A Feasibility Study for Six Sigma Implementation in Turkish Textile SMEs

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Abstract:

This paper aims to investigate the Critical Success Factors (CSFs) for the successful introduction of Six Sigma in Small and Medium Sized Turkish Textile Enterprises. A survey-based approach is used in order to identify and understand the current quality practices of Small and Medium Sized Enterprises (SMEs). CSFs and impeding factors are identified and analyzed. The involvement and commitment of top management, linking quality initiatives to employee and information technology and innovation are found to be important CSFs for textile SMEs. The leadership and commitment of top management, strategic vision, and data collection and measurement, are found to be the most CSFs for the successful introduction of Six Sigma, whereas the lack of knowledge of the system to start the initiative and the presence of ISO-certification in the company are found to hinder its implementation. The lack of qualified personnel and incompetence with new technologies are found to lower the performance of Turkish textile SMEs.

Keywords: Six Sigma, textile industry, SMEs, Turkey

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1. Introduction

In the intensity and pace of today's cutthroat business world, many large organizations have sought strategies such as TQM, balance scorecard, ISO-certification and Six Sigma to improve process and product quality. Since the early 90's, numerous global organizations have undertaken the implementation of Six Sigma methodologies which seek to improve yield and productivity through the identification and elimination of defects, mistakes or failures in business processes or systems by concentrating on the more important aspects of production as seen by their customers. (Snee, 2004; Antony, 2008).

The implementation of Six Sigma extends way beyond the industries of manufacturing and services, to government, the public sector, healthcare and non-profit organizations (Antony et al., 2005; Montgomery, 2005; Pande et al., 2000; Pyzdek, 2003; Breyfogle, 1999). The relevance of Six Sigma has been successfully proven

across the industrial spectrum from shop floor personnel to the senior management level in the organizations which have embraced it. The companies which have invested in and implemented Six Sigma (i.e., allocated a special budget to launch it and created a separate organizational culture), have been rewarded with reduced operational costs and defect rates, achieved high rates on business profits, increased employee morale, and improved the quality of their final product. In addition to these, customer loyalty and Return on Investment (ROI) have also shown measurable improvement (Antony et al., 2005; Kumar et al., 2006, 2008; Snee, 2004).

The importance of Six Sigma as a business strategy has recently been recognized by SMEs as their

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understanding of Six Sigma's ability to address supply chain issues (Antony et al., 2005, 2007). Keller (2003) and Snee and Hoerl (2003) have stated that Six Sigma can offer many SMEs the same benefits as larger organizations. In the Turkish context, however, Turkish SMEs have yet to follow the lead given by large and institutionalized Turkish organizations, as it seems that they have yet to be convinced of the benefits of the implementation of Six Sigma (Antony et al., 2005, 2008; Antony, 2008; Harry and Crawford, 2004; Kumar, 2007). Lack of a formalized strategy, operational focus, limited managerial and capital resources, and misconception of efficiency measurement are the characteristics which distinguish the SMEs from larger organizations (Brouthers et al., 1998; Fuller-Love, 2006; Garengo et al. 2005; Ghobadian and Galleary, 1997; Hudson et al., 2001; Hussein et al., 1998; Jennings and Beaver, 1997).

While there is ample evidence to support the success of Six Sigma in many large corporations, there is still a need for documented evidence in SMEs. The evidence which does exist on Six Sigma implementation in SMEs is based on quality management practices in SMEs, which in turn are based on consultants/ practitioners experience and are not of sufficient depth and volume. (Antony et al., 2005 and 2008; Kumar, 2007; Kumar and Antony, 2008; Wessel and Burcher, 2004).

Using a sample of SMEs in Germany, Wessel and Burcher (2004) have identified the specific requirements for implementation of Six Sigma. Similarly, Antony et al. (2005, 2007) have assessed the current status of Six Sigma implementation in UK SMEs and shown that many of the SMEs show a lack of awareness. In addition, these companies do not have the resources available to implement Six Sigma projects. Likewise, a case study on Six Sigma implementation in a UK manufacturing SME brought to light a cost-effective approach of eliminating the critical-to-quality issue (Thomas and Barton, 2005). Six Sigma application in an Indian SME has also proven successful in improving their delivery rates (Darshak and Desai, 2004 and Desai, 2006). Recently, Timans et al. (2011) implemented Lean Six Sigma in Dutch SMEs.

Improvement in on-time deliveries, labor efficiencies and annual profits have been among the other areas which have been shown to benefit SMEs when Six Sigma has been successfully implemented (Gupta and Schultz, 2005). Antony et al., (2005, 2007), Kumar (2007), Spanyi and Wurtzel (2003), Waxer (2004) have demonstrated that strong leadership and senior management commitment are crucial to successful Six Sigma implementation in

SMEs. Customer focus, communication, cultural change, education and training, rewards and recognition, shared understanding of core business processes, resource commitment, understanding of Six Sigma methodology; and project prioritization and selection have also been identified as significant factors (Antony et al., 2005, 2007; Kumar, 2007; Spanyi and Wurtzel, 2003; Waxer, 2004).

The single most important factor in the successful deployment of Six Sigma is found to be the combination of management involvement and commitment (Kumar, 2007). Kumar's study also shows that the lack of resources and poor training/coaching are the two most important impediments in the successful deployment of Six Sigma. Kumar and Antony (2010) have found that strong leadership and management commitment are the critical factors in the successful implementation of Six Sigma in the UK SMEs.

CSFs are those factors that play an essential role in leading to the success of any organization, since if the objectives associated with these factors are not met, the organization will inevitably fail (Rochart, 1979). Thus, this paper investigates the CSFs for the successful introduction of Six Sigma in Turkish textile SMEs.

2. Turkish SMEs and Six Sigma

Constituting one of its major parts, SMEs are the backbone of the Turkish economy. While the integration of Turkey to the EU is progressing, the business environment and performance of the Turkish SMEs are becoming more important. With the acceptance of EU's Basel-II framework, Turkish SMEs are expected to foster entrepreneurship, competition, innovation and growth by means of access to more financial resources.

The regional rather than global focus of Turkish SME's remains one of their major drawbacks. To attain more share in international markets, they should primarily work on their core competencies, focus more on marketing, human resources, new technologies, innovation and environmental values, and most importantly continuously improve their manufacturing processes to lower scrap rates and increase efficiency rates.

Turkish SMEs are in the earliest stages of implementing Six Sigma. Turan et al. (2008) states that Turkish SMEs readily accept implementing the TQM tools and/or ISO but are still reluctant to introduce the Six Sigma concept. In fact, the use of ISO can be beneficial to SMEs before embarking on Six Sigma (Kumar et al., 2008).

To achieve this, Turkish SMEs should maintain a higher quality of thought. The factors hindering the introduction of Six Sigma in Turkish textile SMEs are investigated in this paper.

2.1. Interview with an A-class Turkish Textile Company

A face-to-face interview with the CEO of Company-A revealed the following facts about the industry. Company-A is one of the most successful SMEs specializing in manufacturing towels and bathrobes in the Turkish textile industry. However, it has not implemented any quality initiative in the past. There are a total of 225 employees working in the SME, including five engineers. The SME has a quality department. All employees are trained for quality. The CEO believes in the benefits of CI and is open to implementing Six Sigma in the SME to decrease the scrap rates in their manufacturing process as the company has been suffering from high rates of 15.07%, 17.48% and 13.44% in 2009, 2010 and 2011, respectively. Following assistance from a Swiss consultancy company, structural improvements have been realized. A French company named SGS periodically continues auditing the SME's quality standards.

The current quality control practice of the SME is as follows. Inspections are made daily during the manufacturing process. Errors are classified into groups such as stains, (mildew, fluff, penmarks, oil stains), holes, tears, folding errors, printing smudge, dying inconsistency, sewing error, fastener error (e.g. missing, damaged, misplaced), joining error, elastic too loose/tight/torn, size error, bridging error, etc. Each error group also has subcategories for different sections of the garment. Next, the number of scrap pieces (i.e. pieces with error) is recorded. Finally, error rates are calculated and reported weekly to the top management.

3. Methodology and Data

In this study, a survey-based approach is used to identify the continuous improvement (CI) initiatives commonly practiced in Turkish textile SMEs as well as understanding the approach of these SMEs to Six Sigma. The 15-item questionnaire was tailored to Turkish textile SMEs requirement from Kumar et al. (2009) with the purpose of identifying the CSFs for implementing Six Sigma in Turkish SMEs (See the Appendix). In the context

of Six Sigma implementation, CSFs represent the essential ingredients without which SMEs performance stands little chance of success (Kumar et al., 2009).

The questionnaire was emailed to 100 randomly selected Turkish SMEs operating in the textile industry. Twenty-eight SMEs returned the questionnaire. This resulted in a response rate of 28%. Six of these SMEs (21.4%) were small-sized enterprises and 22 of them (78.6%) were medium-sized (Figure 1).

The respondents of the survey consisted of CEOs, managing directors and quality managers. The responses reveal that 17.85% of the SMEs (5 out of 28) implemented only the ISO certification. The results show that all the SMEs under study have quality departments and that their employees are trained for quality.

Figure 1: Histogram showing the number of employees for the SMEs under study

3.1. Analysis

The respondents of the survey were asked to shortlist three factors out of seven alternatives available that mostly define the organization's strategic objectives. They were then asked to give information regarding the quality initiatives deployed in the past and present. After this they were asked to rate the importance of 26 CSFs necessary for and 5 impeding factors hindering the introduction of Six Sigma as a quality initiative in their SMEs. Finally, they were asked to rate the 7 possible reasons lowering the performance of their SMEs. The respondents made use of the Likert scale of 1 to 5 while rating the importance of CSFs, e.g. a rating of 1 corresponding to "not important at all", 2 corresponding to "not important", 3 corresponding to "neither important nor not important", 4 corresponding to "important", and 5 corresponding to "very important". Consequently, the ratings are collected and averaged.

Table 1 summarizes the factors defining the strategic objective(s) of the Turkish textile SMEs. Profitability (100%), flexibility (71.43%) and quality (53.57%) are the three most important factors which the SMEs in this study have taken into account while deciding their strategic objectives.

Strategic Objective	Count	%
Profitability	28	100%
Flexibility	20	71.43%
Quality	15	53.57%
Lower costs	13	46.43%
Higher market share	8	28.57%
Innovation	0	0%
Other	0	0%

Table 1: Factors defining the strategic objective (s) of the Turkish textile SMEs

Figure 2: Factors defining the objectives of the textile SMEs

Quality Initiatives Undertaken	Count	%
ISO 9000	5	17.86%
Six Sigma	0	0
TQM	0	0
Lean	0	0
Kaizen	0	0
Others	0	0
No initiative undertaken	23	82.14%

Table 2: History of quality initiatives in Turkish textile SMEs

The results reveal that ISO certification hinders the introduction of Six Sigma in Turkish textile SMEs as the

CEOs are satisfied with the status quo. Those SMEs (23 out of 28, i.e. 82.14%) which have not undertaken any quality initiative, expressed interest in learning more about Six Sigma.

Turkish textile SMEs were asked to identify the top three inhibiting factors that were felt to be barriers to quality initiative implementation. Table 3 shows that 64.29% of the responding enterprises stated that internal resistance was the most common factor in the SMEs. This was followed by lack of knowledge and lack of top management commitment.

Reasons for not implementing quality initiatives	Count	%
Internal resistance	18	64.29%
Lack of knowledge	15	53.57%
Lack of top management commitment	12	42.86%
Availability of resources	11	39.29%
Changing business focus	10	35.71%
Inadequate process control techniques	9	32.14%
Poor employee participation	6	21.43%
Lack of training	5	17.86%

Table 3: Barriers to implementation of quality improvement initiatives in SMEs

It is crucial to understand the perception of Six Sigma and the factors preventing its implementation from the Turkish textile SMEs perspective. SMEs were asked to state the reasons for not implementing Six Sigma as an initiative to drive CI effort within their enterprises. Table 4 shows that all of the Turkish SMEs were discouraged to implement Six Sigma due to a lack of knowledge of the system to start the initiative. This was followed by complacency.

Reasons for not implementing Six Sigma	Count	%
Lack of knowledge of the system to start initiative	28	100%
Complacency/ People prefer status quo	27	96.43%
Availability of Staff/Time for Projects	22	78.57%
Other competing quality initiatives such as ISO	5	17.86%
Cost	4	14.29%

Table 4: Reasons for not implementing Six Sigma in SMEs

CSFs and their mean importance and standard deviation are given in Table 5. The mean ratings above 2.50 signify that the majority of the respondents have

Question	CSF	Mean Rating	Standard Deviation	Rank
Importance of CSF to SME	Involvement and commitment of top management	4.571	0.5040	1
	Organizational infrastructure	3.393	0.4973	12
	Vision and Planning	3.964	0.5079	6
	Linking Quality Initiatives to Employee	4.536	0.5079	2
	Linking Quality Initiatives to Customer	3.643	0.4880	10
	Linking Quality Initiatives to Business	3.857	0.5909	8
	Linking Quality Initiatives to Supplier	3.929	0.6627	7
	Project selection	3.786	0.4170	9
	Project management skills	4.286	0.4600	4
	Information Technology and innovation	4.464	0.5079	3
	Communication	4.250	0.4410	5
	Cultural change	2.857	0.6506	13
	Education and training	3.464	0.5079	11
CSFs for successful introduction of Six Sigma in SME	Leadership and Commitment of top management	4.786	0.4179	1
	Strategic vision	4.750	0.4410	2
	Change management	3.750	0.5853	10
	Commitment of middle managers	4.286	0.4600	7
	Funds and Resources	3.464	0.5079	11
	Education and training	3.929	0.5394	9
	Empowerment of employees	3.429	0.5040	12
	Communication	4.143	0.3563	8
	Cross-functional teamwork	4.607	0.4973	4
	Data collection and measurement	4.714	0.4600	3
	Process documentation	4.357	0.4880	6
	Resource allocation	2.464	0.5079	13
	Regular audits	4.571	0.5040	5
Factors hindering the implementation of Six Sigma in SME	Lack of knowledge of the system to initiate	4.714	0.4600	1
	Availability of Staff/Time for Projects	2.679	0.8630	4
	Cost	2.321	0.6696	5
	Other competing quality initiatives such as ISO	3.214	0.6299	2
	Complacency/ People prefer status quo	3.071	1.0157	3
Factors Lowering SME's performance	Lack of qualified personnel	4.536	0.5079	1
	Lack of financial resources	2.821	0.9833	4
	Incompetence with the organizational structure	1.536	0.5079	7
	Incompetence with new technologies	4.464	0.5079	2
	Legal procedures and obligations (bureaucracy, taxes, etc.)	1.750	0.4410	6
	Lack of quality management	4.429	0.5040	3
	Lack of infrastructure	2.107	0.7860	5

Table 5: CSFs and Mean Ratings of Importance

rated the effect of the CSF as above average. The three most important CSFs cited across the SMEs are found to be the involvement and commitment of top management (4.571), linking quality initiatives to employee (4.536) and information technology and innovation (4.464). The three most common important CSFs cited across the SMEs for successful introduction of Six Sigma are found to be the leadership and commitment of top management (4.786), strategic vision (4.750), and data collection and measurement (4.714).

The majority of the SMEs have stated that they are hesitant to implement Six Sigma due to a lack of knowledge of the system to start the initiative (4.714) and the presence of the ISO-certification (3.214) in the company. The two most important CSFs lowering the performance of SMEs are found to be lack of qualified personnel (4.536), and incompetence with new technologies (4.464). To test internal consistency, Cronbach's alpha values were calculated for each

performance measure. All the Cronbach's alpha values showed satisfactory levels (above 0.7).

Capacity usage per annum	Count	%
81%-100%	5	17.86%
61%-80%	19	67.86%
31%-60%	4	14.29%
Below 30%	0	0%

Table 6: Capacity of the sample SMEs

The respondents were asked about the annual capacity usage rate of their SME (Table 6) and to shortlist the factors that can increase their SME's performance and capacity by lowering the SME's process inefficiencies. Table 7 shows that reductions in scrap rates, increase in productivity and improved sales are the top three factors that can improve the performance and capacity of SMEs.

Factors	Count	%
Reduction in scrap rate	20	71.43%
Increase in productivity	14	50%
Improved sales	12	42.86%
Reduction of customer complaints	11	39.26%
Reduction in cycle time	10	35.71%
Increase in profitability	7	25%
Reduction in delivery time	6	21.43%
Reduction of employee complaints (return rate)	4	14.29%
Reduction of costs	2	7.14%

Table 7: Factors to increase the SME's performance and capacity by lowering its process inefficiencies

The respondents received by email a document (of 15 pages) briefly explaining the Six Sigma methodology with a case study of Six Sigma implementation in a foreign textile company. They were then asked to state the five most important post-benefits that are thought to be realized by their SMEs following the implementation of Six Sigma. The questioned benefits were related to customer satisfaction, employee satisfaction, work environment, learning and job involvement.

Table 8 displays that established performance metrics, top-down and bottom-up communication, increase in customer satisfaction and regular internal audits are found to be the four soft benefits that are to be realized by the SMEs. Development in human capability to sustain the benefits, employee empowerment and process ownership and organizational learning through sharing of benefits and challenges experienced during projects

are to be equally perceived by the SMEs as the fifth benefit.

Benefits	Count	%
Established performance metrics	18	64,29%
Top-down and bottom-up communication	17	60,71%
Increase in customer satisfaction	16	57,14%
Regular internal audit	15	53,57%
Development in human capability to sustain benefits	9	32,14%
Employee empowerment and process ownership	9	32,14%
Organizational learning through sharing of benefits and challenges experienced during projects	9	32,14%
Cross-functional team for projects	8	28,57%
Increase in employee satisfaction	7	25,00%
Proactive approach to problem solving	5	17,86%
Understanding and usage of CI tools and techniques for problem solving	4	14,29%
Investment in education and training	3	10,71%
Involvement of people from accounting and finance	0	0,00%

Table 8: Post-benefits thought to be realized by the implementation of Six Sigma

4. Conclusion

The Turkish textile industry will continue to be Europe's backyard. For Turkish textile SMEs to achieve and sustain a successful share in this market, they need to create difference variety in their products. To create this, they need to implement Six Sigma while investing in skilled personnel, innovative ideas and new technologies.

The key contribution of this article to the literature has been its being the first study that investigates the feasibility of Six Sigma in Turkish textile SMEs. This study shows that the implementation of Six Sigma or other CI initiatives in Turkish textile SMEs is heavily hindered due to a lack of understanding of how to get started.

Before embarking on Six Sigma, it is imperative that Turkish textile SMEs have strong management commitment and leadership skills. They should be aware of the promising benefits of the tools and techniques of CI. The results indicate that Turkish textile SMEs currently have the necessary financial resources to implement Six Sigma. However, the results reveal that the major problem of the industry is the lack of knowledge of Six Sigma. On the other hand, the SMEs complain about the

lack of a database developed specifically addressing the characteristics and necessities of the Turkish textile SMEs as their personnel are not competent enough to manage and work with the foreign software currently at hand. This suggests that the companies have employed unqualified personnel, and have not given the required importance to information technologies.

The results also reveal that the companies are aware of the cross-functional teamwork within the organization. Aside from this, data collection and measurement and regular audits are also indispensable. These show that the SMEs are mentally ready for implementing Six Sigma, yet still need to be more fully introduced to its benefits. This can be accomplished by presenting workshops to the top management of the Turkish textile SMEs by qualified Six Sigma consultants who are well-versed in the textile industry.

The major limitation of this study was the number (28 out of 100) of Turkish textile SMEs that responded to the questionnaire. Future studies should focus on performing a larger survey on quality management practices in Turkish SMEs operating in different industries and understanding the impact of industrial variability on successful implementation of Six Sigma.

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Appendix

The questionnaire used in the study is given below.

1. Which of the following is the most important strategic objective of your SME? Please choose the three most applicable.
 - a. Profitability
 - b. Flexibility
 - c. Quality
 - d. Higher market share
 - e. Innovation
 - f. Lower costs
 - g. Other (Please state)
2. How many employees are working in your SME? Please state.
3. How many engineers are employed in your SME? Please state.
4. Is there any quality department in your SME? Yes/No
5. Are the employees trained for quality? Yes/No
6. Which quality initiative(s) has your SME implemented in the past and present? Please state the ones applicable.
 - a. Six Sigma
 - b. TQM
 - c. Lean
 - d. Kaizen
 - e. ISO certification
 - f. Others (Please state, e.g. TSE, OHSAS 18001, etc.)
 - g. No initiative undertaken
 - h. Undertook no initiative yet but would like to be informed about Six Sigma.
 - i. Is ISO-certified and would like to be informed about Six Sigma.
7. In your opinion, how important are the following CSFs to your SME? Please rate from 1 to 5.
 - a. Involvement and commitment of top management
 - b. Organizational infrastructure
 - c. Vision and Planning
 - d. Linking Quality Initiatives to Employee
 - e. Linking Quality Initiatives to Customer
 - f. Linking Quality Initiatives to Business
 - g. Linking Quality Initiatives to Supplier
 - h. Project selection
 - i. Project management skills
 - j. Information Technology and innovation
 - k. Communication
 - l. Cultural change
 - m. Education and training
8. In your opinion, what are the factors hindering the implementation of a quality initiative in your SME? Please choose the three most important.
 - a- Availability of resources
 - b- Lack of knowledge
 - c- Lack of training
 - d- Internal resistance
 - e- Poor employee participation
 - f- Inadequate process control techniques
 - g- Changing business focus
 - h- Lack of top management commitment
9. In your opinion, what is the importance of the following factor for successful introduction of Six Sigma in your SME? Please rate 1 to 5.
 - a. Leadership and Commitment of top management
 - b. Strategic vision
 - c. Change management
 - d. Commitment of middle managers
 - e. Funds and Resources
 - f. Education and training

- g. Empowerment of employees
 - h. Communication
 - i. Cross-functional teamwork
 - j. Data collection and measurement
 - k. Process documentation
 - l. Resource allocation
 - m. Regular audits
10. In your opinion, which of the following factors hinder the implementation of Six Sigma in your SME the most? Please rate each from 1 to 5. Also please choose the three most applicable.
- a. Lack of knowledge of the system to start the initiative
 - b. Availability of Staff/Time for Projects
 - c. Cost
 - d. Other competing quality initiatives such as ISO
 - e. Complacency/ People prefer status quo
11. What's your SME's annual capacity usage rate?
- a. Below 30%
 - b. 31%-60%
 - c. 61%-80%
 - d. 81%-100%
12. In your opinion, how important and effective are the following factors in lowering the performance of your SME? Please rate from 1 to 5.
- a. Lack of qualified personnel
 - b. Lack of financial resources
 - c. Incompetence with the organizational structure
 - d. Incompetence with new technologies
 - e. Legal procedures and obligations (bureaucracy, taxes, etc.)
 - f. Lack of quality management
 - g. Lack of infrastructure
13. Please list the current inefficiencies in your company.
14. In your opinion, which of the following factors can increase your SME's performance and capacity by lowering the inefficiencies in your SME? Please state the most important three.
- a. Reduction in scrap rate
 - b. Reduction in cycle time
 - c. Reduction in delivery time
 - d. Increase in productivity
 - e. Reduction of costs
 - f. Increase in profitability
 - g. Improved sales
 - h. Reduction of customer complaints (return rate)
 - i. Reduction of employee complaints
15. In your opinion, what are the post-benefits that you think you will realize through the implementation of Six Sigma in your SME?
- a. Increase in customer satisfaction
 - b. Increase in employee satisfaction
 - c. Established performance metrics
 - d. Top-down and bottom-up communication
 - e. Organizational learning through sharing of benefits and challenges experienced during projects
 - f. Cross-functional team for projects
 - g. Involvement of people from accounting and finance
 - h. Development in human capability to sustain the benefits
 - i. Employee empowerment and process ownership
 - j. Investment in education and training
 - k. Regular internal audit
 - l. Understanding and usage of CI tools and techniques for problem solving
 - m. Proactive approach to problem solving