Management Science Letters 8 (2018) 885–890

Contents lists available at GrowingScience

Management Science Letters

homepage: www.GrowingScience.com/msl

Barriers of six sigma in healthcare organizations

Serkan Deniz[a*] and Mesut Çimen[b]

[a]*Yalova University, Termal Vocational School, Yalova, Turkey*
[b]*Acıbadem Mehmet Ali Aydınlar University, Faculty of Health Sciences, Department of Healthcare Management, İstanbul, Turkey*

C H R O N I C L E

Article history:
Received: April 27, 2018
Received in revised format: June 21, 2018
Accepted: June 21, 2018
Available online:
June 22, 2018

Keywords:
Six Sigma
Health
Healthcare organization

A B S T R A C T

Six Sigma approach is based on decreasing defects and variations in the products and processes, and it provides important benefits to healthcare organizations. This study aims to identify managers' opinions, who work in private healthcare organizations, about the reasons behind not using Six Sigma in their organizations. The research was performed between December 2016 and March 2018 in private healthcare organizations (private hospitals and medical centers) operating in Turkey and not using Six Sigma approach. Data were collected from managers, who have knowledge about Six Sigma, through using surveys. In this study, survey methodology was used to collect data. According to the results, the biggest barrier related to not using Six Sigma is based on the lack of knowledge about Six Sigma. The other important barrier about the diffusion of Six Sigma within this organizations is related to the lack of support from top management and leaders. Another finding about the reasons of not applying Six Sigma approach is that there is not a statistically significant difference among managers in terms of their managerial position. In order to overcome the lack of knowledge about Six Sigma, it is advised that managers should take steps in the direction of promoting Six Sigma within their current organization, and provide necessary support and leadership about the process.

1. Introduction

Six Sigma was first developed by Motorola Company during 1980s in order to gain competitive advantage against Japanese products and companies. As a result of implementing Six Sigma method, Motorola gained important benefits, and competitive advantage as well. Therefore, other companies also recognized the success of Motorola, and they started applying Six Sigma method (Bircan & Köse, 2012, p.108). American Express, Boeing, Citibank, Ford, General Electric DAF Trucks, Nokia, and Philips are some of the examples of these firms (Van den Heuvel et al., 2004, p.420). Today, most of the organizations constantly seek for new ways of increasing and maintaining their competitive advantage, and Six Sigma approach has been cited as an important method for this aim (Tlapa et al., 2016, p.927). Six Sigma approach is based on decreasing waste and increasing consumer satisfaction and profitability by designing, improving, and monitoring processes (Lloyd II & Holsenback, 2006, p.42). The main aim of Six Sigma approach is to reach perfect processes and products, which both satisfy consumer needs without any variation or bias. Six Sigma approach provides important returns to organizations, such as decreasing

* Corresponding author.
E-mail address: serkand100@gmail.com; serkan.deniz@yalova.edu.tr (S. Deniz)

doi: 10.5267/j.msl.2018.6.009

costs and error rates and increasing efficiency, market share, consumer satisfaction, and employee satisfaction (Atmaca & Girenes, 2009, p.124). Technically, Six Sigma means 3.4 defects per million opportunities (DPMO). The term sigma is used to emphasis the variation in the process (Reddy & Shammari, 2013, p.523). In order to determine the sigma level of the process, "Defects Per Million Opportunities (DPMO)" is calculated. Sigma conversion table is used to determine the sigma level of the calculated value. A summary of a sigma conversion table is given in Table 1. It can be seen that as the sigma level increases, the number of defects decreases. For instance, in four sigma level, defects per million opportunities are 6,210, whereas it is 3.4 for Six Sigma level (Kansoy & Dirgar, 2008, p.19). As it is noted earlier, the higher sigma level, the lower level of defects (Morgan & Cooper, 2004, p.29). Moreover, the process yield in Six Sigma level is 99.99966% (Linderman et al., 2003, p.194).

Table 1
Summary of Six Sigma Conversion Table

Sigma Level	Defects Per Million Opportunities (DPMO)
6	3.4
5	233
4	6,210
3	66,807
2	308,538
1	691,462

Source: Fursule et al., 2012, p.3.

In Six Sigma approach, two main methodologies are used. First is called as DMAIC process (Define, Measure, Analyze, Improve, and Control). DMAIC process is used to perform certain improvements in the process. The purpose of define phase is to clearly identify the process. In this stage, problems related to the product or service, and critical quality characteristics, which are important for customers, are identified. In measurement phase, both desired and unacceptable performance indicators related to the product and process are identified, and then the current performance is evaluated by collecting data. In analyze phase, the root causes of the problems are identified, and analyzed. In the improve phase, defects are aimed to be decreased, and certain improvements are aimed to be introduced by using statistical methods. Finally, in control phase, the main aim is to monitor and maintain the solutions and improvements developed (Antony & Banuelas, 2002, p.21). Second methodology is called as DFSS methodology (Design For Six Sigma). This methodology is used when new processes are demanded or designing new processes when the existing processes are incapable to accomplish business goals (Aboelmaged, 2011, p.520). Individuals participating in Six Sigma have different roles and responsibilities, depending on their training and experience. These different roles and responsibilities are represented in Champions, Master Black Belts (MBB), Black Belts, and Green belts. Specifically, the job of Champions is to provide the resources required, and to lead the teams in order to correctly ensure that the right projects are being identified and executed. Master Black Belts focus on project choice and project identification, and thus, they work closely with the champions. Moreover, MBBs are also engaged in training both Black Belts and other MBBs. Black Belts provide support to the implementation of Six Sigma projects, and they identify new projects. Green belts support the teams participating in Six Sigma projects or take the lead in smaller Six Sigma projects (Montgomery & Woodall, 2008, p.332-333).

Even though Six Sigma is mostly used in production industry, it has been started to be used widely in the service sector since the late 1990s. When the healthcare organizations had first started to apply Six Sigma, they had some doubts about whether or not they could obtain significant achievements as the organizations in manufacturing sector did. However, there are various studies, which show that Six Sigma provides significant benefits to the healthcare organizations (Galganski & Thompson, 2008, p.135). Many healthcare organizations developed Six Sigma projects, and they achieved important savings and gains by using Six Sigma projects. Healthcare organizations such as Charleston Area Medical Center, Virtual Health, Scottsdale Healthcare, Stanford Hospital and Clinics can be given as significant examples

(Trusko et al., 2007, p.46). Six Sigma provides substantial benefits to healthcare organizations, including decreased variation in the processes, determining patient priorities, invoicing process, medical applications, and enhanced use of technology among employees (Lloyd II & Holsenback, 2006, p.42). However, it is important to note that there are unsuccessful examples of Six Sigma application within healthcare organizations as well. Lack of finance, human resource, time, leadership, education, process, and existence of internal resistance are some of the important reasons behind the failure of Six Sigma (Taner et al., 2007, p.339). This study aims to identify managers' opinions, who work in private healthcare organizations, about the reasons behind not using Six Sigma in their organizations.

2. Material and Methods

The research was performed between December 2016 and March 2018 in private healthcare organizations (private hospitals and medical centers) operating in Turkey and not using Six Sigma method. Data were collected from managers, who had knowledge about Six Sigma, through using surveys. In this study, survey methodology was used to collect data. First, 107 survey forms were collected; however, two survey forms, in which the question of "Do you have any knowledge about Six Sigma?" was replied as "No" by the participants, were excluded. In total, 105 survey forms were used in the analyses. The survey form used in the study has two parts. The first part is based on participant demographics, and the second part is based on identifying the reasons behind not applying Six Sigma. In development of the items in second part, studies of Raghunath & Jayathirtha (2013) and Psomas (2016) were used. Statements in the survey are measured through using 5-point Likert Scale, and the items are as follows: Totally Disagree, Disagree, Partially Agree, Agree, and Totally Agree. In the analysis, descriptive statistics were calculated. In the second part of the analysis, in order to determine the construct validity of the scale, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used. In addition, fit indices were also calculated. Cronbach's Alpha coefficient was calculated in order to determine the reliability of the scale used. According to Kolmogorov-Smirnov test, it was found that the data are normally distributed ($p>0.05$). In order to compare different levels of management, in terms of their opinions about not using Six Sigma, One-Way ANOVA test was used. %95 confidence interval and %5 significance level were used to evaluate the findings.

3. Results

105 people have participated in the study, and 66 (62.9%) of them are female, and 39 (37.1%) of them are male. The age distribution of the participants are as follows: 31 of the participants (29.5%) are between 25-30 years, 36 of them (34.3%) are between 31-35 years, 22 of them (21%) are between 36-40 years, and 16 of them (15.2%) are 41 years or older. Education level of the participants are as follows: 7 of them have (6.7%) high school degree, 10 of them have (9.5%) two-years degree, 48 of them (45.7%) have undergraduate degree, and 40 of them (38.1%) have graduate degree. 22 of the participants (21%) are top managers, 32 of them (30.5%) are middle level managers, and 51 of them (48.6%) are first level managers. Lastly, when the tenures of the participants are examined, it is found that 25 of the participants (23.8%) have 1-3 years of experience, 31 of them (29.5%) have 4-6 years of experience, 22 of them (21%) have 7-9 years of experience, and 27 of them (25.7%) have 10 or more years of experience.

Table 2
Exploratory Factor Analysis of Barriers of Six Sigma

Items	Factor Loading
BSS6. There is an ongoing belief in our organization that Six Sigma applications are complex.	0.84
BSS4. We don't have sufficient knowledge about Six Sigma approach.	0.73
BSS3. Top management or leader support to Six Sigma method is not sufficient.	0.73
BSS5. We have barriers related to organizational culture.	0.63
BSS1. Six Sigma applications take long time, and we don't have enough time for that.	0.52
BSS2. Our employees show resistance to change.	0.47

*BSS: Barriers of Six Sigma

In order to determine the appropriateness of the scale for factor analysis, KMO and Bartlett's Test of Sphericity were performed. KMO value was found to be 0.73, and Bartlett's Test of Sphericity was found to be statistically significant ($p<0.01$). According to these results, data used in the study are appropriate for factor analysis, and there is a high relation among the variables. The results of the Exploratory Factor Analysis are given in Table 2. Statements in the factor analysis were grouped under a single factor, which involves six statements, and it explains 44.51% of the total variance.

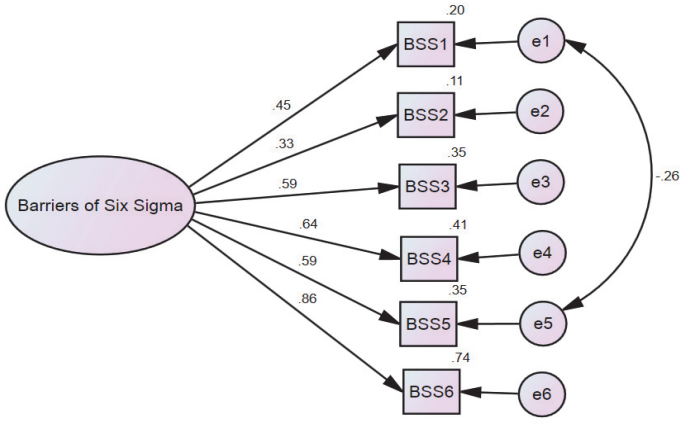

Fig. 1. Confirmatory Factor Analysis of Barriers of Six Sigma

In order to test whether the single factor-six statements structure of the scale is confirmed or not, Confirmatory Factor Analysis was performed. According to the results, fit indices and robustness of the model are examined. After the assessment of the model, it was decided to perform a modification, and modification suggestions were evaluated. As a result, modifications were done according to the recommendations made. The model obtained is presented in Fig. 1. According to the Fig. 1, it is determined that the scale is composed of six statements. In addition, the fit indices are found to be as CMIN/df=1.38, GFI=0.97, AGFI=0.91, NFI=0.93, IFI=0.98, TLI=0.96, CFI=0.98, RMSEA=0.06. Accordingly, it is concluded that the data gathered in the study correspond to the single-factor structure of the scale. In addition, Cronbach Alpha coefficient was found to be as 0.74. Thus, it was concluded that the scale has higher internal consistency and reliability.

Table 3
Comparison of Managers' Opinions about not using Six Sigma

Statements	Top Managers n=22		Middle Level Managers		First Level Managers		General n=105		
	M	SD	M	SD	M	SD	M	SD	
BSS1- Six Sigma applications take long time, and we don't have enough time for that.	3.05	1.21	2.91	0.93	3.16	1.05	3.06	1.05	*F= 0.56 p= 0.57*
BSS2- Our employees show resistance to change.	3.05	0.95	3.09	0.86	2.94	0.83	3.01	0.86	*F= 0.33 p= 0.72*
BSS3- Top management or leader support to Six Sigma method is not sufficient.	3.14	1.08	3.47	0.88	3.12	0.99	3.23	0.98	*F= 1.39 p= 0.25*
BSS4- We don't have sufficient knowledge about Six Sigma approach.	3.23	1.23	3.63	0.75	3.06	1.17	3.27	1.09	*F= 2.74 p= 0.07*
BSS5- We have barriers related to organizational culture.	2.36	0.79	2.63	1.01	2.61	0.85	2.56	0.89	*F= 0.69 p= 0.50*
BSS6- There is an ongoing belief in our organization that Six Sigma applications are complex.	3.23	1.11	3.31	0.90	3.12	0.93	3.20	0.95	*F= 0.42 p= 0.66*

**M= Mean, SD= Std. Deviation*

In Table 3, opinions of managers from different levels about not using Six Sigma are compared. When the table is examined, it is found that there is not a statistically significant difference among managers, depending on their managerial position, in terms of their opinions about not using Six Sigma approach ($p>0.05$).

4. Discussion and Conclusion

According to the results, it is found that there is not a statistically significant variation among managers, depending on their managerial position, in terms of their opinions about not using Six Sigma in their organizations. However, when a more detailed analysis is performed, it was seen that, for top managers, the biggest Six Sigma barriers are based on lack of sufficient knowledge about Six Sigma, and belief related to the complexity of Six Sigma. For middle level managers, the biggest Six Sigma barrier is related to lack of sufficient knowledge about Six Sigma. For first level managers, the biggest Six Sigma barrier is based on not having enough time for Six Sigma projects, which take considerably long time. In general, according to the managers from all levels, the biggest Six Sigma barrier is related to lack of sufficient knowledge about Six Sigma. Similarly, Deniz (2015), in his study performed in private hospitals in Turkey, also founded that lack of sufficient knowledge about Six Sigma is the biggest Six Sigma barrier. Moreover, other studies performed in different sectors also support this finding (Aboelmaged, 2011, p.529; Kumar et al., 2009, p.629). Lack of knowledge about the methodology, process, and implementation creates an important barrier for Six Sigma application. In addition, having lack of knowledge about statistical tools also creates a barrier for Six Sigma. In order to obtain successful results, these barriers must be eliminated. The most important finding in this study is the lack of top management support or leader support. Conclusions of Antony et al. (2005, p.869) correspond with this claim as well. Participation of top management and leaders is crucial for the success of Six Sigma (Tlapa et al., 2016, p.929). Any Six Sigma project without the support of top management or leader cannot achieve success at the end because top management plays a key role both in providing the necessary resources, and in ensuring employee participation. According to the findings of this study, the least significant Six Sigma barrier is related to corporate culture. In Turkey, both private and public healthcare organizations devote important budgets to quality improvement and accreditation projects. Thus, most of the organizations have already established an organization culture, which involves quality improvement and accreditation practices.

It is widely known that Six Sigma approach offers important benefits to healthcare organizations. For instance, it is argued that Six Sigma may provide important solutions to meeting patient expectations, gaining competitive advantage, dealing with financial problems, and utilizing opportunities. Therefore, relying on an academic approach, courses involving Six Sigma approach must be included in the university curriculum in order to overcome lack of knowledge about Six Sigma approach. Moreover, it is also recommended that healthcare organization, universities, and trade/professional associations should collaborate with each other in order to increase knowledge of Six Sigma and reduce the lack of knowledge about the issue. Top management and leaders also have important roles as well. They should initiate and encourage Six Sigma approach within their organizations, and give necessary support to Six Sigma, as they give to quality improvement practices. The biggest limitation of this study is based on its limited sample size; nonetheless this study still has significance in terms of emphasizing the barriers related to Six Sigma approach within healthcare organizations. It is recommended that future studies related to the issue should involve larger samples.

References

Aboelmaged, M. (2011). Reconstructing Six Sigma barriers in manufacturing and service organizations: The effects of organizational parameters. *International Journal of Quality & Reliability Management*, *28*(5), 519-541.

Antony, J., & Banuelas, R. (2002). Key ingredients for the effective implementation of Six Sigma program. *Measuring business excellence*, *6*(4), 20-27.

Antony, J., Kumar, M., & Madu, C. N. (2005). Six sigma in small-and medium-sized UK manufacturing enterprises: Some empirical observations. *International Journal of Quality & Reliability Management*, *22*(8), 860-874.

Atmaca, E. & Girenes, S.Ş. (2009). Literatur Survey: Six Sigma Methodology. *Suleyman Demirel University The Journal of Faculty of Economics and Administrative Sciences, 14*(3)*,* 111-126.

Bircan, H. & Köse, S. (2012). Six Sigma and Companies' Attitude towards Six Sigma: A Study in Kayseri-Sivas Region. *The International Journal of Economic and Social Research, 8*(*2,8*)*,* 107-129.

Deniz, S. (2015). *Reasons Given by Hospital Managers for Non-Utilization of Six Sigma in Private Hospitals: A Case Study in İstanbul.* Doctorate Dissertation. İstanbul: Halic University, Institute of Social Sciences.

Fursule, N.V., Bansod, S.V. & Fursule, S.N. (2012). Understanding the Benefits and Limitations of Six Sigma Methodology. *International Journal of Scientific and Research Publications, 2*(1)*,* 1-9.

Galganski, C.J. & Thompson, J.M. (2008). Six Sigma: An Overview and Hospital Library Experience. *Journal of Hospital Librarianship, 8*(2)*,* 133-144.

Kansoy, O. & Dirgar, E. (2008). What is Six Sigma? *e-Journal of New World Sciences Academy, 4(*1)*,* 14-23.

Kumar, M., Antony, J. & Douglas, A. (2009). Does Size Matter for Six Sigma Implementation? Findings from the Survey in UK SMEs. *The TQM Journal, 21*(*6*)*,* 623-635.

Linderman, K., Schroeder, R.G., Zaheer, S. & Choo, A.S. (2003). Six Sigma: A Goal-Theoretic Perspective. *Journal of Operations Management, 21,* 193-203.

Lloyd II, D.H. & Holsenback, J.E. (2006). The Use of Six Sigma in Health Care Operations: Application and Opportunity. *Academy of Health Care Management Journal (AHCMJ), 2,* 41-49.

Montgomery, D.C. & Woodall, W.H. (2008). An Overview of Six Sigma. *International Statistical Review, 76*(3)*,* 329-346.

Morgan, S.P. & Cooper, C. (2004). Shoulder work intensity with six sigma. *Nursing Management, 35*(3)*,* 29-32.

Psomas, E. (2016). The underlying factorial structure and significance of the six sigma difficulties and critical success factors: The Greek Case. *The TQM Journal, 28*(4)*,* 530-546.

Raghunath, A. & Jayathirtha, R.V. (2013). Barriers for Implementation of Six Sigma By Small and Medium Enterprises. *International Journal of Advancements in Research & Technology, 2*(*2*)*,* 1-7.

Reddy, L.K.V. & Shammari, F.A. (2013). Six sigma approach on discharge process turnaround time in King Khalid Hospital, Hail, Saudi Arabia. *Australian Journal of Basic and Applied Sciences, 7*(14)*,* 523-533.

Taner, M.T., Sezen, B. & Antony, J. (2007). An overview of six sigma applications in healthcare industry. *International Journal of Health Care Quality Assurance, 20*(4)*,* 329-340.

Tlapa, D., Limon, J., García-Alcaraz, J.L., Baez, Y. & Sánchez, C. (2016). Six sigma enablers in Mexican manufacturing companies: A proposed model. *Industrial Management & Data Systems, 116*(5)*,* 926-959.

Trusko, B.E., Pexton, C., Harrington, H.J. & Gupta, P. (2007). *Improving Healthcare Quality and Cost With Six Sigma,* New Jersey, USA: FT Press.

Van den Heuvel, J.V.D., Does, R.J.M.M. & Vermaat, M.B.T. (2004). Six Sigma in a Dutch Hospital: Does It Work in the Nursing Department? *Quality and Reliability Engineering International, 20,* 419-426.