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Study on Effective Factors in using Six Sigma Projects in Saipa Co.

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Abstract

The Six Sigma methodology has been established as a process oriented methodology with emphasis on outcome and effectiveness and seeks to improve the quality of the products, services, and processes. In our country, along with other countries, the industrial facilities and services have acted rapidly to exchange information with other organizations and industrial centers of the world with the high capability and implement it. This methodology has been used for one of the manufacturing companies "Shetabkar Co." that supplies the car parts for Irankhodro Co. This study is a case study on the implementation of Six Sigma projects in Shetabkar Co., which includes introduction, history, and definition of Six Sigma from experts' viewpoints about the Six Sigma quality and the role of the teams in the implementation of Six Sigma strategy and also a series of the research works that are relevant to this topic. Finally, 5 factors are selected as the effective factors in the implementation of Six Sigma and the relationship between these factors with the successful implementation of Six Sigma has consistency and validity due to the questionnaire and Kolmogorov-Smirnov test is applied and proven for the normality and the impact of each factor is individually analyzed and then a series of recommendations have been proposed for the successful implementation of Six Sigma projects.

Keywords: Quality Management, Six Sigma, Saipa Co.

Introduction

In today's economic environment, in order to achieve success, it is necessary that resources and raw material manufacturers and services completely consign optimization. We shall always be seeking the efficient and profitable solutions to produce products and services. The products and services should also take the improvement steps. This continuous improvement can be achieved by internal and external customer satisfaction for organizations, institutions, and companies. Customer satisfaction should be the main goal of every institution. In order to achieve high quality and manage the product quality to the desired direction, these changes and then their causes shall be identified. Although there are many changes, it is more logical to focus on the most important determining factors comprehensively in the organization to fix it. One of the parameters is σ that indicates the changes in the process, wherever its value is lower, it indicates the process is more uniform.

The topic of 6σ aims to reduce defects and reach maximum defect per million opportunity (DPMO) equal to 3.4, while 99.99966% of the healthy parts are produced under these conditions. The easy rapid access to information, products, and services has changed methodology and customers' mindset. Today's competitive environment has left no room for inaccuracy. We shall satisfy customers and tend the strict new ways to prevent mistake and retreat the expectations. This method is 6σ that refers to a part of our culture and achieve the total quality.

Query statement

Today, the productivity improvement is one of the main goals of organizations and institutions. Most organizations increase productivity and ultimately achieve competitive advantage

with sustainable survival in the global business arena, large part of their focus to resolve issues and weaknesses in the systems, and have processes with logical approach. The diversity and nature of issues and barriers force managers to use various tools to overcome obstacles. These tools ultimately improve the organization and its processes; however, their approach and focus are different. The organizations should have excellent understanding of their problems as well as the nature and methods of problem solving tools to select and use appropriate tools and create a continuous improvement in the effectiveness of these measures. Currently, many modern management methods, i.e. six sigma, 5s, Kaizen, etc. are evolved and developed to be used to improve productivity. For this purpose, one of the productivity improvement methods is Six Sigma.

In recent years, the topic of logic-based Six Sigma, C (Control), M (Measure), A (Analyze), I (Improve), D (Define) (=DMAIC) proposed one of the techniques and tools to improve quality engineering in the manufacturing industries with focus on customer needs defined and used in the public service organizations. Hereby this approach provides the appropriate local organizations with productivity in addition to the other methods (e.g. Kaizen). Six Sigma is a business approach that is multi-faceted and comprehensive to reach organizational excellence. If it is used rightly, it could play a crucial role. Although it seems that such process of statistical thinking are coordinated, but the fact is that the quality and excellence through the methodology identifies strengths and opportunities for improvement and establishment of a quality system towards zero defects and have actualized practical goals with six sigma quality level at 3.4 error per million. In Iran, the consulting and project implementation and management tools since mid 1991 and the manufacturing industry has grown. Since then, the different management modes and forms are encompassed (each with a specific purpose and blissful philosophy) in the management area in the framework of the implementation of the project. Without judging the outcome of this process, it will have serious consequences, and it is the key question that has preoccupied the minds, “Why management tools and systems in Iranian companies are expected to have no effect?” Despite the possible range of responses to a variety of reasons, our idea is that the main reasons for the lack of effectiveness of the implementation and deployment management tools is the neglect to rely on the success factor of these tools. In addition, the failure of these projects in Iran could be divided into two categories: “no real need to use these tools” as it the lacks integration in their use to express. The stimulus definition and use of methods and management tools in most cases qualifies the “real needs” to solve problems in the progressive organizations. Perhaps many Iranian organizations have new methods such as Six Sigma with experience as there is no paperwork and documenting on ISO 9000 quality system!

This trend has led the management tools at a very low level in the country and the lack of appropriate responses. As the efforts result to choose more tools! The surveyed companies Shetabkar also inevitably aims to achieve success and look for efficient and profitable solutions to manufacture and provide services with Six Sigma project, but unfortunately, according to the past researches by it could have not been successful, since there are no major factors associated with successful implementation of Six Sigma. Therefore, the implementation of Six Sigma due to these factors and the assessment of the relationship between them shall be under focus. In this study, a survey is conducted at the abovementioned manufacturing company and the statistical analyzes of the data obtained from the questionnaire distributed among the board of directors to examine the relationship between these factors and the literature within the key factors are identified and evaluated in this company.

1. Senior managers’ support,
2. Improvement of the needed infrastructure,
3. Improved decision-making methods,

4. Teamwork instruction,
5. Planning an appropriate monitoring system.

6σ Process:

In the current competitive conditions, the objective shall be the design and manufacture of those products, which have the least fluctuations in the production process with high characteristics of engineering and low gaps among the processes with six average standard deviations and even the average standard deviation of the changes and the technical average non-compliance, PPM = 0.002 in this mode as PPM = 3.4 will be the maximum nonconforming of most items.

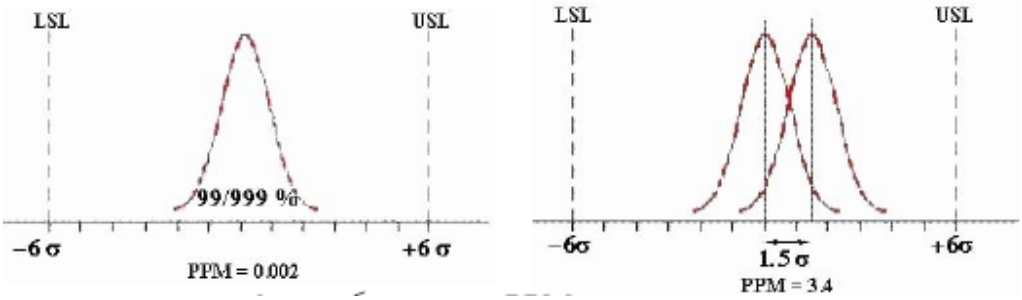


Figure 1: PPM variation of the mean deviation on 6σ

Six Sigma vs.Three Sigma

Table 1: Six Sigma vs.Three Sigma

6σ	3σ
-Expand the sale 5 percent on quality deficiencies. -reliance to process that can`t produce the crop deficiencies. -using of DMAIC and DMAIC methodology. -comparison the itself to best available in world and sampling them. -believe that is unacceptable 99 percent. -definite the external CTQ	Expand the sale of 15 to 25 percent on quality deficiencies. Quality -reliance on search methods for recognizance the deficiencies.— unused from collection regular method and data analyses. -comparison the itself with antagonist and sampling them. -believe that is good and enough 99 percent. -definite the internal CTQ (original specification)..

As mentioned earlier, Six Sigma process is a process with engineering characteristic (USL, LSL) in the same size of Six Sigma above and below the average. There are two ways to achieve this goal:

1) Increasing the gap between the engineering characteristics

2) Reducing the standard deviation of the process (fluctuations)

But, in practice, increasing the gap of the engineering characteristics has limits and the production process should be controlled to achieve Six Sigma. Therefore, in order to achieve this goal, we must first control the process and the average engineering process with average characteristics as this would reduce the deviations. 6σ as a means to reduce costs and increase quality results in lower final costs. In the past, it was thought that the quality enhancement has great costs and that this work resulted in an increase in cost of product. But we know now that the cost is not caused by the control tools, but also increases the costs. For example, duplication, products return, rapid distribution, storage, and loss of defective products, etc. can avoided and prevented.

The success of Six Sigma

The successful implementation of Six Sigma is based on the following concepts,

The substantial management commitment with top-down approach, as the employees must conduct actively during the management of the projects.

A measurement system for tracking and progress, as it gives a tangible impression on the organizational activities.

The internal and external benchmarking of products, services, and organizational processes, while this information is about the organization.

The real situation understanding on the market develops and leads to a very dramatic progress, as this experience leads to the philosophy of problem solving in the organization.

Training at all levels of the organization, as without the necessary training, individuals cannot fully understand and improve their attitude and philosophy.

Ultimate goals of Six Sigma:

Phase	Activity	Used quality tool	result
Phase of one (definition)	Identity the project, owner project –determined the needs projects- definition the problem and projects reference – definition the beneficiary – drawing the map process.	Prism project –analyses the beneficiary-process of total map-consumers call – dependence chart	Identity the importance project – booster, counselors- and leaders – type of process and amount of output process.
Phase second(weatherin g)	Appointment input and output project- implement defined functional, established the performance standards and codify sampling design and collective data	Plan and data collective forms-control, plenty , referencing Parto matrix , able process	Identity of problems process and dates pattern and process, present able,
Phase three(analyses)	Process sampling – establish casual and effect by using dates-process map analyses-appointment Rooty reasons of problems.	Correlation charts, casual and effect, control, plenty and flow, thought PARTO and rainfall	Identity of potential reasons, invest on reasons and how data change
phase fourth(improve ment)	Development solution-risk measures and solution success-signature solution and appointment of effects them and implement solution	Examination design-theory test, beneficiary analyses- thoughts rainfall section, consensus	Identity of solution-chooses scales and handicap to solution and implement.
phase fifth(control)	Appointment the necessary controls and sizing- controls implement - represent the revenue of implementing – end of project and send of information and its results	Process statistic control-control charts-implementing plans outside of control and changing in design in order to removing deficiencies	How make of standards in new methods-ways of supervision on process and process improve methods

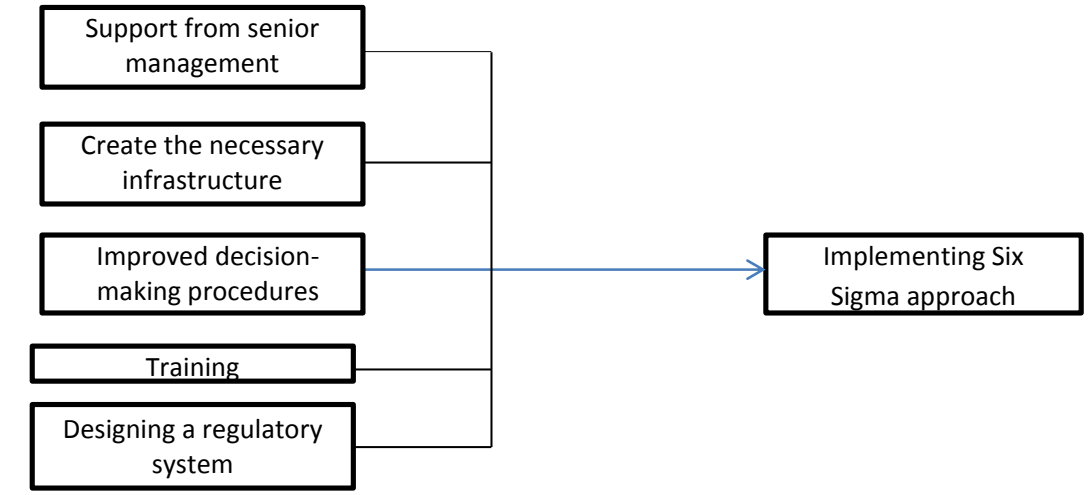
Six Sigma goals in the organization are very clear and emphasized:
Increased market share Strategic reduction of costs
Higher final profits

Six Sigma tactics

The fundamental objective of the Six Sigma methodology is the implementation of the strategy based on the performance measurement and the Six Sigma projects improvement to reduce the process variation. This is done using two Six Sigma sub-methods: DMAIC and DMADV.

Analytical research model

Every field research needs a research model in the framework of the appropriate analytical tools, variables, and relationships between them. According to the conceptual model of Kiwi and Compound, each variable has a concept with many dimensions, in each dimension has many features or components, and each component would be divided to a number of indicators, which are the last level of the conceptual qualification (variables).



Analytical methods

In this section, according to the questionnaires and their responses in Normality Kolmogorov-Smirnov test, the significance of hypothesis is assessed via Spearman's correlation coefficient, as in the following we explain about the statistical methods:

Data test distribution (fitness test)

Sometimes, we want to identify the distribution of the variables and examine whether the variable distribution is homogeneous or not by a particular theoretical distribution? For example, would the variable distribution be normal? Would the variable distribution be exponential? Would the variable distribution be uniform? Etc. . . . In these cases, the test data distribution (fitness test) that use mainly χ^2 and Kolmogorov-Smirnov test (KS).

Correlation analysis

The correlation analysis in the statistical tool determines a quantitative variable type and correlation degree with the other quantitative variables. The correlation coefficient is one of the criteria used in determining the correlation of the variable. The correlation coefficient shows the

intensity of the correlation (direct or inverse). This coefficient is between 1 and -1, if these do not have any relationship between two variables, it is equal to zero.

Spearman correlation coefficient

According to the ordinal and qualitative measurement of the variables, Spearman correlation test is used. Spearman correlation coefficient is calculated using the following equation.

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

d_i = rank difference between two corresponding features
n = number of ordered pairs in the sample

Fitness test (Normality measurement)

Sometimes, we want to identify the distribution of the variables and examine whether the variable distribution is homogeneous or not by a particular theoretical distribution? For example, would the variable distribution be normal? Would the variable distribution be exponential? Would the variable distribution be uniform? Etc. . . . In these cases, the test data distribution (fitness test) that use mainly χ^2 and Kolmogorov-Smirnov test (KS). Hereby we introduce and compare the advantages of $\chi^2$and KS test:

One advantage of KS test is that each observation is considered mainly, while χ^2 test classifies the observations and thus loses some information. Second, in some cases, where the number of observations (n) is small, KS test has higher accuracy and more appli χ^2 cable, while the χ^2 test is primarily used for the large samples. Third, KS test has more simplicity than χ^2 test. Now we count the benefits of χ^2 test: First, χ^2 test can be easily changed, so that estimation of the parameters by the observations can be possible, but KS test has not such flexibility. Second, χ^2 test can be used for both continuous and discrete data, while KS test can be applied for continuous data. In this section, Kolmogorov- Smirnov test was used to assess the normality of data and the following results indicate that the research findings are normal. In regard to to the following table, the reliability level 95% of all test questions is normal evaluated by Kolmogorov- Smirnov test.

Table 2: Normality assessment

Questionnaires question	Kolmogorov-Smirnov Z	Asymp. Sig. 2tailed	Questionnaires question	Kolmogorov-Smirnov Z	Asymp. Sig. 2tailed
1	2.942	0.000	13	2.290	0.000
2	2.678	0.000	14	2.286	0.000
3	2.231	0.000	15	2.573	0.000
4	4.268	0.000	16	2.244	0.000
5	2.030	0.000	17	2.63	0.000
6	2.508	0.000	18	2.454	0.000
7	2.204	0.000	19	3.081	0.000
8	2.762	0.000	20	2.151	0.000
9	2.280	0.000	21	2.325	0.000
10	2.75	0.000	22	2.188	0.000
11	4.287	0.000	23	3.001	0.000
12	3.018	0.000	24	2.567	0.000

Research hypotheses test

The hypotheses test relied on correlation approach (Spearman correlation coefficient). In the following, the hypotheses are motioned and then analyzed.

First hypothesis

There is a significant relationship between senior management support and implementation via the Six Sigma approach. There is no significant correlation between the two components.

$H_0 = \rho = 0$

There is a significant correlation between the two components.

$H_1 = \rho \neq 0$

Table 3: the simple and two- side correlation coefficient (2-tailed)

Senior management support	6-sigma dismount approach
0-652	(Spearman Correlation)
0-000	Meaningful level(Sig. 2-tailed)
56	Numbers(N)

In the table above, as the significance level is less than 0.05, hypothesis H0 is rejected and there is a correlation between these two variables and the correlation coefficient is 0.652 for 56 data. As a result, we can conclude that: There is a significant relationship between the senior management support and the implementation of the Six Sigma approach.

Second hypothesis:

There is a significant relationship between the required infrastructure and the implementation of the Six Sigma approach.

There is no significant correlation between the two components. $H_0 = \rho = 0$

There is a significant correlation between the two components. $H_1 = \rho \neq 0$

Table 4: the simple two-side correlation coefficient (two train)

Creation the necessary infrastructure	senior management support
(Spearman Correlation)	0-852
Significance Level (Sig. 2-tailed)	0-000
Numbers (N)	56

It can be seen in the table above, the significance level is less than 0.05, thus hypothesis H0 is rejected and there is a correlation between these two variables and the correlation coefficient is 0.652 for 56 data. As a result, we can conclude that:

There is a significant relationship between the required infrastructure and the implementation of the Six Sigma approach.

Third hypothesis:

There is a significant relationship between the improved decision-making and the implementation of the Six Sigma approach. There is no significant correlation between the two components. $H_0 = \rho = 0$ There is a significant correlation between the two components $H_1 = \rho \neq 0$

Table 5: the simple two- side correlation coefficient (2- tailed)

Improve the decision methods.	Support the senior managers
(coefficient Spearman Correlation)	0-76 meaningful level
Sig. (2-tailed)	0-000
Numbers (N)	56

It can be seen in the table above, the significance level is less than 0.05, as the hypothesis H0 is rejected and there is a correlation between these two variables and the correlation coefficient is 0.761 for 56 data. As a result, we can conclude that:
There is a significant relationship between the improved decision-making and the implementation of the Six Sigma approach.

Fourth hypothesis:

There is a significant relationship between the staff training and the implementation of the Six Sigma approach.

There is no significant correlation between the two components. $H_0 = \rho = 0$

There is a significant correlation between the two components. $H_1 = \rho \neq 0$

Table 6: the simple 2-side correlation coefficient (2-tailed)

Instruction the personnel	Support the senior managers
(coefficient Spearman Correlation)	0-522
Sig. (2-tailed)	0-000
Numbers (N)	56

It can be seen in the table above, the significance level is less than 0.05, as the hypothesis H0 is rejected and there is a correlation between these two variables and the correlation coefficient is 0.522 for 56 data. Therefore, we can conclude that there is a significant relationship between training the staff and the implementation the Six Sigma approach.

Fifth hypothesis:

There is a significant relationship between the appropriate monitoring system planning and implementation of the Six Sigma approach.

There is no significant correlation between the two components. $H_0 = \rho = 0$

There is a significant correlation between the two components. $H_1 = \rho \neq 0$

Table 7: the simple and 2-side correlation coefficient (2-tailed)

Counter of system the appropriate supervision system	Support the senior managers
(coefficient Spearman Correlation)	0-759
Sig. (2-tailed)	0-000
Numbers (N)	56

It can be seen in the table above, the significance level is less than 0.05, as the hypothesis H0 is rejected and there is a correlation between these two variables and the correlation coefficient is 0.759 for 56 data. Therefore, we can conclude that there is a significant relationship between the appropriate monitoring system planning and the implementation of the Six Sigma approach.

Prioritization of hypotheses based on Friedman test

Table 8: Prioritization

agent	Rank average
Improve the decision-making methods	2-67
Creation the necessaries infrastructure	2-69
Support the senior managers	2-65
Design the appropriate supervision system	1-69
personnel training	1-45

Conclusion

In regard of the fifth chapter of the thesis, the conclusions and proposals are discussed in this study, as the researcher has presented the results.

According to the performed activities, there is a summary of the research activities as follows.

The high costs and loss may forfeit excessive compensation for a company on the low-quality and low-cost product or services that in today's competitive world would lose the customers.

In order to provide quality products and provide good services to the customers in service organizations, the organizations make efforts to promote and surpass the competitors and capture a great division of the market with the accurate approaches aligned with customers' needs and in many cases predict their future needs.

According to the past studies on the research institutions, the Six Sigma approach has applied very good quality tools based on the project type. Hence, in order to increase the effectiveness of this method. In this study, the key effective factors in the implementation of the projects are identified flawlessly. The critical success factors are specially identified on selection and implementation of the Six Sigma processes that are important in the organizations and reduce the fluctuations that is the objective of the Six Sigma processes. In fact, it means the processes restructuring is focused today in the Six Sigma approach, therefore this issue is regarded central to succeed in The Six Sigma projects. In this study, Shetabkar Co. is selected and the literature is studied and finally the significant success factors are identified and evaluated in this company. For the effectiveness of the Six Sigma projects, these projects should be purposefully implemented. In order to achieve this goal, first it is necessary to select the projects properly and second, the implementation of the projects should have special attention to the key success factors. The neglect of the key success factors often causes the projects to have undesirable results and fail in some cases. Therefore, it is essential that these factors should be analyzed systematically.

In this regard, the identification and the prioritization of the critical success factors have particular attention to the type of organization (manufacturing/service-provider) and mindful focus on the activities to have effectiveness and efficiency in the Six Sigma projects, therefore this question is being answered in this study: Would many factors, such as senior management support, infrastructure requirements, decision-making procedures, successful training, and monitoring system planning for the implementation of the Six Sigma project be effective?

Also the statistical population was among the senior managers, managers, and experts of Shetabkar Co. who were 56 individuals to carry out the research. The statistical sample is defined based on the random sampling. In this study, the questionnaires are used to collect information. The questionnaire validity was examined by three experts and the improvements were made and Cronbach's alpha test was used to measure the reliability, in this sense, the used method in this study is descriptive survey.

The data analysis was performed by Kolmogorov-Smirnov (KS) to determine the effect or lack of effect of a variable on a certain phenomenon and for the same priority (ranking) of the ranking factors by using the Friedman test in this study.

Improved decision-making methods

According to the analysis, the improved decision making methods are the most important factors in the implementation of Six Sigma projects. The proper analysis of the long-term plans are based on the financial matters, the careful analysis of the domestic/foreign policies, and the projects definition in this regard, the decision making based on the facts, the organization of the innovation elements in the system to effectively improve the decision making methods.

Necessary infrastructures factor

According to the analysis, the necessary infrastructures factor is the second factor in the implementation of Six Sigma projects and it indicates that such changes in the attitude of the staff and the staff familiarity with the culture of Six Sigma, the resources allocation (human, hardware, software, etc), full-time occupation in projects, process management system for the proper defined relationship with the projects in the organizational units, customers' needs, addressing the teams' problems, the proper implementation of the projects, and the incentive programs contribute to the success of this factor.

Senior management support factor

According to the analysis, the senior management support factor support is the third factor in the implementation of Six Sigma projects that indicates the senior management support and their direct and active commitment, projects evaluation before commitment, projects prioritization based on the organizational strategy, and a summary of the projects are required to pursue the strategy of the Six Sigma projects, which are senior managers' tasks to be able to implement successful Six Sigma projects in the organizations.

Monitoring system planning factor

According to the analysis, the monitoring system planning factor is the fourth factor in the implementation of Six Sigma projects. The software and hardware systems control time, cost, and quality are used to implement systematically and assess the performance of the team members, properly identify the key variables that lead to added value to the effective planning monitoring system.

Training factor

According to the analysis, the training factor is the fifth factor is the implementation of Six Sigma projects and it indicates that the continuous training techniques and methods exist in Six Sigma projects for the staff and the project members, meanwhile the effective training and focusing on the quality of training are important and the stronger and more apt individuals are rated to participate in courses that contribute to the success of this factor.

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