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Selection Criteria for Six Sigma Projects in Slovenian Manufacturing Companies

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Researches reveal that successful six sigma implementation is related to proper six sigma project prioritisation and selection. This research is limited to the selection of six sigma projects in some manufacturing companies in Slovenia. The purpose of this study is to identify what criteria are considered for prioritisation and selection of six sigma projects and how six sigma projects are selected. A research sample is limited by the number of companies which have implemented six sigma so far. The results indicate that Slovenian manufacturing organisations tend to select six sigma projects based on criteria such as customer satisfaction, connection with a business strategy financial benefits, and growth of the organisation. Several tools and techniques such as quality cost analysis, brainstorming and interviews are used to identify and prioritise projects. Identification of the most commonly used criteria to select six sigma projects can help practitioners to select projects based on multiple criteria by using tools and techniques identified in this study. This topic has not been applied in the field of Slovenian manufacturing companies and thus it presents the first study in this field in Slovenia.

Keywords: Six sigma, project management, project selection, management, manufacturing companies, preliminary study, Slovenia

1 Introduction

Selection of six sigma projects is one of the most frequently discussed issues in the six sigma literature today (Goldstein, 2001; Fundin at al., 2003). Exchanged business and environment relations are directing us to focus on the customer needs, innovations and measuring differently related parameters more than ever. 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. The six sigma benefits have been also a topic of many studies and are extensively reported in the literature by many authors (Hendricks and Kelbaugh, 1998; Harry, 1998; Hahn et al., 1999; Lanyon, 2003; Robinson, 2005). Many of them propose a key ingredient for successful six sigma implementation is project prioritisation and selection (Pande et al., 2000; Banuelas and Antony, 2002) (Table 1). The selection of process improvement projects is probably the most difficult aspect of six sigma (Pande et al., 2000; Snee, 2001). However, there are noticeable cases where six sigma failed to deliver the desired results. Bertels (2003) points out that the key characteristic differentiating successful six sigma projects from unsuccessful projects are a well-defined project objective which will reflect customer needs and fulfil their expectations.

Methods used for selection of six sigma projects defined by different authors are shown below in Table 1.

Table 1: Methods used for selection of six sigma projects

Author	Tool(s)
Pyzdek (2000, 2003)	Pareto priority index -PPI, QFD, theory of constraints -TOC)
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).

Project selection is a process of evaluating individual projects or groups of projects, and then choosing them so that the objectives of the organisation will be achieved (Meredith and Mantel, 2003). Projects should be linked to the right goals and impact at least one of the major stakeholders' issues, e.g. growth acceleration, cost reduction or cash flow improvement. (Kumar et al, 2007). A good project selection is a process itself; if properly carried out, potential benefits of six sigma can improve substantially (Pande et al., 2000). Project selection is related to the project implementation; it contributes to a success and not only to efficiency of the business processes and supports development of the project culture in the organization. Authors and consultants have proposed project selection process models, tools, and key elements in six sigma project selection producing a variety of models (Breyfogle et al., 2001; Adams et al., 2003; Pyzdek, 2003). Because of dynamics of business environment directing us to manage business activities as projects, it often occurs that many of projects are managed parallelly at the same time.

In the future many companies and industries including Slovene manufacturing industry will focus more on the following projects: (Gošnik, 2009); carrying out projects on managing globalisation, research and development projects, cost management oriented projects, production cost management projects, innovative product development and brand management related projects. Thus, for a successful project selection and implementation we do not need only support of excellent product management in the company but also excellent project team management (Gošnik, 2006) supported by six sigma projects. Their selection and prioritisation might be crucial for a company's success.

Successful companies do not focus only on products but also on processes (Gošnik, 2008). The lack of market aspects of products can lead to defining wrong project objectives (not customer-focused) and consequently to unsuccessful products (Gošnik, 2005). Partial views on the project are related with many risks, as well. Company's management has a crucial role in customer focused project management related to different fields of knowledge such as marketing, R&D and technology . It enables us to manage projects empowered by high degree information exchange and to connect different key elements aiming at a project success.

Many researches in Slovenia have been dedicated to the studies of relations between quality, management, business process and strategies and its measurements (Vujica-Herzog et all, 2006; 2007; 2009). None of the studies so far have studied relations between quality management within companies and six sigma as a possible business strategy. This study reveals what criteria are considered for selecting six sigma projects and how and who selects six sigma projects in organisations.

Consequently, this study investigates the current status of selected six sigma projects in Slovenian industry and identifies the main criteria used for project selection. The first part of this research presents an overview of the research methodology employed. The second part of the paper discusses the results of the survey and compares them with the literature. This represents the first study in this field by offering a brief summary and directions for further research.

2 Conceptual Framework of the study

Many researches in the field of Slovene industry are related to quality management (Vujica-Herzog et all, 2006; 2007; 2009). Parameters such as scrap level and reworks, warranty claims, cost of scrap and reworks, quality costs in many existing models for measuring business performance represent an important content of a model (Vujica-Herzog et all, 2006; 2007; 2009). Management of those crucial parameters is very strongly related to the business performance of the company. Therefore, focus on those quality management issues can represent an important part of business efficiency of a company. Focusing on these parameters by carrying out six sigma projects can help us to detect key projects which would have a significant effect on our business performance. The role of different levels of management in identification and prioritisation of six sigma projects, the tools used for identification of six sigma projects and the key criteria for six sigma project selection in the Slovenian manufacturing organisations are the main research issues in this study.

This study represents the first study of exploring this topic in Slovenia in this field and it is preliminary. The number of data collected is limited by a small number of six sigma companies in Slovenia. Data collection was oriented to many manufacturing companies in Slovenia unaware of the fact if they already deal with six sigma or not. Some data of the companies which have already implemented six sigma were included by the Slovenian six sigma society. The main objective of this study is for the first time in Slovenia to detect which and how many companies are familiar with six sigma and to research how six sigma projects are indicated, prioritised and selected. The results of this study have a great orientation value for further detailed researches in this field.

Research questions in this study were:

RQ1. What is the role of different levels of management in identification and prioritisation of six sigma projects?
RQ2. What tools are used to identify six sigma projects?
RQ2. What are the key criteria for six sigma project selection in the Slovenian manufacturing organisations?

This research consists of the following conceptual framework:

(1) Background of the companies.
(2) Participation of different levels of management in defining six sigma projects.
(3) The use of different tools for identification of potential six sigma projects.
(4) Key criteria for project selection and progression.

3 Research methodology

The study is oriented in many different manufacturing companies, so we decided to gather information from the companies' quality managers (Table 2). We prepared a questionnaire for them. Questions were defined based on experiences, literature and previous researches of the authors in the respective field. These questions were produced for Slovenian manufacturing

companies and are useful for further researches and continuous studies in this field and for further possible comparison studies. The data were collected in April 2008 (Table 2).

Originality/value

The provision of empirical data on the criteria used to select six sigma projects and how six sigma projects are selected in manufacturing companies. This topic presents unique study in this field in Slovenia.

Sample

The data analysed in this study were gathered using a questionnaire. The questionnaire was e-mailed in April 2008 to 100 large production companies in Slovenia. Some of the data were gathered from Slovenian six sigma society data base. The others were collected according to available public data for organisations, functions and addresses. Because the whole expansion of six sigma in Slovenia was not known before this research, a huge number of organisations from different industries was included in the research. Out of 100 questionnaires e-mailed, 21 totally completed questionnaires were returned within 3 month. This represented a 21 percent response rate (Table 2). Because this is the first study in this field in Slovenia the study represents only a preliminary study.

Data collection in this study consists of several main sections: background of the companies, participation of different levels of management in defining six sigma projects, use of different tools for identification of potential six sigma projects and key criteria for project selection.

The first section was intended to determine fundamental issues such as the companies' industry sector, the maturity of six sigma in the companies investigated regarding the number of projects carried out and the number of years since six sigma was launched. The second section focuses on participation of different levels of management in defining six sigma projects. The third and the fourth section consist of the use of different tools for six sigma project detection and criteria for six sigma project selection.

The companies were asked to rank the criteria if and which of the claims fit to their practice in their organisation. Simple yes/no type of questions in the questionnaire was defined to provide us a better perspective of the current six

Table 2: Characteristics of the sample.

Sample	Number
e-mail	100
Response e-mail	21
Companies	
Companies implementing six sigma	8
Other companies	13
Total	21
Number of employees in companies	
50 to 100	3
100 to 500	9
500 to 2000	7
more than 2000	2
Industrial sector – manufacturing companies	
Automotive	5
Electro	2
Chemical	4
Mechanical engineering	7
Telecomunication	3
Participants - position of all respondents in the company	
MBB	1
BB	2
GB	8
YB	2
Six sigma implemented projects within the company	
Less than 10	4
Between 10 and 20	2
Between 20 and 30	1
More than 30	1
Current status on 6 sigma in the organisation	
Less than 1 year	4
Between 1-3 years	3
More than 3 years	1

sigma practices in this field of the research in Slovenian companies. The questions in each sector were defined based on literature, similar researches abroad, and practice experiences of some authors.

4 Results of the study

(1) Background of the companies

Characteristics of the sample

The first part of the data collected helps us to understand the findings of this study better. Several crucial aspects were analysed such as; number of employees, therefore, aspects such as number of the employees in each organisation, the position of the respondents in their organisations, the areas of industry, the status of six sigma implementation, number of years of presence of six sigma in the company and number of completed six sigma projects within the organisation.

(2) Participation of different levels of management in defining six sigma projects

The first step of six sigma project selection is establishment of a cross-functional team including the top management (Davis, 2003). The responsibility of a team or a steering committee is to identify, prioritise, select, monitor and evaluate six sigma projects (Banuelas et al, 2006). Top management helps company strategy to be included in six sigma projects. It supports project management by removing the obstacles and barriers more effectively (Kelly, 2002).

Accordingly, respondents in this survey were asked about people involved in their six sigma projects selection process. About 33 percent of functional managers and even 34 percent of direct top managers were included in the survey (executive managers, directors of business areas).

This top-bottom approach to select projects has three main advantages. First, the projects would fit with the business strategy. Second, it is more structural and managerial and finally, it has benefit to six sigma projects with management support (Harry and Schroeder, 2000).

Klefsjo et al. (2001), six sigma methodology is a top-down, rather than a bottom-up approach. In addition, adopting the bottom-top approach can result in lack of management commitment, selection of wrong projects, a failure in incorporate both the external customer satisfaction and the business strategy (Lynch and Soloy, 2003).

Final projects in Slovenian companies are chosen by top management (50 percent). Less frequently the final decision is made by functional management, and even less frequently by senior managers. The final decision about six sigma project selection is the least frequent decision made by a project management team.

That is not so surprising and is related to a strong commitment of top management and its role in project identification and using top-bottom strategy at project definition. That can be related also to the fact that majority (Table 2) of the companies included in this research employs six sigma up to three years. That can be considered as an early stage of implementation. The crucial role and responsibility for it is entitled to top management which is interested in demonstrating the best possible effects of six sigma on business.

(3) The use of different tools for identification of potential six sigma projects

Selecting adequate sources and identifying useful information to identify six sigma projects are seen as the 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, development in technology, extension of other six sigma projects and waste.

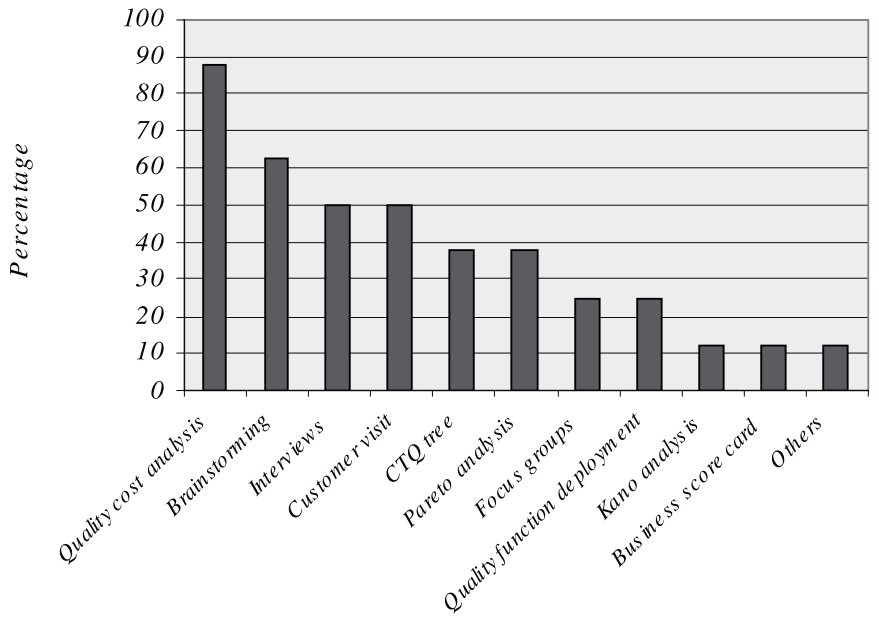

Figure 2: Tools and sources of data used to identify potential projects

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 customer" (VOC) should be used to identify potential six sigma projects (Johnson, 2002; Man, 2002).

During this survey companies were asked if they identify projects according to customer requirements. About 60 per cent of the companies identify potential projects from their customers. This result shows the alignment with the thinking that six sigma should include customers need into improvement projects (Pande et al., 2000).

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). Respondents were asked which tools of six sigma they are currently employing.

In this survey, almost 90 per cent of respondents identify projects by means of quality cost analysis, 60 percent by means of brainstorming of the project team and 50 percent by means of customer interviews, a CTQ tree and the Pareto analysis follow. Figure 2.

Focus groups, Quality Function Deployment (QFD), Kano diagram and business score card are employed by the minority of the companies. A detailed analysis shows us that all of the companies use more than one tool at the same time to identify potential six sigma projects.

(4) Criteria for six sigma project selection

Effective project selection is based on identifying the projects that best match the current needs, capabilities and objectives of organisations (Pande et al., 2000). Different measurements, rules and standards which help us to guide the six sigma project selection are proposed in the literature. During this survey the criteria found in the literature were grouped into six main criteria as is shown in Table 2. Regarding literature overview (Harry and Schroeder, 2000; Pande et al, 2000; Snee, 2001; Goldstein, 2001; Breyfogle et al. 2001; Pyzdek, 2000, 2003; Antony, 2004) respondents were asked to rank the following critical criteria for six sigma project selection (Table 4). Selection criteria need to be prioritised so that those which are most critical to the overall success of the organisation will have the most impact on the project selection. Sometimes, a particular criterion is a useful gauge of how well a project will deliver several outcomes (Banuelas, 2006).

As it can be seen from Figure 4, these criteria, customers, connected to business strategy, finance and learning and growth factor present significant influence on selection of six sigma projects in Slovenian manufacturing companies. These results can be related to previous studies of critical success factors for six sigma implementation, where customer focus, linkage to business strategy, top management commitment and financial benefits are considered as essential factors for successful implementation of six sigma (Banuelas and Antony, 2002; Antony, 2004). This can be related to the beginning stage of implementation of the six sigma in Slovenian companies where analysis shows (Table 2) that 49 percent of the companies use six sigma up to 1 year and even 87 per cent of the companies use six sigma from 1 to 3 years. In this early stage of implementation it is reasonable that the first projects - pilot projects - are oriented in customer benefit, strategy and in finances, because they are usually used to demonstrate the best effects on a later stage or further projects. In addition, they are much more oriented in quick wins with high probability of success.

5 Discussion and implications of the results

The results of this study represent a study of selection criteria for six sigma projects in Slovenian manufacturing companies by investigating;

- the role of different levels of management in identification and prioritisation of six sigma projects;
- the quality management tools used for identification of six sigma projects;
- key criteria for six sigma project selection in the Slovenian manufacturing companies.

Research consisted of the following conceptual framework; study of the background of the companies, study of the participation of different levels of management in defining six

Table 4: Impact factor on six sigma project selection

Impact factor on six sigma project selection	Number of answers	Percent %
Customer benefit	6	75
Connected to business strategy	4	50
Finance benefit	4	50
Learning and growth	4	50
Feasibilty	4	50
Measurable results	3	37.5
Duration time of project	3	37.5
Contribution to company development	3	37.5
Top management support	2	25
Availability of knowledge	1	12.5
Resources capacity	1	12.5
Availability of data	1	12.5

sigma projects, study of the use of different tools for identification of potential six sigma projects and study of the key criteria for project selection and progression.

Results show that:

most of the companies that completed the questionnaire use the top-bottom strategy for identification of six sigma projects. Selection criteria are usually prioritised to those, who are from the top management recognised as the most critical to the overall success of the organisation. This top-bottom approach to select projects has three main advantages. First, the projects would fit with the business strategy. Second, it is more structural and managerial and finally, it has benefit to six sigma projects with management support. In opposite, adopting the bottom-top approach can result in lack of management commitment, selection of wrong projects, a failure in incorporate both the external customer satisfaction and the business strategy. Final projects in Slovenian companies are chosen by top management (50 percent). Final decisions are less frequently made by functional management, senior managers follow and the least frequent final decision-making processes about six sigma project selection are allotted to a project management team.

Almost 90 per cent of respondents identify projects by means of quality cost analysis, 60 percent by means of brainstorming of project team and 50 percent by means of customer interviews, followed by CTQ tree and Pareto analysis.

All of the companies employ more than one tool to identify potential projects, including brainstorming, CTQ tree, focus group, interviews, customer visits, QFD and Kano analysis, among others. Focus groups, quality function deployment (QFD), Kano diagram and business score card are employed by the minority of the companies. A detailed analysis shows us that all of the companies use more than one tool at the same time to identify potential six sigma projects.

The main criteria to select six sigma projects are focused on customers, connection to business strategy, finance and learning and growth. These results can be related to previous studies of critical success factors for six sigma implementation, 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. This can also be related to the beginning stage of the implementation of the six sigma in Slovenian companies where analysis shows (Table 2) that 49 percent of the companies use six sigma up to 1 year and even 87 per cent of the companies use six sigma from 1 to 3 years. In this early stage of implementation it is reasonable that the first projects - pilot projects - are oriented in customer benefit, strategy and in finances, because they are usually used to demonstrate the best effects on a later stage or further projects. In addition, they are much more oriented in quick wins with high probability of success.

Six Sigma within manufacturing companies in Slovenia is a rapidly emerging methodology. On the other hand many of the Slovenian manufacturing companies are still unaware of six sigma and many of them do not use it. One of the reasons for not using six sigma in Slovenia might also be that management in manufacturing companies is often satisfied with the current quality management system in their organisation, which can be related to the fact that companies do not exactly know the relation between customer satisfaction, processes management, costs and possible savings inside the company.

Limitations and Further Research

This paper is limited to the selection of six sigma projects in manufacturing companies in Slovenia. A sample is limited by the number of companies which have implemented six sigma. The identification of the most commonly used criteria to select six sigma projects can help practitioners to select projects based on multiple criteria and using tools and techniques identified in this survey.

This study was carried out with some boundaries such as a number of companies, available resources and it is also limited to Slovenian organisations. An important limitation of this paper is the respondent rate, however, the response rate is similar to other surveys on six sigma. The results presented in this study are preliminary and are based primarily on descriptive statistics. Future studies will be focused on research of some other basic six sigma status in Slovenia, and further attempts to generalise some of the findings will be proceeded.

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Kriteriji izbire šest sigma projektov v slovenskih proizvodnih organizacijah

Raziskave kažejo, da je uspešno uvajanje šest sigma metodologije v organizaciji povezano z določanjem kriterijev in s primerno izbiro projektov. Ta raziskava se osredotoča na merila izbire šest sigma projektov, ki se izvajajo v proizvodnih organizacijah v Sloveniji. Namen te raziskave je raziskati, katera merila se v slovenskih proizvodnih organizacijah uporabljajo pri določanju in pri izbiri šest sigma projektov prioritet in pri izbiri šest sigma projektov. V raziskavo vključen vzorec organizacij je omejen s številom organizacij, ki so do sedaj v Sloveniji že uvedle metodologijo šest sigma. Rezultati te raziskave kažejo, da slovenske organizacije najpogosteje izbirajo projekte na osnovi koristi, ki jih bodo rezultati projekta doprinesli k zadovoljstvu kupca, skladnost in povezanost projekta s strategijo organizacije ter njeno rastjo. Kot pomoč pri določitvi nabora potencialnih šest sigma projektov in njihovi izbiri se uporablja več orodij kot je analiza stroškov, viharjenje možganov, pogovori s kupci. Identifikacija najbolj pogosto uporabljenih metod in uporaba njihovih kombinacij strokovnjakom iz prakse pomaga pri izbiri njihovih šest sigma projektov. Ta raziskava predstavlja prvo študijo na tem področju v Sloveniji in je preliminarna.

Ključne besede: Šest sigma, Projektni management, Izbira projektov, Management, Proizvodne organizacije, Študija primera, Preliminarna raziskava, Slovenija,