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Providing the Success of Six Sigma by Proper Project Identification and Selection: Comparison Study between Slovenia and the UK

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Results of Six Sigma projects are related to company performance. Successful Six Sigma projects increase customer satisfaction and have many other positive effects on organisations. Success of Six Sigma projects is related to key management decision about how to identify potential projects and which projects to select for final implementation. This research is oriented toward the study of tools used in the phase of Six Sigma project identification and criteria used in the phase of Six Sigma project selection. The purpose of this research is to compare results from manufacturing sector in Slovenia and the UK. Results of this study indicate that management within the organisations tend to identify potential Six Sigma projects with the use of different tools, such as: brainstorming (Slovenia and UK.), followed by Critical To Quality tree (UK.), and interviews and customer visits (Slovenia). Further, the results show that the final decision about Six Sigma projects selection in the UK and Slovenia include different criteria, such as: customer benefit (Slovenia and UK), finance impact (UK) and connection to business strategy (Slovenia). Many companies in the UK as well in Slovenia combine the use of tools and balanced selection criteria at the same time.

Keywords: Six Sigma, tools, criteria, identification, selection, project, management, Slovenia, United Kingdom

1 Introduction

Six Sigma is a business management strategy, initially implemented by Motorola, which nowadays enjoys widespread application in many sectors of industry and services. It is a methodology and set of tools (most frequently used are DMAIC tools - Define, Measure, Analyse, Improve, Control, and DFSS - Design For Six Sigma), which can help us to reduce quality problems to less than 3.4 defects per million or better. Many other benefits of Six Sigma had been a topic of numerous studies and are extensively reported in the literature by many authors (Hendricks and Kelbaugh, 1998; Harry, 1998; Hahn et al., 2003; Robinson, 2005; Kumar et al., 2008; Gutierrez et al., 2009; Johannsen and Leist, 2009; Kumar, Antony and Douglas, 2009; Aboelmaged, 2010; Barnes and Walker, 2010).

This paper is oriented towards the study of tools used in the phase of Six Sigma project identification and criteria used in the phase of Six Sigma project selection in Slovenia and in the UK. There is just one study concerning Six Sigmaproject selection in Slovenia, but no comparison studies were presented (Gošnik and Hohnjec, 2009). This study aims at comparing studies and results from Slovenia and the UK. The first part of this paper presents an overview of the research methodology employed in Slovenia and in the UK. The second part discusses the results of the study and compares them against the similar studies for the UK (Banuelas et al., 2006). It culminates by offering a comparison study between Slovenia and the UK and identifying which tools for Six Sigma project identification and criteria for Six Sigma project selection are most frequently used in both countries. Finally, the results are discussed, pointing out the main limitations of the study and indicating possible future lines of research.

2 Theoretical background

2.1 Six Sigma project identification and selection

Six Sigma has evolved into a statistical oriented project driven approach to process and product quality improvement; some

multinationals, like Ford Corporation, reported completing over 10.000 projects (Banuelas et al., 2006). However, not all Six Sigma projects produce bottom up benefits; many produce only local improvements (Pyzdek, 2000) and about 20 percent of projects are cancelled (Banuelas et al., 2006). Therefore, empirical studies suggest that successful Six Sigma implementation is related with proper Six Sigma project prioritisation and selection (Pande et al., 2000; Banuelas and Antony, 2002).

Key characteristics of Six Sigma are the following:

- Six Sigma places a clear focus on bottom-line impact in costs and savings. No Six Sigma project will be approved unless the team determines the savings generated from it. However, not all Six Sigma projects produce large direct benefits, many produce only local improvements (Pyzdek, 2008).
- Six Sigma has been very successful in integrating both, human aspects (culture change, training, customer focus, etc.) and process aspects (process stability, variation reduction, capability, etc.) of continuous improvement.
- Six Sigma methodologies (DMAIC) link the tools and techniques in a sequential manner. Different steps of Six Sigma framework are outlined below (Pyzdek, 2000):
  - *Define* (D): Selection of appropriate Six Sigma projects, development of project plans and identification of the relevant process. The Supplier-Input-Process-Output-Customer (SIPOC) mapping exercise can be used effectively to describe the process.
  - *Measure* (M): Measurement of process variables through data quality checks, repeatability and reproducibility (R&R) studies, and addressing process stability.
  - *Analyse* (A): The use of graphical techniques for process analysis.
  - *Improve* (I): Improvement of the existing processes through experimentation and simulation techniques.
  - *Control* (C): Development of the control plan for process improvement.
- Six Sigma creates a powerful infrastructure for training of Six Sigma personnel; champions, master black belts, black belts, green belts.
- Six Sigma involves changing major business value streams that cut across organisational barriers. It is the means by which the organization's strategic goals are to be achieved. This effort cannot be lead by anyone other than the Chief Executive Officer who is responsible for the performance of the organisation as a whole. Six Sigma must be implemented from the top-down (Pyzdek, 2000).

Project identification is the process of identification of different possible resources of useful information which helps us define top priority projects. It is related to the use of different tools which help us to identify potential areas of Six Sigma projects. Use of inadequate tools can lead us to partial information and can direct us to wrong problem focus and consequently to identification of less important projects. Several authors (Pyzdek, 2000, 2003; Breyfogle, 2001; Pande, 2000; Kelly, 2002) suggest the use of different tools for Six Sigma project identification (see Table 1).

The selection of process improvement projects is probably the most difficult aspect of Six Sigma and is one of the most frequently discussed issues in the Six Sigma (Pande et al., 2000; Snee, 2001). For many companies, the question is not whether or not to implement Six Sigma, but how to implement a successful Six Sigma process improvement project.

Selecting adequate sources and identifying the useful information to identify Six Sigma projects is seen as a key step in project selection (Banuelas et al, 2006). Adams et al. (2003) propose seven main sources for identification of potential Six Sigma projects, including: customers, suppliers, employees, benchmarking, developments in technology, extension of other Six Sigma projects and waste.

Project selection is the process of evaluating individual projects or groups of projects, and then choosing to implement some set of them so that objectives of the organisation will be achieved (Meredith and Mantel, 2003; Banuelas et al., 2006). Selecting a project that is too large will cause valuable

Table 1: Proposals of tools used for identification of Six Sigma projects

Author	**Tool**
Pyzdek (2000, 2003)	Pareto priority index, QFD (quality function deployment),
Breyfogle et al. (2001)	Project assessment matrix
Pande et al. (2000)	QFD (quality function deployment)
Kelly (2002)	Project selection matrix
Adams et al. (2003)	Project ranking matrix
Larson (2003)	Pareto analysis
De Feo and Barnard (2004)	Reviewing data on potential projects against specific criteria

Source: Kumar et al, 2007.

Table 2: Criteria for selection of Six Sigma projects

Critical criteria/Author	Customer impact	Financial impact	Top management commitment	Measurable and feasible	Learning and growth	Business strategy and core competence
Harry and Schroeder, 2000	×	×		×		×
Pande et al., 2000	×	×	×	×	×	×
Snee, 2001		×		×		×
Breyfogle et al., 2001	×	×		×		×
Pyzdek, 2000, 2003	×	×		×		
Lynch and Soloy, 2003	×	×		×		
Antony, 2004	×	×			×	×

Source: Banuelas et al, 2006.

time to be lost during the define phase (Banuelas et al., 2006), and will result in low efficiency by irrational use of resources. Good project selection is a process itself and if it is properly carried out the potential benefits of Six Sigma can be improved substantially (Pande et al., 2000).

Different authors (Breyfogle et al., 2001; Adams et al., 2003, Pyzdek, 2003, Banuelas, 2006) have proposed project selection process models and tools, and key elements in Six Sigma project selection producing a variety of models (see Table 2).

The understanding of markets, operations, measures used and creativity to maximise value and performance are the core elements of Six Sigma approach (Pande et al., 2000). Consequently, the "Voice of the Customer" (VOC) should be used to identify potential Six Sigma projects (Johnson, 2002; Man, 2002). Six Sigma teams employ different tools to identify potential projects from several sources, i.e. customers, waste, employees, suppliers, technology or extension of projects (Banuelas, 2006).

3 Conceptual Framework

Main objective of this study is to analyse how Six Sigma projects have been identified and selected in Slovenia and to compare results with the similar study from the UK. Comparison is interesting because of the possibility to compare Six Sigma experiences from Slovenia with well developed practice in the UK in this field. To study that efficiently, base study in the UK was used (Banuelas et al, 2006). Based on their research, literature overview and experiences of researchers, the research questions for Slovenia were developed.

In order to conduct the study effectively, the general objective is divided further into a number of specific research questions (RQ) as follows:

RQ1. What is the status of use of different tools in the phase of Six Sigma project identification in Slovenia and the UK?

RQ2. What is the status of use of different criteria in the phase of Six Sigma project selection in Slovenia and the UK?

RQ3. Which similarities and differences between Slovenia and the UK can be detected in the field of Six Sigma project identification and Six Sigma project selection?

Research consists of the following conceptual framework:

(1) Background of manufacturing companies.
(2) Participation of different levels of management at defining Six Sigma projects.
(3) Use of different tools at identification of potential Six Sigma projects.
(4) Key criteria for Six Sigma project selection and progression.

4 Methodology

The study was based on the comparison of Six Sigma development stage and current status in the manufacturing sector in Slovenia and in the UK. For the study in Slovenia, a questionnaire was developed based on previous research conducted by Banuelas et al. (2006) and latest literature review. The questionnaire consisted of the following main sections: background of companies, participation of different management levels at defining Six Sigma projects, use of different tools at identification of potential Six Sigma projects and key criteria for project selection and progression. Respondents included in this study were all Six Sigma quality managers.

The survey was sent out to one hundred Slovenian manufacturing companies in 2008 which had been already emplo-

ying Six Sigma concept. From those sent, twenty-one usable surveys were retrieved in six month period, meaning a response rate of 21 percent. Though the sample was rather small due to the size of Slovene economy and limited number of manufacturing companies implementing Six Sigma, the companies were good representatives of different industry branches and offer space for some general conclusions concerning Six Sigma use in Slovenia. An important limitation of this study is the response rate; however, the response rate is similar to other surveys on Six Sigma, ranging from 8.5 to 14 percent (Antony et al., 2005; Banuelas et al., 2006; Dusharme, 2006).

The survey used in this study for a comparison was sent by Banuelas et al. in 2006 to one thousand and one hundred UK companies in the manufacturing sector. From those sent, ninety five usable surveys were retrieved, meaning a response rate of 8.5 percent.

The first section of the questionnaire aimed at determining the fundamental issues such as the industry sector, maturity of Six Sigma projects subject to investigation, number of projects carried out and number of years since Six Sigma had been launched.

The following two sections were focused on the use of different tools for Six Sigma project identification and criteria for Six Sigma project selection. Respondents were asked to rank the criteria in terms of whether each of the claims fit to their practice in the organisation. The yes/no type of questions were asked to provide a better perspective of the current Six Sigma practices in Slovenian manufacturing companies and compared to available UK data (2006).

4.1 Sample characteristics

Characteristics of both samples have been analysed for the number of employees in organisations, the position occupied by the respondents, the areas of industries, the status of Six Sigma implementation, number of years of presence of Six Sigma in the company and number of finished Six Sigma projects within the organisation and are presented in Table 3.

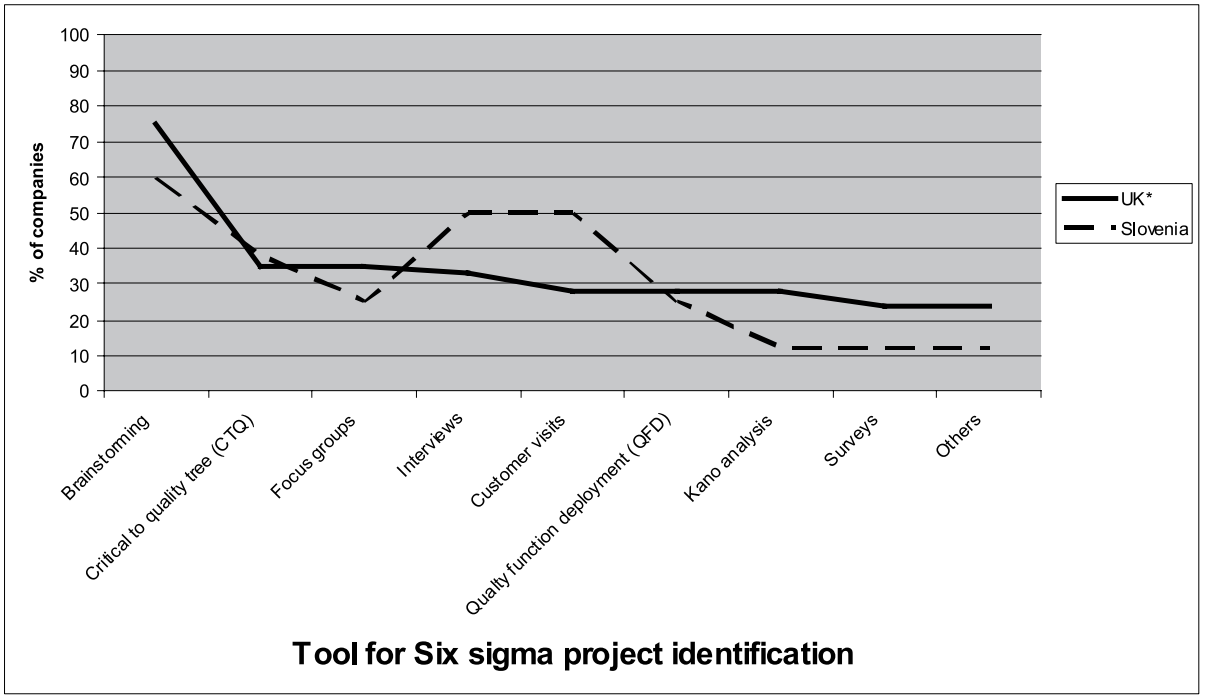
5 Results and discussion

Six Sigma teams in the UK employ different tools to identify potential Six Sigma projects from several sources, i.e. customers, waste, employees, suppliers, technology or extension of projects. The majority of them (76 percent) use brainstorming. Critical-to-quality (CTQ) tree, focus group, interview are employed by around one third of the surveyed companies. Customer visits, quality function deployment (QFD), Kano analysis, surveys are used by 20 to 30 percent of all surveyed companies. (Figure 1).

Table 3: Sample characteristics

	UK*	**Slovenia**
Companies implementing Six Sigma		
Total	13 companies	8 companies
Participants - position of respondents (rank)		
Master black belt	5 managers	1 manager
Black belt	8 managers	2 managers
Green belt	2 managers	8 managers
Yellow belt	5 managers	2 managers
Six Sigma implemented projects in the company		
Less than 10 projects	6 companies	4 companies
Between 10 and 100 projects	7 companies	3 companies
More than 100 projects	12 companies	1 company
Current status on Six Sigma in the company		
Less than 1 year	4 companies	4 companies
Between 1-3 years	9 companies	3 companies
More than 3 years	12 companies	1 company

**Source: Banuelas et al. (2006)*



** Source: Banuelas et al. (2006)*

Figure 1: Tools for identification of potential Six Sigma projects

Figure 1 shows that the most common tools for Six Sigma project identification used in both countries, Slovenia and the UK, is brainstorming. In the process of Six Sigma project identification in Slovenia, the most frequently used tool is brainstorming, interviews and customer visits (50 percent), followed by critical to quality tree - CTQ (38 percent), focused groups (25 percent), quality function deployment - QFD (25 percent) and Kano analysis and others (15 percent). According to Banuelas et al. (2006) most of the companies in the UK employ more than one tool to identify potential projects, including tools such as; brainstorming, CTQ tree, focus group, interviews, customer visits, QFD and Kano analysis, among others. It was found that the main criteria to select Six Sigma projects are customer satisfaction, financial benefits, linkage to business strategy and top management commitment. Companies implementing Six Sigma for short period of time tend to put less emphasis in the linkage between projects and business strategy and in learning and growth.

In the study of Six Sigma project selection, the criteria found in the above mentioned literature were grouped into six main criteria as shown in Figure 2. Selection criteria need to be prioritised so that those which are the most critical to the overall success of the organisation will have greatest impact on the project selection. Sometimes, a particular criterion is a useful gauge of how well a project will deliver several outcomes.

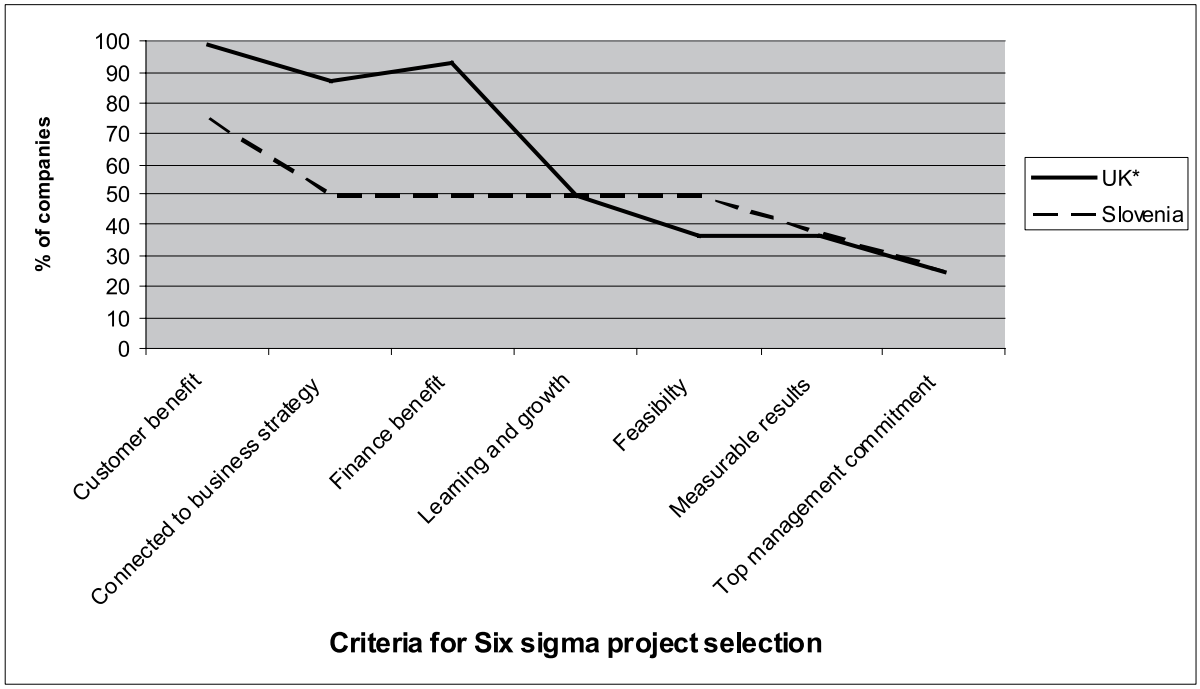
As shown in Figure 2 for Slovenia, practically all of the companies in the Six Sigma project selection phase use criteria customer benefit (75 percent), followed by criteria financial benefit (50 percent), connection to business strategy (50 percent), finance benefit criteria, learning and growth criteria (all 50 percent), feasibility criteria (50 percent), and to lesser extend include criteria such as measurability of the results (37 percent) and management commitment (25 percent).

Results of this study reflect customer orientation and can be explained considering results in the phase of Six Sigma project identification. The results of this study can be also related with previous studies in the UK and US (Banuelas and Antony, 2002; Antony, 2004) where customer focus, linkage to business strategy, top management commitment and financial benefits are considered as essential factors for the successful implementation of Six Sigma.

In this study for Slovenia, almost 90% of respondents identify projects with the help of cost of quality, 60% by brainstorming of project team and 50% by customer interviews, followed by CTQ tree and Pareto analysis. All of the companies employ more than one tool to select potential projects, including brainstorming, CTQ tree, focus group, interviews, customer visits, QFD and Kano analysis, among others. Focus groups, QFD, Kano diagram and business score card are employed at the minority of the companies.

6 Conclusion

Six Sigma projects in the UK and Slovenia were being identified by using different tools at the same time. Studied manufacturing companies in the UK use much more equal and balanced number of tools in the phase of Six Sigma project identification; on the other hand, studied manufacturing companies in Slovenia put more emphasis to the tools which are directly oriented to the detection of customer needs.



**Source: Banuelas et al. (2006)*

Figure 2: Criteria for Six Sigma project selection

Six Sigma has been used for much shorter period of time in Slovenia than in the UK and it is suggested that customer projects demonstrate full potential of Six Sigma in early stages of its implementation. As our study shows, about half of all studied companies in Slovenia have been utilizing Six Sigma for about one year.

Both, Slovenian and UK manufacturing companies put in a lot of attention to use of brainstorming to identify potential Six Sigma projects, but differ in their use of various tools which include direct customer involvement. Not surprisingly, Slovenian manufacturing companies are more toward quick wins and focus on projects with a high probability of success. Contrary to that, UK manufacturing companies, beside customer orientation, are more oriented toward customer orientation, relation to business strategy and financial impact.

Frequently exposed criterion in Slovenia is feasibility, which can be attained to early stage of use of Six Sigma and availability of the Six Sigma resources in Slovenian manufacturing companies. Slovenian manufacturers are mainly suppliers for other EU companies strongly depending on export in one sector, i.e. automotive industry.

The study shows significant differences in the use of Six Sigma method in developed market economies such as the UK with long tradition of its implementation in comparison to post-transition economies such as Slovenia. Short term orientation with quick financial gains of Slovenia manufacturing companies should give a way to long term orientation toward identification and selection of Six Sigma projects focused on total quality management, operational effectiveness and consequently higher profitability. Higher profitability should come as a result of better quality and effectiveness in long run and not only as a quick fix of certain problems in manufacturing process. This research is limited by the number and structure of companies which have already implemented Six Sigma in Slovenia. Authors also believe that a larger research sample might affect generalisation of the results of this study.

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