

Investigating the Impact of Lean Six Sigma Tenets Implementation on Competitiveness

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ABSTRACT

Six sigma refers to one of the quality control tools used by many organizations for making the customers satisfied. This paper is aimed to investigate the impact of six sigma implementation on competitiveness of the companies placed at special economic region of Shiraz. Data was gathered using an interview – based approach. From the results, it becomes clear that there is a meaningful relationship between the use of six sigma and competitiveness. Moreover, educational degree affects the basics of sigma implementation.

KEY WORDS: Six sigma, competitiveness, quality management, effectiveness.

INTRODUCTION

As a modern quality management program, six sigma is used to evaluate the initial techniques of quality management (Clifford, 2001). By focusing on the view points of the customers, this is to say that six sigma aims to omit the factors by which the business errors are made (Antony & Fergusson, 2004:1028).

Apparently, six sigma seems be similar to the other theories of quality management, but it differs from all other quality systems. This is because six sigma regards quality improvement as the main factor by which speed is increased and expense is decreased (Sung & Park, 2003). Meanwhile, pioneer organizations accept six sigma in order to improve their quality. Such organizations believe that six sigma has changed their structures (Keller, 2005).

REVIEW OF LITERATURE

Six Sigma

Six sigma was initially used as an operational strategy, but today it is used by the world wide companies as a group comparative strategy. Even traditional companies, seeking tradition – directed managers, use six sigma as a method by which their market profits are increased (Hardy, 2000:62).

Schroder et al (2008) considered five main elements to define six sigma theories:

- 1- The management role in fulfilling processes such as appointing experts, recognizing project and facilitating program fulfillment (Gitlow and Levine, 2005).
- 2- Training or employing experienced experts at various six sigma levels in order to present different techniques proportional to six sigma (Pizdak, 2003).
- 3- Measurable efficiency of six sigma programs based on expense, quality and design (Keller, 2005).
- 4- Use of systematic method for fulfilling six sigma (Pizdak, 2003; Keller, 2005).
- 5- Choosing / classifying projects based on some criteria including loss and profit (Bannerols et al, 2005:555).

Although six sigma originates from the quality management, it differs with other programs (e.g. pure systems, ISO 9000, etc.) in terms of time framework, project structure and quality – based / measurable goals. In reality, there is a difference between six sigma and other process improvement programs (e.g. TQM, pure production and Baldrige's model) because it creates an organizational content and facilitates the way of problem solving (Dahlgard & Dahlgard Park, 2006:262).

It is believed that six sigma enables the organization to act better through changing its structure. Moreover, it helps the organization to be stable during the challenges created by new ideas (Schroeder et al, 2008: 538).

Some programs including total quality management, business processes engineering and six sigma emphasis on the improvement and increase of organizational processes ((Hardy & Schroder, 2000).

From knowledge management perspective, Chu et al (2007) developed a knowledge – based framework relative to the six sigma projects. Emphasizing on the resources of knowledge creation, they believe that it is possible to balance the effective elements of descriptive research method (techniques such as quality control) and research area (leadership, organizational culture and the role of researchers). Organizations can reach such balance by improving their ability on which the quality is preserved (Chu et al, 2007:438).

Six sigma enjoys various skills (e.g. focused training) in order to fulfill its basic needs (Lindeman et al, 2003: 195).

Theoretical six sigma basics include:

- The high manager's participation and responsibility
- business strategies based on the customer's request
- establishment of basic framework
- how the project is performed
- investment in basic resources
- investment in trainers and consultants
- reward and motivation process
- data analysis
- paying attention to short – and – long terms goals
- project conformity with the business strategy of company
- cooperation and communication
- use of six sigma tool
- Influence of trained subjects on the learning of green belt trainees (Yin chin Hue et al, 2006).

Competitiveness

Competitiveness is a comparative concept of the ability and performance of a firm, sub-sector or country to sell and supply goods and services in a given market (Porter, 1990). The term may also be applied to markets, where it is used to refer to the extent to which the market structure may be regarded as perfectly competitive. This usage has nothing to do with the extent to which individual firms are "competitive" (Stajano, 2009).

In his book "comparative advantage of the nations", Michel porter introduced Diamond model in competitiveness. He believes that competitiveness refers to the interaction between the following factors:

- 1- internal factors
- 2- interior demand conditions
- 3- supportive industries
- 4- strategy , structure and competition

Porter argues that the above mentioned factors have an influence on each other and when one factor changes, the other ones change too. Moreover, two external factors (I.e. government and unpredicted events) impact on these factors indirectly (Porter, 1990).

When examining competitiveness we should pay attention to the factors by which competitiveness is created. These factors include technology, organization and human resource among which human resource is of importance (Alavi & Maryam, 2005).

Firm Competitiveness

Empirical observation confirms that resources (capital, labor, technology) and talent tend to concentrate geographically (Easterly and Levine 2002). This result reflects the fact that firms are embedded in inter-firm relationships with networks of suppliers, buyers and even competitors that help them to gain competitive advantages in the sale of its products and services. While arms-length market relationships do provide these benefits, at times there are externalities that arise from linkages among firms in a geographic area or in a specific industry (textiles, leather goods, silicon chips) that cannot be captured or fostered by markets alone. The process of "clusterization," the creation of "value chains," or "industrial districts" are models that highlight the advantages of networks (Thompson, 2004).

Within capitalist economic systems, the drive of enterprises is to maintain and improve their own competitiveness, this practically pertains to business sectors. In recent years, the concept of competitiveness has emerged as a new paradigm in economic development. Competitiveness captures the awareness of both the limitations and challenges posed by global competition, at a time when effective government action is constrained by budgetary constraints and the private sector faces significant barriers to competing in domestic and international markets. The Global Competitiveness Report of the World Economic Forum defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country" (World Economic Forum, 2009-2010).

Research hypotheses

Main hypothesis

Six sigma's implementation has an influence on competitiveness.

Sub – hypotheses

*Sub – hypothesis*1: the high managers' responsibility and participation (X_1) affects on competitiveness.

Sub – hypothesis2: The quality of business strategies based on the clients' demand (x_2) affects on competitiveness.

Sub – hypothesis3: The establishment of six sigma framework (x_3) affects on competitiveness

Sub – hypothesis4: The way of project implementation (x_4) affects on competitiveness.

Sub – hypothesis5: Investment in basic resources (x_5) affects on competitiveness.

Sub – hypothesis6: Investment in trainers and consultant (x_6) affects on competitiveness

Sub – hypothesis7: Reward and motivation creation system (x_7) affects on competitiveness.

Sub – hypothesis8: Data analysis using available data (x_8) affects on competitiveness.

Sub – hypothesis9: Paying attention to the long – and – short term goals (x_9) affects on competitiveness.

Sub – hypothesis10: The knowledge management system affects on competitiveness.

Sub – hypothesis11: The balance between project and business strategy of company (x_{11}) affects on competitiveness.

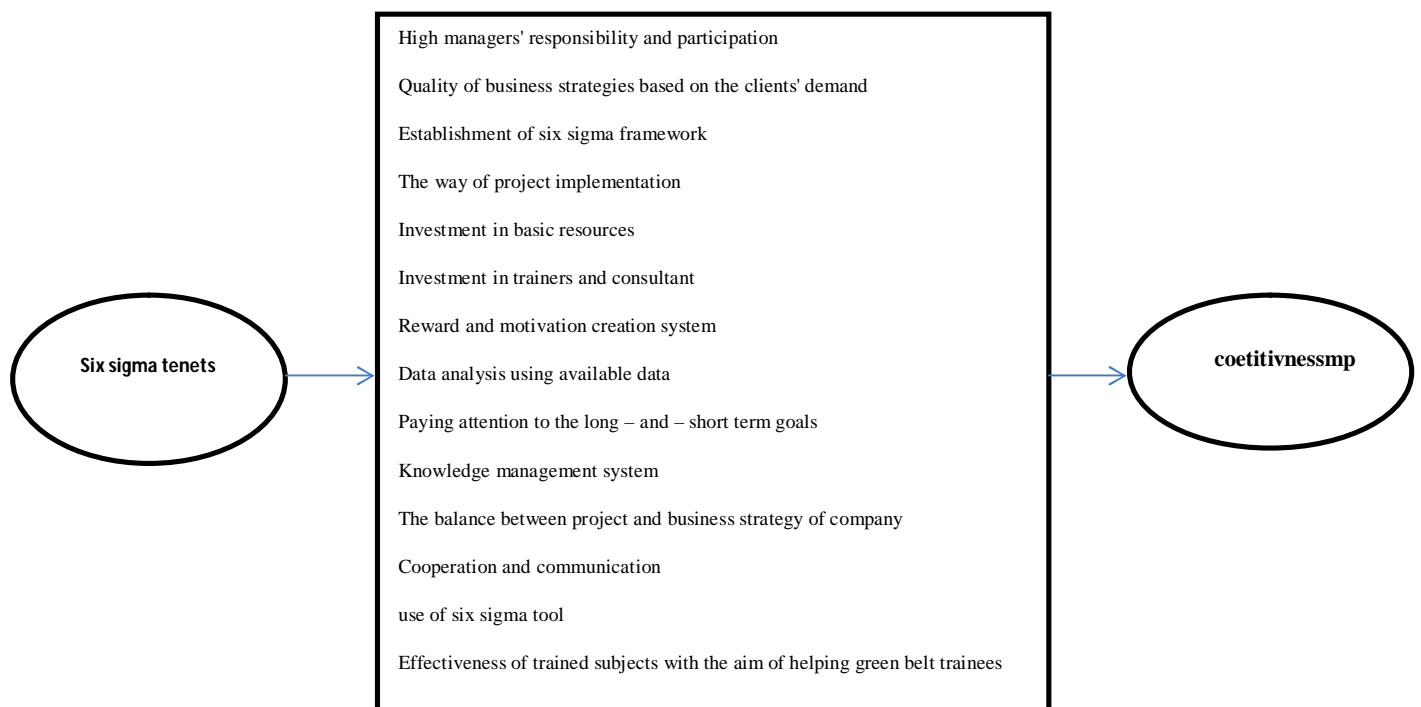
Sub – hypothesis12: cooperation and communication (x_{12}) affects on competitiveness.

Sub – hypothesis13: The use of six sigma tool (x_{13}) affects on competitiveness.

Sub – hypothesis14: Effectiveness of trained subjects with the aim of helping green belt trainees(x_{14}) affects on competitiveness.

Sub – hypothesis15: Educational degree (x_{15}) affects on the six sigma implementation.

Fig. 1: Research model



RESEARCH METHODOLOGY

In this study, six sigma implementation and competitiveness are regarded as the independent and dependent variables, respectively. This is a questionnaire – based study. The questionnaires used in this study include the six sigma's standard questionnaire of Arizona university(ssfd) which contains some questions for examining the basics of six sigma (Dan L. Shun, 2011) and a questionnaire designed by the researcher which examines some aspects including service quality , financial capability, reconstruction , technology, training and prediction capability of the organization. In this study, Liker's five – choice criterion was used. In order to examine the validity of the two questionnaires, the quality control managers of companies of industrial region of Shiraz were consulted. Moreover, Cronbach's α coefficient was used in order to determine the reliability of the study (Table. 1).

Table 1:Cronbach's α coefficient

variable	Cronbach's α
Six sigma	0.893
Competitiveness	0.788

Population includes all of the managers of companies placed at the specific economical region of Shiraz who have implemented six sigma processes. Since the population includes 60 persons, all of them were selected as the sample.

DATA ANALYSIS

Main hypothesis test

Implementing six sigma affects on competitiveness.

Table 2: Pearson correlation coefficient

Pearson correlation	0.218
Sig(2-tail)	0.006
N	60
P<0.05	

Due to the results of Pearson correlation test (table.2), there is a positive relationship between six sigma implementation and competitiveness (error level = %5).

Sub – hypotheses test

Table 3 illustrates the results of sub – hypotheses tests. Multiple regression tests have been used for answering these hypotheses.

Table 3: the results of multiple regression tests related to the relationship between six sigma implementation and competitiveness

model	Unstandardized Coefficients		Standardized Coefficients	t	Sig(2-tail) P<0.05
	B	Std. Error	Beta		
(Constants)	2.622	.299		8.770	0.000
X ₁	-0.195	0.911	-0.451	-1.64	0.110
X ₂	0.017	0.091	0.043	1.516	0.009
X ₃	0.144	0.078	0.344	1.851	0.072
X ₄	0.251	0.103	0.533	2.431	0.020
X ₅	-0.201	0.089	-0.464	-2.245	0.031
X ₆	0.017	0.097	0.032	0.171	0.865
X ₇	-0.099	0.140	-0.197	-0.707	0.484
X ₈	0.488	0.164	0.960	2.978	0.005
X ₉	-0.480	0.142	-0.741	-3.380	0.002
X ₁₀	0.399	0.119	0.663	3.359	0.002
X ₁₁	-0.321	0.152	-0.437	-2.112	0.042
X ₁₂	-0.020	0.130	-0.038	-0.157	0.876
X ₁₃	0.509	0.220	0.832	2.309	0.027
X ₁₄	-0.259	0.150	-0.372	-1.72	0.094

As depicted in table 3, competitiveness is not affected by some factors including participation of high managers, establishment of six sigma framework, investment in trainers and consultant, reward and motivation system, cooperation and communication, effectiveness of trained subjects and helping green belt trainees to learn because $p - \text{value} > 0/05$. Therefore, sub – hypothesis 1, 3, 6,7,12 and 14 are not confirmed.

Sub – hypothesis 2 test

Because $P - \text{Value} = 0.009 < 0.05$, coating of business strategy based on the customer demand affects on competitiveness. Although six sigma aims to increase the customers' satisfaction and profit, some of projects focus on industrial / service processes. Six sigma projects should be selected proportional to the organization's strategies and they should be supported by commercial objectives of organization.

Sub – hypothesis 4 test

Because $p - \text{value} = 0.020 < 0.05$ and reliability is %95, the way of project implementation affects on competitiveness.

In order to implement six sigma projects desirably, the managers should report the stages and results of the project exactly. They should review the related rules and present its time table.

Sub – hypothesis 5 test

Because $P - \text{value} = 0.031 < 0.05$, investment in basic resources affects indirectly on competitiveness ($r = \%95$). Companies who have performed six sigma project successfully and decreased their losses, believe that management participation in coordinating project operations, financial supports and planning should be considered in order to achieve the main goal. Otherwise, using six sigma causes relative expenses and losses to increase (Sneer, R.D, Hurl, R.W, 2003).

Sub – hypothesis 8 test

Since $P - \text{value} = 0.005 < 0.05$, analyzing data by use of available data affects on competitiveness. The reliability coefficient is %95.

Data play a key role in six sigma process. Moreover, data is simply analyzed and improves the six sigma performance. On the other hand, other methods should be used in order to prevent probable problems (Sneer, R.D. Hurl, R.w, 2003) when it is not possible to reach new data from data base.

Sub – hypothesis 9 test

Since $P - \text{value} = 0.002 < 0.05$ and $B = -0.480$, the long – and – short term objectives affect indirectly on competitiveness. When performing a project, the long – and – short term objective must be determined. The performance of each company would be changed by going to extremes. Moreover, the relationship between long – and –short term objectives and six sigma project is apparent when the company's objectives are incorrectly stated, the short term objectives are heavily emphasized and the long term objectives are not so emphasized (Lindeman, K, Schroeder, R. G, Zaheer, S. &Chou, A.s, 2003).

Sub – hypothesis 10 test

Because $P - \text{value} = 0.002 < 0.05$, the knowledge management system affects directly on competitiveness ($r = \%95$).

Knowledge management is the basic element of an organization by which comparative advantage is achieved. Knowledge management means "to recognize processes relative to knowledge achievement in order to increase comparative power".

In the modern word, achievement of stable comparative advantage is based on the quality improvement and customers' satisfaction. In so doing, it is necessary to use knowledge management in implementing six sigma projects (Nonaka. I. Konno, N, 1998).

Sub – hypothesis 11 test

Since $P - \text{value} = 0.042 < 0.05$ and $B = -0.321$, the balance between project and business strategy of company affects on competitiveness ($r = \%95$).

Evidences show that the companies whose strategic criteria was not clearly defined and those in which there was no balance between implemented six sigma projects and strategic goals , didn't achieve suitable output, because the employees were not encouraged to choose a project in proportion to the company's strategies (Lindeman, K, Schroeder, R.G, Zaheer, S., &Chou, A.S, 2003).

Sub – hypothesis 13 test

As seen in table 3, $p - \text{value} = 0.027 < 0.05$, therefore, this is to say that the use of six sigma tool affect s on competitiveness ($r = \%95$).

By using statistical instruments, six sigma describes performance of the process quantitatively. Therefore, we observe created changes including improvement of process and services presented by the organization (Antony, J, Fergusson C, 2004).

Sub – hypothesis 15 test

ANOVA test was used in order to examine sub – hypothesis 15.

Table 4 ANOVA test, the effect of educational degree on six sigma implementation

	Sum of squares	df	Mean squares	F	Sig(2-tail)
TR	0.59	1	0.445	1.026	0.047
Error	20.5.5	59	0.169		
Total	21.395	60			
P<0.05					

From the results, it becomes clear that educational degree affects on six sigma implementation. In order to determine the effectiveness level of educational degree on six sigma implementation, Duncan test was used.

Table 5: Duncan test

	N	Subset for Alfa=0.05
		1 2
Technician	10	3.447
M.Sc.	15	3.34
B.Sc.	32	3.31
PhD	3	3.25
Sig(2-tail)	0.037	0.0208
P<0.05		

Results show that there is a meaningful relationship between educational degree and six sigma implementation. Due to the results of Duncan test, the highest and lowest scores belonged to those whose educational degrees were associates of arts and PhD, respectively. This is to say that those having PhD degree didn't pay much attention to learning compared to the others.

Conclusion

The modern world has encouraged industrial and service organizations to compete with each other. Organizations whose products are in proportion to the society needs, created changes and customers' demands can succeed in such competitions.

Six sigma uses DMAIC improvement circle. Moreover, some management techniques, soft wares and statistical charts are used proportional to five – fold stages of this circle. Results show that with the help of such methods, problems are solved and six sigma projects are developed.

From the results, it becomes clear that six sigma can affect on the competitiveness of the organizations as a systematic and statistic process. It helps the organizations to reach a stable comparative advantage. "Appropriate choice" is one of the main factors having influence on six sigma projects. Choice of six sigma projects depends on organizations work identity.

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