

Identify the key Factors in the Implementation of Six Sigma Projects, Using Multi-Criteria (Including Case-Study)

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Abstract:

During the past decade, knowledge management, has made remarkable progress and completed, even as much as a new management theory. Can be seen, the quality of management, Managerial Revolution, a new way of thinking in terms of organization, a paradigm shift, a comprehensive approach to improve the overall performance of the organization, or framework, to manage the competition. Despite various attempts, the promoters of quality management knowledge, experience has shown that many organizations are not able to run, a quality management program, as successful. Six sigma as well as an approach to improving the quality, not the exception. Identify the key elements of Six Sigma, in order to create a comprehensive and flexible system for achieving, sustaining, and maximizing the success of the organization, that is, improving process performance, is it binding on the current situation. So far, extensive research on Six Sigma, performance, and many researchers have studied the application of Six Sigma, the extraction of the key factors in multi-criteria method, can be effective, to identify key factors in the success of Six Sigma. Results, it is shown that the outputs obtained using multivariate assessment, are effective in identifying key factors.

Keywords:

Six Sigma, Multi-Criteria Evaluation, Key Success Factors

1. Introduction

Since the first organization in 1987, used the approach of Six Sigma, and gained very good results so far, many organizations have introduced the use of Six Sigma methodology as a key determinant of success itself, however, is that many companies have also not been reached, the desired six sigma results. The experience of David Fitzpatrick (Head of Global Consultants in Lean Thinking), less than ten percent of companies have implemented Six Sigma, so that, in particular, affect the financial

balance and price of product, in a period specific time frame. These results are distinct, can implement Six Sigma, are a complex and intensive process, which will be key factors of the success of this process are identified. For effective implementation of Six Sigma projects, the organization should identify the critical factors for its success. Key factors for success are vital components, without which, the projects have little chance for success. Key elements are the factors that are essential for successful implementation of any kind of action, in order to improve the quality and design of the application development stage, these factors will be, as an incentive to those involved. Search Six Sigma literature shows that, in several studies conducted to identify and prioritize the CSFs, and various authors, have pointed to several factors (Cho, 2006; Nantalrak, 2008; Breyfogle, 2011, Pyzdek, 2003, Hahn, 2005; Anthony, 2006; Rostami, 2007; Satarifard, 2006; Krrary, 2006) Thus, the central question of the present study is that, what are the key factors in the implementation of six Sigma projects in organizations?

2. The Main Objectives of the Study, It Is Noted, As Follows

- Identify the key factors in the implementation of Six Sigma projects using multi-criteria methods in organizations
- Decision matrix is formed by experts and professionals
- Identify the key factors in the implementation of Six Sigma projects

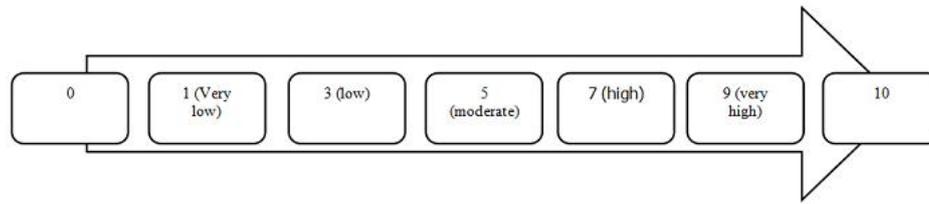
3. Foundations of research

Multi Criteria Decision Making is a multi-criteria evaluation method, which has many applications in various fields. Decision making is one of the most important management tasks, and one of the reasons for the success of some individuals and organizations are making good decisions. Hence, the necessity of scientific methods to help the man, in this context, it is quite sensible. This has led to the attention of researchers in recent decades, the multi-criteria model (MCDM), for complex decisions. The decision models, divided into two categories:

- a. model of multi-objective (MODM)
- b. Model of Multi-Attribute (MADM)

Model of Multi-Attribute (MADM), so that the multi-objective models, are used to design the model of multi-criteria are used to select the best option. Since the purpose of this study is to select the model of multi-criteria. In this problem, several options are analyzed, and in their case, a type of prioritization is done. As it is, the name of multiple attribute decision-making, there are several factors that the decision maker must define them carefully in their affairs. These indicators are discussed in connection with, any of the options. Therefore, a multi-criteria decision making, it is dealing with, the decision matrix. Typically, this type of decision can be formulated by the following Table 1.

It can be said, A_j , is showing the option i have, C_j , is showing the index I_j , and a_{ij} , represents the value of option i , j -th index. You can also describe the options selected by the two types of indicators: quantitative indicators and qualitative indicators, a general method of measuring a quantitative index, interval scale, is a scale-pole distance, as shown in the following figure:



This measure is based on an eleven-point scale, where zero is the highest, the lowest value is 10, and has the highest value. Also, the center also has a break point scale, between favorable and unfavorable. Third, the parameters of a decision matrix are associated with positive and negative indicators, together, in a matrix. It should be of no scaling, by which the values of different indicators, which, without dimensions, and additive. There are several ways to Scale buildings, some of which include: no scaling, using a soft, non-linear scaling. In the model, TOPSIS, no scaling software is used. Scale in the making, using, sharing, every element in the decision matrix, the sum of squares of the elements of each column. That is:

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^m a_{ij}^2}}$$

n_{ij} , is no scale value of item i , the index j . In this way, all the columns of the matrix, decision-making, will have the same length, and can compare them with each other easily. (Asgharpour, 2004) Model TOPSIS, is one of the best models of multi-criteria decision-making, and use a lot of it. In this method, a discrete multi-criteria analysis, m options are evaluated, with the index n , and the options are ranked based on the similarity to the ideal solution. By this technique is based on the notion that the choice should be a minimum distance from the positive ideal solution and the distance to the negative solution. Data collection methods of interviews and surveys will be used. Thus, the decision to form a matrix, and determining the Key Success Factors used in the interview, and to rank each factor used in the questionnaire. After collecting data, analyzing, and verifying hypotheses with statistical methods such as factor analysis, structural equation modeling, done.

Table 1. Matrix multi-criteria decision; Source, Momeni, 2006.

جدول ۱. ماتریس تصمیم‌گیری چند معیاره: ماخذ: مومنی، ۱۳۸۵.

شاخص‌ها گزیندها	C_1	C_2	...	C_j	...	C_n
A_1	a_{11}	a_{12}	...	a_{1j}	...	a_{1n}
A_2	a_{21}	a_{22}	...	a_{2j}	...	a_{2n}
⋮	⋮	⋮		⋮		⋮
A_i	a_{i1}	a_{i2}	...	a_{ij}	...	a_{in}
⋮	⋮	⋮		⋮		⋮
A_m	a_{m1}	a_{m2}	...	a_{mj}	...	a_{mn}

4. The Research Questions Were

The research questions posed in this study are as follows, as described, for testing hypothesis:

- Is the prioritization and selection of projects is one of the successful implementation of Six Sigma projects, which have been obtained, using a multi-criteria

- Do you have the link of Six Sigma, a client, a successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach?
- Can be, process management, and cultural changes, one of the successful implementation of Six Sigma projects, with using multiple criteria?
- Do you have the commitment and support of senior management, the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach?

Research methodology

The method of research is the development of applications and in some cases the field. Given the purpose of this study is to identify the key factors in the implementation of Six Sigma projects using multicriteria methods, population studies, has 160 company-driven projects (in Iran), which implements, the six Sigma process. Sample size is 36, the company, which was obtained using Morgan, who is selected randomly. Researchers to calculate sample size are turning to different methods; one of these techniques is the use of Morgan. In cases where the variance of the population, or the percentage required is not available, it can be used from this table, the estimated sample size. This table shows the maximum number of samples. To collect data, a questionnaire has been prepared, a Likert scale, in which 20 questions were considered and included responses never, rarely, sometimes, often, always, that the Thus, scores of 1 to 5 were considered. To verify the validity of the questionnaire has been placed in the hands of experts, and after revisions, the validity of the questionnaire was confirmed. To evaluate the reliability of the questionnaire, Cronbach Alpha test was used, which was based on data and calculations, respectively $\alpha=0.86$, since the amount that was greater than 0.7, the reliability of the questionnaire was confirmed.

5. A Review of Research History

Taghipour et al.[1], studied Risk analysis in the management of urban constructrelationship from the perspective of the employer and the contractor.

Haj Abukahaki et al.[2], studied Identificaion and prioritization of effective indicators on optimal implementation of customer relationship management in the insurance industry(including case study).

Mahboobi et al.[3], discussed Assessing Ergonomic Risk Factors Using Combined Data Envelopment Analysis and Conventional Methods for an Auto Parts Manufacturer. occupational injuries are currently a major contributor to job loss around the world.

Khalilpour et al.[4], studied The Impact of Accountant's Ethical Approaches on the Disclosure Quality of Corporate Social Responsibility Information an Islamic in Iran.

Mirzaie et al.[5], studied The Relationship Between Social Bearing Capacities with Conflict as a result, of the Perception of Visiting Historical Sites.

Taghipour et al.[6], studied A Survey of BPL Technology and Feasibility of Its Application in Iran (Gilan Province).

Seddigh Marvasti et al.[7], studied Assessing the Effect of the FRP System on Compressive and Shear Bending Strength of Concrete Elements.

Jalili et al.[8], studied Utopia is considered to be the physical form of an ideal human society where the goals are met.

Taghipour et al.[9], studied Insurance Performance Evaluation Using Bsc-Ahp Combined Technique.

Rezvani Befrouie A et al. [12], discussed the design of high-rise building with ecological approach in Iran (Alborz Province).

Taghipour et al.[10], studied The identification and prioritization of effective indices on optimal implementation of customer relationship management using TOPSIS, AHP methods.

Taghipour et al.[11], studied Investigated the Relationship between Competitive Strategies and Corporates Performance. Seismic Analysis (Non-Linear Static Analysis (Pushover) and Nonlinear Dynamic) on Cable-Stayed Bridge.

Taghipour & Moosavi.[12], studied A look at Gas Turbine Vibration Condition Monitoring in Region 3 of Gas Transmission Operation.

Rezvani Befrouie A et al. [13], discussed the design of high-rise building with ecological approach in Iran (Alborz Province).

Changiz Delivand et al.[14], studied Investigating the effective factors in measuring customers' credibility with a combined approach of data mining and multidisciplinary decision making.

Alamdar khoodaki et al.[15], studied Effect of integrated marketing communication on brand value with the role of agency's reputation .

Ghadamzan Jalali et al.[16], studied Explain the Relationship Between Intellectual Capital, Organizational Learning and Employee Performance of Parsian Bank Branches in Gilan province.

Mohammadi et al.[17], studied Investigating the role and impact of using ICT tools on evaluating the performance of service organizations.

Taghipour et al.[18], studied Investigating the Relationship between Competitive Strategies and Corporates Performance.

Taghipoor.[19], studied Identify the key Factors in the Implementation of Six Sigma Projects, Using Multi-Criteria.

6. Findings

Mentioned questionnaire composed of 20 questions, each of the research questions, in a sense, 5 items of the questionnaire, as shown in Table 2:

Table 2. Number of questions allocated to each of the questions of the questionnaire.

No assignment questions in the questionnaire	Concise titles research questions	Number of research questions
1-5	Is the prioritization and selection of projects, the successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach?	1
6-10	Whether it is Link Customer Six Sigma, one of the successful implementation of Six Sigma projects, which are obtained using the method of multiple criteria?	2
11-15	Can manage the process of cultural change, one of the successful implementation of Six Sigma projects, with using multiple criteria?	3

16-20	Do you have the commitment and support of senior management, the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach?	4
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The frequency of the respondents, the questions of the questionnaire is shown in Table 3. We can provide, outcomes, descriptive, for each of the five research questions.

Table 3: Relative frequency distribution of the respondents, the research questions

The percentage of research questions				Classes
Question Four	Question three	Question two	Question one	
12.14	11.89	13.08	9.62	Never
20.32	15.37	21.67	22.12	Rarely
34.78	35.43	31.21	38.54	In some cases,
23.65	29.74	28.65	22.98	Often
9.11	7.57	5.39	6.74	Always
100	100	100	100	Total

For example, the descriptive results related to the first research question, which is as follows:

Research Question One: Does the prioritization and selection of projects, the successful implementation of Six Sigma projects, which are obtained with using a multi-criteria approach?

9.62 percent of respondents, stated, content adaptation, never, 22.12 percent, rarely, sometimes, 38.54 percent, 22.98 percent more often, and 6.74 percent, ever.

According to Table 3, for the remainder of the research questions, the results can be expressed in the form of a cross.

7. Statistical Hypothesis

In this section, paid to the study of statistical hypotheses, that the hypothesis, the hypothesis will be tested. It is noteworthy that, according to the central limit theorem, the sample size $n = 36$, the following words shall comply with, the distribution of Z. In addition, due to the large sample ($n > 30$), can be used, the sample variance, rather population variance.

If $n > 30$

$$Z = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

Critical area, or the hypothesis H1, is as follows:

$$Z \geq Z_{1-\frac{\alpha}{2}}, \quad Z \leq Z_{\frac{\alpha}{2}}$$

Table 3. Test results Z, for each of the hypotheses.

Z-value	S standard error	\bar{x} mean	n: number of samples	Hypothesis
0.878	0.082	3.012	36	One
-2.24	0.187	2.93	36	Two
1.54	0.155	3.04	36	Three

-1.5	0.08	2.98	36	Four
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According to the results of Table 3, discussed the idea of the project:

Hypothesis One: prioritization and selection of projects is a key factor in the successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach.

H0: Does the prioritization and selection of projects, the successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach?

H1: H0 hypothesis is rejected

Value is calculated, 0.878, for Hypothesis 1, according to Z - test, and the corresponding results in Table 3 by taking $\alpha = 0.05$ and critical area, $Z \geq Z_{1-\frac{\alpha}{2}} = 1.96$ and $Z \leq Z_{\frac{\alpha}{2}} = -1.96$, the computed value is placed not in the critical region. Consequently, the hypothesis H0 is accepted and H1 is rejected.

Hypothesis two: Six sigma bonds, with customer is one of the factors in the successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach.

H0: Do you have the link of Six Sigma, with customer, the successful implementation of Six Sigma projects, which are obtained using a multi-criteria approach?

H1: Link Customer Six Sigma Six Sigma is one of the factors for successful implementation of projects that use a multi-criteria approach is obtained.

Value is calculated, -2.24, for Hypothesis 2, according to Z - test, and the corresponding results in Table 3 by taking $\alpha = 0.05$ and critical area, $Z \geq Z_{1-\frac{\alpha}{2}} = 1.96$ and $Z \leq Z_{\frac{\alpha}{2}} = -1.96$, the calculated value is, located in the critical region. Consequently, the hypothesis H0 is rejected and H1 is accepted.

Hypothesis Three: Managing the process of cultural change is one of the factors in the successful implementation of Six Sigma projects using multicriteria methods.

H0: Can it be, process management, and cultural changes, one of the factors in the successful implementation of Six Sigma projects, with using multiple criteria?

H1: Process management and cultural change can be one of the factors in the successful implementation of Six Sigma projects using multicriteria methods.

Value is calculated, 1.52, for Hypothesis 3, according to Z - test, and the corresponding results in Table 3 by taking $\alpha=0.05$ and critical area, $Z \geq Z_{1-\frac{\alpha}{2}} = 1.96$ and $Z \leq Z_{\frac{\alpha}{2}} = -1.96$, the computed value is placed not in the critical region. Consequently, the hypothesis H0 is accepted and H1 is rejected.

Hypothesis Four: senior management commitment and support, is one of the factors in the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach.

H0: the commitment and support of senior management, the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach?

H1: senior management commitment and support, is one of the factors in the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach?

Value is calculated, 0.878, for Hypothesis 1, according to Z - test, and the corresponding results in Table 3 by taking $\alpha = 0.05$ and critical area, $Z \geq Z_{1-\frac{\alpha}{2}} = 1.96$ and $Z \leq Z_{\frac{\alpha}{2}} = -1.96$, the computed value is placed not in the critical region. Consequently, the hypothesis H0, is accepted and H1 is rejected.

Value is calculated, -1.5, for Hypothesis 4, according to Z - test, and the corresponding results in Table 3 by taking $\alpha = 0.05$ and critical area, $Z \geq Z_{1-\frac{\alpha}{2}} = 1.96$ and $Z \leq Z_{\frac{\alpha}{2}} = -1.96$, the calculated value is, is not located in a critical area. Consequently, the hypothesis H0 is accepted and H1 is rejected.

8. Results

According to survey results, the analysis carried out, are as follows:

(1) the prioritization and selection of projects is one of the successful implementation of Six Sigma projects, which are obtained using multi-criteria methods.

(2) the commitment and support of senior management, is one of the successful implementation of Six Sigma projects, that is, the output of the multi-criteria approach.

(3) Process management and cultural change can be one of the successful implementation of Six Sigma projects using multicriteria methods.

(4) Six sigma bond with the customer is not a factor in the successful implementation of Six Sigma projects.

9. Conclusions

Today, to survive in the intense competition between manufacturing companies need is creativity and innovation. Among the most innovative methods of providing such a requirement, is Six Sigma methodology, which in recent years has been used by leading companies have developed, and then revealing the astonishing results of qualitative and quantitative results that, at present, is regarded by the scientific community and industrial world. The results showed that, the detailed project prioritization and selection of six sigma projects, at present, is the preferred one. As Six Sigma is a methodology based project, it is important to identify and prioritize projects that have the greatest financial benefit to the organization. Also, the selection of six sigma projects, should, in the first step toward possible alternatives, and then select the appropriate project. For this purpose, there are several scientific methods (MCDM methods such as AHP, etc.). They can be considered by customers as well as the target population, to assess the implementation of key elements of Six Sigma in an organization, and therefore, have to assess the implementation of these principles in the organization.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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