equipped with capabilities of leadership and implementation of the project plan. Integration of Six Sigma system needs new management skills, so that Six Sigma is treated as a basic leadership skill and operation, and tools become an important foundation for building an excellent organization (Kumar & Verma, 2008). Full support is given to the Six Sigma in the aspects of finance, human resources, technology. CEO and the Champion have a 1-3 week education and training, which focuses on how to develop vision and strategy, how to manage change, and leadership, communication skills, etc. Black Belt has the most education and training which is at least 3 to 4 weeks. The contents of the training is mainly the operation of DMAIC approach, necessary use of statistical tools, as well as project management, communication and leadership, etc. Green Belt is responsible for its own work responsibilities, under the supervision of Black Belt, and chaired the small improved programs. The project-related training is about 3 to 6 days per month (Schroeder, Liedtke, & Choo, 2007).

Performance Evaluation

Snee (1999) believes that six sigma project action plan is a plan for improving specific issues and also with specific project objective indicators to monitor the progress of the project work. The main objective is to confirm the correctness of product attributes, as well as zero defects process management. Product attributes correctness is enough to meet customer needs, increase customer satisfaction and process management is closer to zero defects which eliminate the shortcomings, waste and repeated work, and take project management to increase capability of corporate profitability.

Johnson (2003) put emphasis on the result of business performance survey, conducted by enterprises within the promotion of Six Sigma, finds that companies 4 main performance results after promotion of Six Sigma with the percentage from high to low ordinary are cost reduction, profits increase, reduction of defect rate and shorten the time for work flow.

According to Karageorghis and Smyrlis (2006) on the performance benefits of the promotion of Six Sigma can be summed up the 6 main terms. They are reduction of defect rate, reduction of cost, increase of customer satisfaction, shortened time for work flow, increase profitability and performance growth. From this it is known that the performance is the degree of measuring corporate goals and it is closely related to the business competitiveness assessment. To sum up the above, the following research hypotheses to be proposed in this study:

H1: Top management's support and participation has a significant effect on the Six Sigma performance

H2: Employee participation has a significant effect on the Six Sigma performance

H3: Customer-oriented has a significant effect on the six sigma performance

H4: The choice of six sigma's tools has a significant effect on Six Sigma performance

H5: Education and training has a significant effect on Six Sigma performance

Research methods

This study has obtained the research data through a questionnaire survey. The questionnaire is designed mainly in four parts: the first part is the demand for the Six Sigma. It is aimed at understanding the evaluation of Six Sigma in companies and the benchmark considerations; the second part is the Six Sigma's critical success factors with reference of domestic and overseas literature. The third part is the performance of Six Sigma. The aim of this section is to understand the obtained performance of the company after implementation of the Six Sigma. The fourth part is the companies' basic information.

Sample of this study

This study is to explore the quality standards and operating performance of companies the company which implement Six Sigma. The target of the study is the related personnel involved in Six Sigma activities in companies. Questionnaires have been delivered to companies which has Six Sigma built into and filled in by employees who meet the requirements. Questionnaire was distributed from 10 April, 2008 to 18 May, 2008.

Descriptive statistical analysis

The target of this study is mainly the domestic companies which have implemented Six Sigma, so non-targeted questionnaire will be excluded. 250 questionnaires were distributed. A total of 223 questionnaires were received. Among them, 31 questionnaires are incompleting which regarded as invalid. A total of 192 questionnaires were valid and effective return rate is 76.8%.

The above information is summed up as: The majority of interviewees is male (62.5 %); year of work experience: less than 5 years (26.6 %); 11-15 years (29.7 %); The total number of employees: more than 2000 is the majority (51 %); Type of enterprises: machinery industry (27.6 %) and the semiconductor industry (25.5 %); Title to Green Belts is the majority (76.6 %); Implementation of Six Sigma for more than 4 years is the majority (56.8 %); "The motive for the company to implement Six Sigma is quality enhancement" is the majority (92.7 %); It is followed by improving the process capability (85.9 %): The next is reduction of cost (81.8 %) and fulfilling customers' needs (77.1 %). The last one is increasing

the business sales (54.2 %); the company promoting the Six Sigma methodology by themselves (43.2 %).

Questionnaires for investigating the need of Six Sigma

In this study, it is focused on the evaluation and planning for basic measurement and considerations for companies which implement Six Sigma. The following data of the valid sample is shown in details as table 1 below. Table 8 shows that the highest executive unit within company implementing Six Sigma. They believe that the highest executive units within the company to implement Six Sigma is CEO or general managers (46 persons, 9%).

Table 1 The highest executive unit within company promoting Six Sigma

Project	Number (person)	Percentage (%)
CEO or General Managers	90	46.9
Departmental executives	41	21.4
Company's planning staff	16	8.3
Quality Assurance Department	33	17.2
Manufacturing department	12	6.3

Table 2 shows the main motive for the company implementing Six Sigma. It shows the main motive for company to implement Six Sigma is demand for self-improvement which is 90.1 % of the total. It's followed by enhancing company's image which is 83.3 % of the total.

Table 2 The main motive for company to promote the Six Sigma

Project	Number (person)	Total (person)	Percentage (%)
The same industry has been promoted	26	192	13.5
Customer demand	95	192	49.5
Demand for self-improvement	173	192	90.1
Enhance the company's image	160	192	83.3

Table 3 shows the issues of concerned for the company to implement Six Sigma. It is followed by implementation costs which is 67.2 % and human resources workload which is 60.9 % of the total.

Table 3 Issues of concern for the company promoting Six Sigma

Items	Number (person)	Total (person)	Percentage (%)
Human resources' work load	117	192	60.9
The impact of organizational culture	57	192	29.7
Implementation costs	129	192	67.2
Insufficient learning ability of the staff	76	192	39.6
Acceptance of the staff	143	192	74.5
Unexpected performance	99	192	51.6
Identical with the existing quality activities	25	192	13

Table 4 shows the decision-maker for company to implement Six Sigma. It shows whether enterprises would implement the Six Sigma is decided by the business operator in the present which is 39.1 % of the total.

Table 5 shows operating budget for the implementation of Six Sigma's. It shows that the operating budgets for implementing Six Sigma on the curve is evenly distributed, of which 1-

3 million for the implementation of Six Sigma is the highest, 29.7% of the total.

Table 4 Decision-maker for the company implementing Six Sigma

Items	Number (person)	Percentage (%)
Business operator's personal decision	75	39.1
Department in-charge's decision	19	9.9
Planning staff's decision	34	17.7
Quality Assurance department's decision	43	22.4
Manufacturing department's decision	11	5.7
Administration department's decision	10	5.2

Table 5 Operating budget for company to promote Six Sigma

Items	Number (person)	Percentage (%)
Below 300,000	14	7.3
300,000 ~ 500,000	26	13.5
500,000 ~ 1 million	39	20.3
1 ~ 3 million	57	29.7
3 ~ 5 million	19	9.9
More than 5 million	37	19.3

Table 6 shows the timing for education and training. However, there is still 39.1 % which is willing to have training & education to be arranged in the working hours.

Table 6 Time for education and training

Items	Number (person)	Percentage (%)
Working hours	75	39.1
Both of working hours and non-working hours	113	58.9
Non-working hours	4	2.1

Table 7 shows the specific improvements for implementing Six Sigma. It shows that Six Sigma can best improve the item of reduction of product defect rate which is 90.6 % of the total. It is followed by items increasing customer satisfaction and shortening the process time with 77.6 % and 73.4 % of the total sample respectively.

Table 7 Six specific improvements for promoting Six Sigma

Items	Number (person)	Total (person)	Percentage (%)
Reduction of cost	116	192	60.4
Reduction of defect rate of product	174	192	90.6
Shorten the processing time	141	192	73.4
Increase profitability	97	192	50.5
Increase customer satisfaction	149	192	77.6
Increase market share	74	192	38.5
Performance growth	92	192	47.9
Enhance employee morale	38	192	19.8

Table 8 shows difficulties encountered by company implementing Six Sigma. It shows the most likely encountered difficulty is a lack of professional knowledge for the staff which is 83.3 % of the total. It is followed by poor cooperation of employees and cognitive bias of

senior executives which are 81.8 % and 79.7 % respectively. It is obvious that the most concerned is the expertise of staff, cooperation from employees and cognitive bias problem with the senior executives.

Table 8 Difficulties may be encountered by company promoting Six Sigma

Item	Number (person)	Total (person)	Percentage (%)
Without support from top management	92	192	47.9
Cognitive bias of senior executives	153	192	79.7
Poor staff quality	56	192	29.2
Poor cooperation of employees	157	192	81.8
Lack of professional knowledge for staff	160	192	83.3
Under budgeted	140	192	72.9
Too difficult, learning disabilities	65	192	33.9
Conflict with the existing activities	36	192	18.8
Affected by failure in the past	16	192	8.3
Shortage of manpower	102	192	53.1

Validity and reliability analysis

In this study, the items in the questionnaire is used from the proposed questions from the scholars in related literature. Ambiguous and inconsistent items have been modified or deleted. All the contents in the questionnaire are assessed and revised by 3 experts. Therefore, the questionnaire items in this study should have a good content validity. In this study, six critical success factors were verified by Cronbach's α value of verification scale reliability, the reliability analysis is summarized in the following table:

Reliability analysis for implementation of Six Sigma is shown in Table 9. The standard deviation of implementation dimensions of Cronbach's α value is 0.930, his son dimensions executives support and participation of Cronbach's α value of 0.843, employee involvement Cronbach's α value of 0.859, customer-oriented Cronbach's α value of 0.880, education and training Cronbach's α value of 0.788, and Six Sigma tools Cronbach's α value of 0.724. According to Nunnally's (1978) recommendations, α value above 0.7 is good. It is acceptable when it is between 0.7 to 0.6. If α coefficient is below 0.6, it should be considered to revise the scale, add or delete the items. In this study, the reliability of performance indicators is greater than 0.7. It represents that the questionnaire is up to a reliable standard.

It can be seen the reliability analysis from Table 10 at the standard deviation of the performance of the Cronbach's α is 0.732, which represents a high reliability.

The overall Cronbach's α value is 0.952, thus, reliability analysis for this study is $\alpha > 0.70$. The reliability of the questionnaire is high and the questionnaire is acceptable. It shows all questions in the six dimensions for companies implementing Six Sigma have a good consistency.

Table 9 A table of reliability Analysis for implementation of Six Sigma

Six Sigma Methodology				
Factor dimensions		Measure Project		
Support and participation of top management	1	Top management has a strong support and a clear commitment on the implementation of Six Sigma activities	0.836	
	2	Top management is personally involved in Six Sigma can help to establish good quality	0.801	
	3	Top management provides adequate resources and investment to carry out Six Sigma	0.815	0.843
	4	Top management forms the Six Sigma Committee to promote the Six Sigma	0.798	
	5	Top management support the project and understand the situation and promotes the project regularly	0.800	
6	Employees must understand how the operation of the Six Sigma is	0.810		
7	Employees must understand the benefits for company after the application of Six Sigma	0.834		
Participation of employees	8	Employees must have a supportive attitude towards Six Sigma	0.823	0.859
	9	Employees must understand the company's business goals	0.848	
	10	Employees must understand the relevance between the company's goals and their work	0.831	
Customer-oriented	11	Combination of company's goals and customer needs	0.856	
	12	Companies must have a clear understanding of customer needs	0.840	
	13	Effectively handling of customer grievances and abnormal issues of quality	0.863	0.880
	14	Based on the needs of customers, analyze and improve the process enthusiastically	0.865	
	15	To maintain interaction with the customer or market, in order to maintain customer satisfaction and loyalty	0.856	
	16	Combine customer needs, processes, information and innovation in the design of new processes for customers	0.872	
Education and training	17	Company conducts regular education and training	0.675	
	18	Company can provide training and assist all the department members for improvement	0.753	
	19	Project responsible person must complete the Six Sigma's core training courses	0.709	
Use of Six Sigma tools	20	Actually execute DMAIC steps	0.702	0.724
	21	Project participants must understand the basic concepts of various statistics and its usage	0.712	

Table 10 A table of reliability Analysis for Performance of Six Sigma

	Alpha If Item Deleted	Cronbach's α
Product defect rate is significantly lower	0.724	
Customer satisfaction has been improved significantly	0.654	
The processing time is shortened significantly	0.696	0.732
Reduce costs significantly	0.672	
Significant performance growth	0.641	
Operating profit is increased significantly	0.690	

Correlation analysis

In this study, Pearson correlation analysis issued and it is shown in the following table 11-13.

Table 11 The related coefficient of Six Sigma implementation method and performance of Six Sigma.

	Six Sigma implementation
Product defect rate is significantly lower	0.196
Customer satisfaction has been improved significantly	0.185
The processing time is shortened significantly	0.135
Reduce costs significantly	0.278
Significant performance growth	0.149
Operating profit is increased significantly	0.167

As shown on table 11, the correlation coefficient of Six Sigma implementation method and performance indicators is positive. It indicates that Six Sigma implementation method and Six Sigma performance indicators are positively related. Six Sigma implementation methods and reduction of time for workflow is more related correlation coefficient is .278; while Six Sigma implementation method and increase in operating profit is less related correlation coefficient 0.135. Therefore, the higher levels of the Six Sigma methodology, it will improve "reduction of product defect rate", "enhance customer satisfaction", "increase operating profit" "shorten the process time", " performance growth" and "cost reduction". Therefore, hypothesis H1 is supported in this study.

Table 12 The related coefficient of corporate decision making and Six Sigma performance

	Corporate decision
Product defect rate is significantly lower	0.207
Customer satisfaction has been improved significantly	0.305
The processing time is shortened significantly	0.257
Reduce costs significantly	0.387
Significant performance growth	0.322
Operating profit is increased significantly	0.426

As shown in table 12, the correlation coefficient of corporate decision-making and Six Sigma performance indicators are positive, indicating the corporate decision making is positively related to Six Sigma performance indicators. Corporate decision making and cost reduction is more related, correlation coefficient is 0.426; while the company decision-making and reduction of product defect rate is less related, correlation coefficient is 0.207. Therefore, the higher the level of corporate decision making, it will improve "reduction of product defect rate", "increase operating profit", "shorten process time", "performance

growth", "cost reduction" and "enhance customer satisfaction", so H2 hypothesis is supported in this study.

Table 13 The related coefficient of project management and Six Sigma performance

	Project management
Product defect rate is significantly lower	0.164
Customer satisfaction has been improved significantly	0.342
The processing time is shortened significantly	0.296
Reduce costs significantly	0.318
Significant performance growth	0.389
Operating profit is increased significantly	0.391

As shown in table 13 the correlation coefficient of project management and Six Sigma performance indicators are positive, indicating project management and Six Sigma performance indicators are positively related. Project management and cost reduction are more related, correlation coefficient is 0.391; and project management and reduction of product defect rate are less related, correlation coefficient is 0.164. Therefore, the higher the level of project management will make "reduction of product defect rate", "enhance customer satisfaction", "increase operating profit", "shorten process time", "performance growth" and "cost reduction" improved, so hypothesis H3 is supported in this study.

In addition, the Pearson correlation analysis of Six Sigma methodology of Six Sigma into the company decision-making and project management is shown in Table 14 indicating Six Sigma methodology into the company, decision-making and project management positive. These three dimensions to Six Sigma performance are positively related. Corporate decision making and Six Sigma performance are more related, the correlation coefficient is 0.463. Six Sigma implementation methods and Six Sigma performance are less related, the correlation coefficient is 0.264. Therefore, the higher the level of the Six Sigma methodology into the company decision-making and project management will improve "reduction of product defect rate", "enhance customer satisfaction", "increase operating profit", "shorten process time", "performance growth" and "cost reduction".

Table 14 The correlation analysis of Six Sigma implementation method, corporate decision-making and project management.

	Six Sigma implementation	corporate decision	project management	Six Sigma Performance
Six Sigma implementation	1			
corporate decision	0.587*	1		
project management	0.513*	0.708*	1	
Six Sigma Performance	0.264*	0.463*	0.451*	1

Multiple regression analysis

There is content validity and reliability testing in this study. After knowing that Six Sigma methods and Six Sigma performance are up to a certain degree of reliability and validity, it is followed by the testing of the relationship of company's implementation of Six Sigma's sub-dimensions and Six Sigma performance and to verify whether the assumptions to be supported. In this study, multiple regression analysis is used to test the impact of the Six Sigma implementation methods, corporate decision-making and project management on Six Sigma performance.

When multiple regression analysis is carried out in research study, Durbin-Watson value test model is used first to test if there is existence of self-related value. When the D-W value is close to 2, it indicates that the correlation coefficient is close to 0, the residual is non-self-related. And VIF test is used to test the variables whether there is linearity. If the variable's VIF value is greater than 10, indicating that there is co-linearity between the variable and other variables. Then the coefficient is determined by R2. F-test, significant level, and to analyze the value of β , determine the value of relatively standardized regression, and to know that the more independent variables have some influence on the dependent variables.

The impact of Six Sigma implementation model on Six Sigma performance

In this study, "top management' support and participation", "employee participation", "customer-oriented", "education training" and "use of Six Sigma tools". The Six Sigma implementation method is independent variables, while the "Six Sigma Performance "as the dependent variables. Results of regression analysis in Table 15 as follows:

Table 15 Regression Analysis of Six Sigma implementation

Hypothesis	Variable	β	t	Standard error	VIF
H1a	Support and participation of top management	0.381	3.436*	0.074	1.546
H1b	Participation of employees	0.295	2.983*	0.075	1.835
H1c	Customer-oriented	0.146	2.083*	0.070	2.401
H1d	Education and training	0.221	2.325*	0.131	2.415
H1e	Use of Six Sigma tools	0.173	1.728	0.171	1.809

$R^2 = 0.365$, Adj- $R^2 = 0.324$, $F = 11.513$, $P = 0.00$, $D-W = 1.968$

From the Table 15, in the Six Sigma implementation methods, $D-W = 1.968$ close to 2, indicating no self-related. VIF shows 1.546, 1.835, 2.401 and 1.809, respectively. The co-linearity problem is not serious. The overall coefficient of multiple determination: $R^2 = 0.365$, Adj- $R^2 = 0.324$, $F = 11.513$, $P = 0.00 < 0.05$ reach significant level. Top management's support and participation ($P < 0.05$, $\beta = 0.381$), shows that "top management's support and participation" has a positive impact on the Six Sigma Performance; employee participation ($P < 0.05$, $\beta = 0.295$), shows "employee participation" has a positive impact on the Six Sigma performance; customer-oriented ($P < 0.05$, $\beta = 0.146$), shows "customer-oriented" has a positive impact on performance for the Six Sigma ; education and training ($P < 0.05$, $\beta = 0.221$), displays "education and training" has a positive impact on the Six Sigma Performance; use of Six Sigma tools ($P > 0.05$, $\beta = 0.173$), shows "Six Sigma tools" no positive effect on the Six Sigma Performance. Therefore, H1, H2, H3 with H4 hypothesis are supported in this study, H5 "Six Sigma tools for use" is not supported. This study shows the higher level of Six Sigma methodology influences on the higher performance for the Six Sigma even higher level. Therefore, this study partially supports the hypothesis H1.

The standardized regression equation is as follows: Six Sigma performance = (0.381) * top management's support and participation + (0.295) * employee participation + (0.146) * Customer-oriented + (0.221) * education and training. -----(1)

Conclusions

Within Six Sigma implementation methods "top management's support and participation", "employee participation", "customer-oriented" and "education and training"

have significant effect on the Six Sigma performance; while, "use of Six Sigma tools" does not have a significant effect on performance. But the use of Six Sigma tools does not help to improve performance for Six Sigma. Maybe it is due to major companies with different operating background and structures, the implementation of Six Sigma program to adopt different management models and the use of tools (Goldstein, 2001). A result of this research is that using Six Sigma tools has obviously no impact on Six Sigma performance.

From this study it is found that Six Sigma implementation top management's methods an executive support and involvement, employee participation, customer-oriented education and training will help enhancing the performance of Six Sigma. Therefore, when leaders consider the promotion of Six Sigma, should properly understand the content of Six Sigma which is in line with the objectives of the reform the company, as well as organizational resources related issues. A leader's commitment and participation has significant influence on the Six Sigma activities and members' participation in the entire organization. As members of the Organization are universal are used to, custom application routine work patterns and methods, it is common for them to show resistant mentality for the newly implemented reform. Therefore, the leading Six Sigma team should cooperate and be guided by the Six Sigma Commissioner and to focus on the strategy the activities and the relevant education and training in order to achieve more effective.

The focus of implementation needs to face customers and listen to their voice and fully understand their needs, focus on the core processes for measurement, analyze, design or improve, and to ensure the continuous improvement of results, in order to achieve customer demand. Serving customers from the beginning to the end, and to collect information from the changing customers market demand improve continuously the customer satisfaction. For the Six Sigma education and training, companies must cultivate the internal lecturers, such as the professional Master Black Belt, so the study results of Six Sigma techniques can be strengthened and businesses also have the ability to extend Six Sigma techniques which is focused on the companies' structural and industrial properties. The Six Sigma technology will be suitable for enterprise's own culture and technology.

Contributions and recommendations for the research

Six sigma quality management system is used to reach the niche enterprise competition. In order to gain a competitive advantage, six sigma process must align with the business strategies and adopt statistical tools and process management, pursue the measurable targets in order to increase efficiency, productivity and reduce waste and process capability. It is a very difficult business reengineering for a company to promote Six Sigma successfully. If the company does not have a good foundation for the implementation strategy it will gradually lose the support and cooperation of staff within the company. Employees will also worry for the activities. In this way, it would be a failure.

To promote Six Sigma is definitely difficult. It needs to continue to bring forward the implementation to be successful. If it is given up, it will fail. Therefore, corporate leaders and the promoting group must show the determination to promote in the end. The recommendations for this study are as follows:

1. Corporate leaders must personally participate in decision-making Six Sigma implementation and education and training.
2. Must adopt top down approach in the promotion process, starting from the high-level management.
3. The company's organizational system, education and training, and project execution must be reviewed. Performance must be closely integrated with the rewards and punishments system.

For the customer-oriented, it is necessary to listen to the voice of customers and fully understand their needs, focus on the core processes for measurement, analyze, design or improve, and to ensure the continuous improvement of results, in order to achieve customer demand. Serving customers from the beginning to the end, and to collect information from the changing customers market demand improve continuously the customer satisfaction.

Education and training is an important factor for successful promotion of Six Sigma, especially the concept of Six Sigma and use of its tools are the most important. Staff must be educated and trained ongoing and in a long term, in order to demonstrate professional competence in utilizing the Six Sigma tools to achieve the expected performance. The recommendations for this study are as follows:

1. In the initial stage of promotion, experts are help to conduct education and training and counseling, but their own education and training system must be established in the long run.
2. Education and training emphases on practical, the training process must be of practice with the project.
3. Assessment system must be established for education and training, and keep track of the performance of education and training outcomes.

Prospects for future research

This study investigates mainly "Six Sigma implementation strategy and performance", which aims to explore and analyze the critical successful factors for Taiwan's industry for implementation of Six Sigma now, to focus on investigating the correlation of Six Sigma influence and its performance indicators, the effect of six factors and to understand the quality standards and operating performance of domestic enterprises in implementing Six Sigma practices. During the research process of this study, rigorous and integrity sought, it is still not comprehensive enough, but hopefully can provide a reference for the future research.

1. This study is limited by the subjective time, manpower, material and other constraints. It can only be focused on the sample of the domestic enterprises in the South of Taiwan; thus it may not fully represent the factors for all the enterprises to promote Six Sigma. It is recommended that future research should be focused on exploring the status of individual industries or expanding the scope of the study to both domestic and overseas companies. It may further understand the implementation strategy of Six Sigma.
2. It is recommended that companies which have been promoting the Six Sigma should continue to do that, because the more years it is promoted, the higher improvement performance will be shown.
3. Enterprises in implementing Six Sigma quality management system has been a trend. It is combined with the Balanced Scorecard, building the most beneficial corporate development strategies and management programs and should be the direction for future academic research.
4. This research study is mainly focused on the domestic enterprises, but not the foreign enterprises. Thus it is proposed that the follow-up study can be aimed at comparing the domestic and the foreign enterprises' situation of promoting Six Sigma.

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