

APPLICATION OF SIX SIGMA AS AN INNOVATIONS GENERATION TOOL

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Abstract: *The Six Sigma approach has gained a reputation as widely-spread means for the improvement of operations quality in a number of well-known companies. Over the course of time it has proved its effectiveness not only as the next technique enabling quality management systems improvement, but it has gained grounds as a philosophy, attitude and new management approach. This paper presents a general concept outlining the development of ‘company – customer’ relations, a framework for the implementation of Six Sigma as a managerial approach, and a practical model for Six Sigma application as an innovation generation tool leading to general management improvement.*

Key words: *Six Sigma, quality, value, innovations generation model, management, strategy.*

1. INTRODUCTION

Innovations are considered to be of key importance for gaining and sustaining a competitive advantage in the contemporary economy.

Innovation is something quite different from *invention*. *Innovation* means *invention* implemented and taken to market [1].

This concept raises another issue of key importance. How the innovation generation ideas are created, and what factors and processes enable the transition process of an invention to an innovation, in terms of gaining rents for the company.

The essence of the firm in the current economy is its ability to create, transfer, assemble, integrate, protect and exploit knowledge assets.

Knowledge assets underpin competences, and competences in turn underpin the firm’s products and service offerings to the market [9].

The contemporary market economy is regarded as very customer-driven, though in management theory and practice it is widely acknowledged that there are other forces impacting the competitive advantage.

The goal of the competitive strategy for a business unit in a particular industry is to find a position in the industry where the company can best defend itself against the “5-forces”: *buyers, suppliers, substitutes, new entrant, and existing competition*, or can influence them in its favour [8].

Still, in quality management [2, 5, 7, 10] and innovation management literature [1, 6] the influence of the customers is considered to be of critical importance for gaining a competitive advantage.

On the other hand Six Sigma is an evolutionary development in the quality science that combines the best elements from many earlier quality initiatives.

The philosophies related to Six Sigma have existed in one form or another long before this approach was created and gained popularity.

Customer focus, data-driven decision-making, business results focus and process understanding are not new approaches to business success. What is new, and what makes Six Sigma so powerful, is the combination of these elements with a rigorous, disciplined approach and well-publicized, proven business success [3].

Originally created and implemented in 1986 by Motorola [4], developed further and applied by companies like General Electric Co. and Allied Signal (now Honeywell International Inc.) in the 1990s, Six Sigma gained much popularity as a quality improvement methodology and imposed itself as a system guaranteeing improvement of all processes to level, producing only 3.4 defects (defined as something not meeting the customer’s requirement) per million opportunities [2].

This paper presents a general concept for the development of the “company – customer” relations, based on which a framework for implementation of Six Sigma as a managerial approach is presented.

Building on the wide abilities for monitoring and evaluation of almost any kind of process, which are provided by the Six Sigma methodology, a model for innovation creation has been suggested.

The innovations are defined based on the registered causes for process variations. A project is developed for each potential innovation.

Finally the paper is focused on an assessment approach for selecting the most suitable innovation projects in line with for the enterprise’s business and main objectives.

2. RESEARCH DESIGN

The research findings are a result of an extensive literature review of Six Sigma and innovation management theory, and secondary data case studies in-depth analysis. Analyzed are the interrelatedness between a practically applicable quality management approach such as Six Sigma, and the innovation generation process from a “company – customer” perspective.

3. SIX SIGMA AS AN INNOVATION GENERATION TOOL

3.1. Understanding Six Sigma

Six Sigma has been studied and applied mainly as quality management systems improvement methodology, implemented at several stages – *define, measure, analyze, improve* and *control* [2].

During the last decade it has further developed as leadership and process management tool in organizations of different types and sizes. Research on the feasibility and sustainability of the approach has outlined the following requirements as key for Six Sigma success: management commitment and visible support; treatment of Six Sigma as a holistic concept; investment of adequate resources; focus on results; customer orientation; focus on training and its content; adaptation to an organization's situation and needs; development of strategy to introduce Six Sigma; follow-up and communication of success stories; responsiveness to external influences.

However, little attention has been paid to the Six Sigma potential as managerial approach, and especially as an innovation generation tool.

3.2. “Company – customer” perspective

Acknowledging the key role customers play in the business success in all types of companies irrespectively of their size, origin, or other specific characteristics, the main objective driving businesses towards performance excellence can be defined as: *maximal financial benefits achievement while maximally satisfying the customer needs*.

Customers would like to receive the exact product or service they expect, and they want to get it at a price that corresponds to their perception for the specific value of the product. Research and evaluation of the exact specification of customer requirements are a guarantee for the realization of this objective.

From the “company – customer” perspective, the precise specification of the customer requirements leads to a change in management focused on the achievement of the company's objective. The idea of satisfying the dynamically changing requirements of the customers is not new. Many authors [4, 5] treat the issues related to the hidden needs, wishes and requirements of customers and the possibilities for their actual fulfillment in the products made and services offered.

The level of customer satisfaction is often represented by two main factors – “quality” and “value”. The “quality” of a certain product and/or service is a widely discussed concept, which is often misinterpreted and has different definitions. Though the debate about what quality actually is, is still going, there is more or less general agreement to regard quality as having two components: *quality in fact* (achieved by doing exactly what you set out to do by fulfilling your own specifications) and *quality in perception* (achieved when a customer believes that what you are offering matches his or her expectations) [10].

The second equally important factor to the level of customer satisfaction is “value” [5]. It represents the customer's evaluation of the product or service.

The analyses of “company – customer” relations made and the research of practical experience of leading world companies [1, 2, 4] has led to the conclusion that there is a gap between the customer's perception of “quality” and “value” of the product, and the “quality” and the “value” according to the understanding of the company. Often the actual wishes and needs of the customers are quite different from the products or services offered by the company, irrespectively of the fact that they meet the technical and production requirements. Along with this there is a mismatch between the customer's view of the “value of the product” and the evaluation of a company, based on the cost made during the whole process from the innovation idea generation to the actual realization of the final product. Therefore it is argued that the products and services can be presented in terms of two critical parameters representing the understanding of a customer for the “quality” and “value” of a product. In order to get the overall picture of the processes describing the innovation generation from a “company – customer” perspective the following concepts have been introduced: “quality of the product for the customer”; “value of the product for the customer”; “quality of the product for the company” and “value of the product for the company”.

- ‘Quality of the Product for the Customer’ (QPC) – The combination of all customer requirements for the product, including their “hidden” needs, which though rarely expressed, is expected to be met. It also includes some requirements which the customer fails to mention, considering them technologically impossible. This term combines these with the new needs and wishes, which the producer can evoke in the customer as a result of innovation implementation.

- ‘Value of the Product for the Customer’ (VPC) – The individual evaluation by the customer for the price of a specific product.

- ‘Quality of the Product for the Company’ (QPCo) – The level of the products' parameters reached according to preliminary specified technical requirements and conditions as a result of the company's operation.

- ‘Value of the Product for the Company’ (VPCo) – The combination of all product expenditures during the production process, from the idea creation to the cease of production.

Such a distinction by itself is useful, but is not sufficient to describe the whole picture. An important point in the relationship “company – customer” is its dynamic character. On the one hand customers continually change their requirements and wishes, sometimes even too fast, on the other hand companies constantly provoke new requirements and wishes in customers. This relationship is based on innovations creation – the process related to new ideas generation, turned into products or services, implemented in practice, launched on the market and found needed by customers, i.e. ideas for which the customer is ready to pay. Six Sigma is an approach that reflects the latest achievements of quality management theory and practice, and leads to the improvement of organizations management.

Six Sigma makes it possible to consider the business as a whole continuous process, developing in space and time and comprising a number of sub-processes. The

process variations causes are preconditions for innovations generation. Through monitoring, defining, measuring and analyzing them, innovation projects can be developed.

This concept, from which Six Sigma approach has evolved, provides opportunities for some corrective measures to be taken. These corrective measures might be viewed as innovations of different kind, made in order to ensure the achievement of the objective.

The application of Six Sigma approach can lead to changes in: resources, materials and semi-manufactured items; the organization of the production process; the technology of production; the products and services offered; the human resources – education, training and life-long learning; organization of the work of employees and management; the machines and equipment used; the requirements towards the suppliers, etc.

The Six Sigma approach directs the focus towards elimination of the causes leading to variations in the process from the stage of design and development of products. This way failures and time wasted for rework are decreased and the production cycle is shortened, leading to remarkable financial results. The ability to create “*value of the product for the customer*”, to respond to the “*quality of the product for the customer*” and to motivate the personnel depends not only on the availability of more and better information, effective management and exchange of knowledge, know-how and experience, but is directly related to the determination and parameterization of the different types of failures, mismatches and inconsistencies.

3.3. Model for the application of Six Sigma as an innovations generation tool

The methodological sequence in the application of Six Sigma as a managerial approach, focused on the determination of innovations that are needed to be done, comprises the following sequence:

- development of *strategies* for achieving the main objective;
- preparation of specific *projects* for the realization of one of these strategies, and
- definition of the *processes* that are “key” for closing the gap between the “*quality of the product for the customer*” and the “*quality of the product for the company*”, as well as for minimizing the “*value of the product for the company*” and maximizing the “*value of the product for the customer*” (Fig. 1).

Following this methodology the Six Sigma approach can be applied as an instrument for determining the process-critical parameters, diagnostics of variations from the upper and lower control limits of the technical requirements and specifying the innovations that have to be done in order to achieve the main objective of the enterprise. A project is developed for addressing the causes of each variation.

The economic gains as a result of process improvement, projects performance and strategies realization is evaluated by the “sigma” level reached. The increase of the “sigma” level of a certain process is related to the realization of a specific Six Sigma project, and leads to increasing the company’s overall “sigma” level.

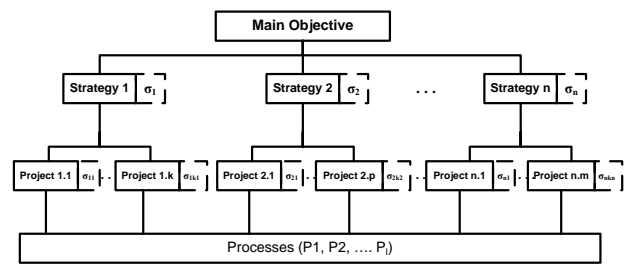


Fig. 1. Six Sigma as a management approach.

Therefore the “sigma” level can be used as a criterion for the comparison of alternative strategies and the selection of suitable projects. It is important to understand the hierarchical nature of the issues related to the performance of a given process.

These problems are interrelated with issues from the operational level, and they in turn are internally related to strategic level issues – customer satisfaction, profitability, profit increase, etc.

Each one of the developed strategies leads to the achievement of the objective, but the different strategies have different levels of effectiveness. The solution to the problem set is to determine the sigma level to be achieved as a result of the application of each one of the strategies.

The strategy which leads to the achievement of the highest sigma level is of course the most effective one. Provided that two strategies lead to equal Sigma levels, the choice is made by the enterprise manager and the decision makers’ team.

Building on the eight stages of Six Sigma recommended [4]: *recognize, define, measure, analyze, improve, control, standardize, integrate*, the model is developed further (Fig. 2).

- **Determine the core problems of the enterprise.** The definition of the core problems of the enterprise is aimed at finding out the way in which business is done, to study the main customers, “key” processes and the “critical” for quality outputs of the product. Customer satisfaction is a reflection of company activity and products offered. Determining the core problems of the enterprise comprises the *recognize* and *define* stages.

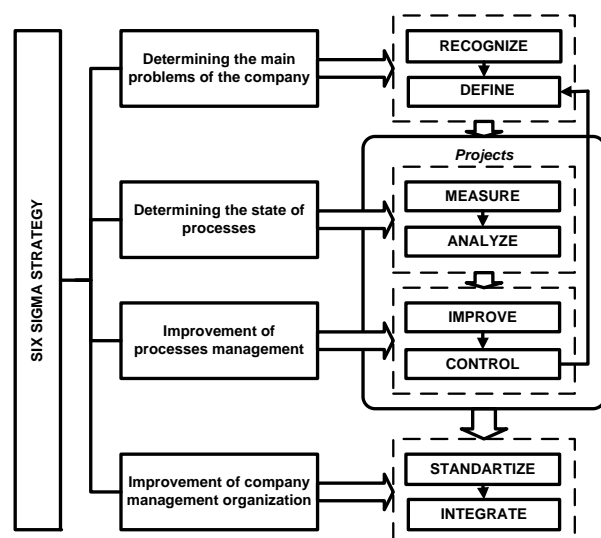


Fig. 2. General model for Six Sigma implementation.

- **Determine the state of the processes.** Evaluating the present state of the processes provides the opportunity to specify tasks which the enterprise should address in order to achieve the main objective. It is a starting point for determining the improvements and innovations which must be done. This phase involves the *measure* and *analyzes* stages. The “critical” parameters of the output are specified.

- **Improve the process management.** The *improvement* of processes management determines what is to be done in order to improve a certain process and decrease the impact of the factors leading to deviation from the technical requirements and conditions. Based on the information collected from the previous phases, the type and form of changes needed is determined. This can result in the implementation of innovations which change the technical requirements and conditions of the processes performance, the materials used, technologies, equipment, etc. The *control* stage guarantees that the process is capable and in control.

- **Improve the enterprise management organization.** The main objective of the Six Sigma strategy is the maximal utilization of the positive results achieved. They must be embedded in the management of the company and become part of the organizational culture. This imposes binding the results of the lower hierarchical levels with the results of the processes of higher hierarchical level. In order to achieve improvement of enterprise management, it is important that this way of thinking is accepted by the enterprise managers and is integrated in the way of thinking of the whole company. The stages of *standardization* and *integration* are included here.

The specific tasks which the projects can address are of varying importance. The sequence in solving the projects proposed is determined by the relative share of each of them in achieving the final objective. The appropriate choice of a project depends on its parameterization and clear definition of its role in the enterprise.

The Six Sigma innovation projects' selection can be based on criteria such as: economic effectiveness; potential influence on the “company – customer” relations; extend to which the project is in consistence with the goals and tasks directed towards the achievement of the “*quality of the product for the customer*” and “*quality of the product for the company*”; project feasibility, bearing in mind the existing resources and technical possibilities of the enterprise.

The methodology for innovation projects selection is based on the multi-criteria analysis approach, applying a Project Assessment Matrix.

The assessment of the project is made by a group of experts evaluating the level of influence of the i -th project (Pr_i) to the k -th criterion (E_k). The choice is based on the sum of the values of the co-relation between the relevant project and the criterion multiplied by the weight coefficients for each one of the criteria.

The respective functional area of management in the enterprise and the aims and tasks determined must be taken into consideration. A list of innovation projects, arranged based on their priorities, is developed.

The selection of each project is based on the possibility of its application and its impact on main objective achievement.

4. CONCLUSIONS

The Six Sigma approach not only registers the quality of products or services, but also monitors the quality, capability and suitability of the whole process as it foresees the “points” where a problem with the quality might arise, and offers preventive measures for the minimization of their influence. This in turn is related to the improvement of the effectiveness and efficiency of company management.

The projects Six Sigma area implemented innovations that provide conditions for the improvement of the management and lead to improvement of the efficiency and effectiveness.

The application of the Six Sigma approach enables the discovery of new opportunities and sets a serious basis for better flexibility, adaptability and innovativeness of companies. The benefit is that it is directed towards the improvement of all sub-processes within a given process, which guarantees the faster achievement of results.

REFERENCES

- [1] Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press, ISBN 1-57-851-837-7, Boston Massachusetts.
- [2] Eckes, G. (2001). *The Six Sigma Revolution: How General Electric and Others Turned Process into Profits*, John Wiley & Sons, New York.
- [3] Floran, J. (2003). *The Evolution of Six Sigma*, Six Sigma Forum Magazine, August 2003, pp. 38-39.
- [4] Harry, M., Schroeder, R. (2000). *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*, Doubleday, Random House, New York.
- [5] Kotler, Ph. (1991). *Marketing Management*, Prentice-Hall International Editions, 7th edition, 1991.
- [6] Lefterova, T. (2006). *Virtual Cellar Manufacturing Systems – the Means for Increase of the Competitiveness of the Industrial Enterprises*, Proceedings of Business, Management and Education '2006, Technika, pp. 227-240, Vilnius Gediminas Technical University, Vilnius.
- [7] Nikolova, I. (2005). *Concept for Management Integration in the Bulgarian Enterprises*, Proceeding for scientific conference “Restructuring of the Bulgarian Economy”, UNWE, ISBN 978-954-494-837-7, University Publishing House ‘Stopanstvo’.
- [8] Porter, M.E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*, The Free Press.
- [9] Teece, D.J. (2000). *Managing Intellectual Capital: Organizational, Strategic and Policy Dimensions*, Oxford University Press, ISBN 0-19-829541-3.
- [10] Townsend, P., Gebhardt, J. (2006). *The Future of Quality*, The Smart Manager, Oct.-Nov. 2006, Vol. 5, Issue 6.

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