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REASONS AND BENEFITS OF IMPLEMENTING SIX SIGMA IN THE EMPIRICAL STUDY OF ENTERPRISES OPERATING IN POLAND

Abstract. The aim of this article is a presentation of methodologies which refer to improvement of processes and products defined as Six Sigma. The workers' qualifications play the essential role in the implementation of improvement projects while utilizing these methodologies. The organizations which are using Six Sigma as the tool operating improvement try to actively include all the workers in realization of these projects. The employees have to have a cycle of intensive trainings. These courses could help them to acquire the knowledge which is necessary to use the tools and techniques for the implementation of improvements.

Key words: Six Sigma, process improvement.

1. INTRODUCTION – SIX SIGMA APPROACH ASSUMPTIONS

The concept of Six Sigma as a process and product improvement approach was Founded as an internal company initiative within Motorola. The company is being supplanted by a strongly competitive in quality and affordable products. The Japanese concentrated their efforts on developing an effective management system using advanced static methods. Identifying the expectations of customers (called Voice of Customers) identifies the critical values of quality (CTQ – called Critical to Quality). These were also measured in the number of defects, discrepancies in each process. (Watson, 2004) This concept is called the Motorola Six Sigma and has the ability to continually reduce costs through lowering the cost of inadequate quality (CIPQ – Cost of Poor Quality) by continuous monitoring and controls to eliminate and prevent incompatibilities in processes and products (Dedhia, 2005; Ravichandran, 2006). This introduced the concept level meter in assessing the quality of comparable areas of the organization. It is a measure of DPMO (Defects per Million Opportunities) specifying the number of errors in relation to the commission of a million possibilities. Probability in the case of Six Sigma was set at 3.4 errors per million operations. Functional support areas such as finance, accounting, marketing, human re-

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sources, procurement, and retail, however, have not kept pace with manufacturing in implementing Six Sigma programs. In part, this is due to the rigorous applications of requirements that were considered too difficult to be applied in areas other than functional or a predominantly service organizations (Pyzdek, 2003). Six Sigma involves conducting continuous measurement and analysis of the results. A particularly important measure in the framework of this concept is FPY (First Pass Yield) which is defined metric, as the number of units coming out of a process divided by the number of units going into that process over a period of time, specified this concept was in fully developed industry at large corporations as Allied Signal/Honeywell and GE (Pande et al., 2000). The process of implementing the concept of Six Sigma begins with the awareness of the need for its implementation in the enterprise. The decision to implement it can have many causes, such as: finding new opportunities for development (through the introduction of product innovations and/or organizational), ahead of competitors, market share growth, more rapid delivery of new products/services to market (reduction of process cycle) cost reduction processes, and increase profits (Da Vison, Al-Shaghana, 2007).

2. IMPLEMENTING SIX SIGMA

Six Sigma approach can be used both for improving existing and the implementation of new processes and products (Wilson, 2005). In the case of improvement of existing processes, the most commonly used methodology known DMAIC (Define-Measurement-Analyze-Improve-Control). In the Define phase, the project team must work with stakeholders to closely and clearly define the problem statement, project scope, budget, schedule, and constraints. (Creveling et al., 2006). The Six Sigma project team has to define problems and establish the goals of the project (should be transparent to all employees) which are consistent with custom expectations and with the company's business strategy. In this phase, there should be established a project charter (to show the business case, problem definition, target, focus, roles and milestones of the project), and SIPOC diagram (that analyze suppliers, input, process steps, output, and Customers) and the Critical-to-Quality (CTQ) matrix (Incorporating customer demands) are common in this phase (George, 2003; Pande et al., 2000). During the measure phase, the team creates a Value Stream Mapping (VSM) of the process, capturing the flow of information. The most widely used tools are VSM, run charts, brainstorming, balanced scorecards, documentation tagging, data collection check sheets, and decision metrics. During the analyze phase, the team needs to collect and analyze. The tools that can be used are process flow chart, value stream mapping, cause-and effect diagram, Pareto analysis, histograms, control charts, and root cause analysis. During the Improve

phase, the team uses all possible solutions that should be developed, enabling the team to eliminate the root causes of problems. The recommended tools include brainstorming, cost-benefit analysis, priority metrics, failure mode and effect analysis, and process flow diagrams. During the control phase, the team should standardize and document the new process to support and sustain the desired improvements. Tools used include Statistical Process Control charts, flow diagrams, and Pareto charts (Foster, 2007). Six Sigma methodologies can be used for improving existing processes and products, as well as implementing new processes/products. The latter approach is referred to as DFSS (Design for Six Sigma – Stevenson, Kashef, 2008; Edgeman, Dugan 2008). Most used DFSS methodology is DMADV (Define-Measurement-Analyze-Design-Verify/Validate), which includes:

– defining the new project and what you expect your customers (and other stakeholders, especially the owners, employees);
– defining a new specification and customer requirements;
– analyzing processes to satisfy the requirements of the recipient;
– drawing up a detailed design process to satisfy the requirements of the recipient;
– verification/validation process and the effects of capacity to meet the requirements.

Therefore Six Sigma a methodical approach to solving problems, streamlining the system repeatedly, challenging the expectations of customers in the first place but also to improving the efficiency and effectiveness of the organization. It focuses on meeting the requirements of stakeholders (customers, owners, suppliers, employees and society). Six Sigma projects are primarily related to the implementation of new products/processes, improving the technical quality of existing products, improving efficiency, shortening process cycles, improved internal and external communications, as well as improving safety and reducing the burden on the environment. Implementation of this concept can be applied to all conditions, without restrictions concerning the business type or size of business (Santurk et al., 2006).

3. SIX SIGMA PROJECT MANAGEMENT

Particularly important in the implementation of Six Sigma projects is communication between team members. It is done through monthly and quarterly meetings (combined with the exchange of experiences, training and evaluation of results) and intranet (through which employees have access to the tools, data). The success of Six Sigma implementation depends largely on effective communication with stakeholders of the organization (customers, direct users of its products, suppliers, employees, community centers, government, regulatory

bodies, financial institutions, owners, managers), allowing to define their expectations, as well as skillful development strategy aimed at efficient use of resources, to define precise goals and metrics for the assessment activities to improve implementation of the processes within an organization. In organizations implementing Six Sigma, the approach to individual levels of governance are assigned by corresponding hierarchical levels: champions, sponsors, master's black belts, black belts, green belts. Champions are usually members of senior management organization (chairman or deputy chairman). They shall remain in the role of champions. As a rule, for one business unit (plant) a champion is set up. Sponsors Six Sigma defines the process owners, recruited among senior managers. In turn, master black belts, are people who have the most experience in both technical and organizational matters. Their task is to manage projects by focusing on analyzing processes and identifying potential opportunities for improvements (by removing non-compliance, prevent the emergence of potential non-compliance, performance improvement processes). Black belts are trainers, advisers, and motivators for other employees. They identify emerging causes of errors and develop a methodology for their efficient elimination. The green belts, the project leaders, possess both the skills and abilities to lead teams implementing the improvements in processes. These individuals are also responsible for conducting the instruction of conduct in workplaces. They are recruited from their positions related to the project. Some companies create additional levels in the hierarchy of roles ascribed to the implementation of Six Sigma. These include yellow belts and white belts. The first group are the heads of surgical teams that, when properly trained are capable of using simple tools and used them after the transfer of powers to develop and manage small projects, directly respond to perceived problems. The last group is the white belts. These belong to the ranks of employees who underwent training in the basic issues related to implementation of Six Sigma projects. Completion of such training enables them to easily understand the processes and techniques and methods used for their improvement through improvement projects (which are consistent with the overall objectives and strategy of the organization), aimed at raising the level of customer satisfaction (internal and external) and the level of profitability. Number of projects implemented by the company should not be too large, as this may cause, that they are not properly conducted and supervised. Excessive number of projects are distracting employees and reducing the chance of proper implementation which could result in drawing the erroneous conclusion that Six Sigma does not produce the desired effect. The responsibility of organizations is to develop a detailed plan of training, including who will be trained, from which range and when. Mandatory training for all staff should be carried out explaining the basic issues related to Six Sigma and the need to implement the concept in the enterprise. Training related to Six Sigma projects includes advanced methods and tools for statistical and organizational solutions. Trainees shall be selected

by taking into account their experience, education and knowledge, and interpersonal abilities (Han, Lee, 2002). Furthermore, much of the current Six Sigma training structure is based on the specific training of the Statistical and process improvement tools (Harry, Schroeder, 2000; Antony, 2006), while training in soft skills, leadership and coaching often is a more technical skills.

4. THE RESULTS OF EMPIRICAL RESEARCH ON THE CONDITIONS RELATED TO THE IMPLEMENTATION OF SIX SIGMA IN POLAND

The aim of this research was to identify the conditions, benefits and difficulties of implementing the concept of Six Sigma. The study was conducted in 30 purposefully selected companies operating in the Polish market, which have implemented this concept. Results of studies show that Six Sigma is mostly implemented by large and medium-sized manufacturers (employing over 50 employees) with foreign capital on international scale activities that provide B2B products to market. Companies by implementing this concept are guided chiefly by its main objectives, namely improvement of processes (by shortening implementation cycles, increase their reliability, efficiency improvement measures), as well as product development (by internal errors and complaints, and technical improvements). The results are presented in Tables 1–8.

Table 1. Reasons to be taken into account by the surveyed companies in implementing Six Sigma (the comparison between segments depending on manufacturers and companies on an international scale; percentage rate)

Reasons to be taken into account by the surveyed companies in implementing Six Sigma	General, N = 30	Manufacturers, N = 27	Companies on an international scale, N = 28
Shortening process cycles	76.67	74.07	75.00
Improvement of product quality	56.67	62.96	57.14
Reducing the number/cost complaints	50.00	48.15	50.00
Increase process efficiency	46.67	48.15	46.43
Increase the reliability of processes	40.00	37.04	42.86
Increase awareness and commitment of staff	36.67	29.63	39.29
Successful achievement of the objectives	36.67	33.33	39.29
Reduction of internal nonconformities	36.67	33.33	39.29
Requirements of business group	33.33	29.63	35.71

Source: own research.

Table 2. Achieved advantages by the surveyed companies in implementing Six Sigma (the comparison between segments, depending on and companies with international scope of activity; percentage rate)

Achieved advantages	General, N = 30	Producers, N = 27	International scope of business activity N = 28
Shortening process cycles	56.67	55.56	57.14
Improvement of product quality	36.67	44.44	39.29
Reducing the number/cost complaints	36.67	44.44	39.29
Increase process efficiency	43.33	48.15	46.43
Increase the reliability of processes	33.33	37.04	35.71
Increase awareness and commitment of staff	33.33	25.93	35.71
Successful achievement of the objectives	23.33	25.93	25.00
Reduction of internal nonconformities	26.67	29.63	28.57
Requirements of business group	26.67	29.63	28.57

Source: own research.

Table 3. Reasons to be taken into account by the surveyed companies in implementing Six Sigma (the comparison between segments depending on source of capital; percentage rate)

Reasons to be taken into account by the surveyed companies in implementing Six Sigma	Foreign companies, N = 23	Home companies N = 7
Shortening process cycles	78.26	71.43
Improvement of product quality	52.17	71.43
Reducing the number/cost complaints	52.17	42.86
Increase process efficiency	47.83	42.86
Increase the reliability of processes	43.48	28.57
Increase awareness and commitment of staff	43.48	14.29
Successful achievement of the objectives	39.13	28.57
Reduction of internal nonconformities	39.13	28.57
Requirements of business group	39.13	14.29

Source: own research.

Table 4. Achieved advantages by the surveyed companies in implementing Six Sigma (the comparison between segments, depending on source of capital; percentage rate)

Achieved advantages	Foreign companies, N=23	Home companies N=7
Shortening process cycles	65.22	42.86
Improvement of product quality	39.13	42.86
Reducing the number / cost complaints	39.13	42.86
Increase process efficiency	47.83	42.86
Increase the reliability of processes	39.13	14.29
Increase awareness and commitment of staff	43.48	0.00
Successful achievement of the objectives	26.09	14.29
Reduction of internal nonconformities	34.78	0.00
Requirements of business group	30.43	14.29

Source: own research.

Table 5. Reasons to be taken into account by the surveyed companies in implementing Six Sigma (the comparison between segments depending on number of employees; percentage rate)

Reasons to be taken into account by the surveyed companies in implementing Six Sigma	Number of employees	
	51-250, N = 8	More than 250 N = 22
Shortening process cycles	62.50	81.82
Improvement of product quality	62.50	54.55
Reducing the number/cost complaints	50.00	50.00
Increase process efficiency	37.50	50.00
Increase the reliability of processes	37.50	40.91
Increase awareness and commitment of staff	37.50	36.36
Successful achievement of the objectives	25.00	40.91
Reduction of internal nonconformities	37.50	36.36
Requirements of business group	12.50	40.91

Source: own research.

Table 6. Achieved advantages by the surveyed companies in implementing Six Sigma (the comparison between segments, depending on number of employees; percentage rate)

Achieved advantages	Number of employees	
	51-250. N = 8	More than 250 N = 22
Shortening process cycles	37.50	68.18
Improvement of product quality	25.00	45.45
Reducing the number/cost complaints	25.00	45.45
Increase process efficiency	25.00	54.55
Increase the reliability of processes	12.50	40.91
Increase awareness and commitment of staff	25.00	36.36
Successful achievement of the objectives	0.00	31.82
Reduction of internal nonconformities	12.50	31.82
Requirements of business group	0.00	36.36

Source: own research.

Table 7. Reasons to be taken into account by the surveyed companies in implementing Six Sigma (the comparison between segments depending on target market of products; percentage rate)

Reasons to be taken into account by the surveyed companies in implementing Six Sigma	Target market of products	
	B2B, N = 23	B2C N = 7
Shortening process cycles	73.91	85.71
Improvement of product quality	56.52	57.14
Reducing the number/cost complaints	43.48	71.43
Increase process efficiency	43.48	57.14
Increase the reliability of processes	39.13	42.86
Increase awareness and commitment of staff	39.13	28.57
Successful achievement of the objectives	34.78	42.86
Reduction of internal nonconformities	34.78	42.86
Requirements of business group	30.43	42.86

Source: own research.

Table 8. Achieved advantages by the surveyed companies in implementing Six Sigma (the comparison between segments, depending on market of products; percentage rate)

Achieved advantages	Target market of products	
	B2B, N = 23	B2C N = 7
Shortening process cycles	52.17	85.71
Improvement of product quality	34.78	57.14
Reducing the number/cost complaints	34.78	57.14
Increase process efficiency	43.48	57.14
Increase the reliability of processes	34.78	28.57
Increase awareness and commitment of staff	34.78	28.57
Successful achievement of the objectives	21.74	28.57
Reduction of internal nonconformities	26.09	28.57
Requirements of business group	21.74	42.86

Source: own research.

The main barrier to the implementation of this concept is the low level of awareness and commitment of operational staff, as well as the high costs associated with its implementation (consultation, training). Especially the problem of low awareness of staff and operational staff from all the stress the major companies operating in the B2B market. Detailed results are presented in Tables 9–12.

Table 9. Difficulties identified by the surveyed companies in the implementation of Six Sigma (results of 2009, a total and a comparison between the manufacturers and companies depending on an international scale; percentage rate)

Difficulties	General, N = 30	Manufacturers N = 27	Companies on an international scale N = 28
Low level of awareness and commitment of operational staff	33.33	37.04	35.71
Implementation costs (consultations, training)	23.33	25.93	21.43
Low awareness of staff	20.00	22.22	17.86

Source: own research.

Table 10. Difficulties identified by the surveyed companies in the implementation of Six Sigma (results of 2009, a total and a comparison between the companies depending on number of employees; percentage rate)

Difficulties	Number of employees	
	51-250 N = 8	More than 250 N = 22
Low level of awareness and commitment of operational staff	12,50	40,91
Implementation costs (consultations, training)	25,00	22,73
Low awareness of staff	12,50	22,73

Source: own research.

Table 11. Difficulties identified by the surveyed companies in the implementation of Six Sigma (results of 2009, a total and a comparison between the companies depending on source of capital; percentage rate)

Difficulties	Capital	
	Foreign N = 23	Home N = 7
Low level of awareness and commitment of operational staff	34,78	28,57
Implementation costs (consultations, training)	26,09	14,29
Low awareness of staff	17,39	28,57

Source: own research.

Table 12. Difficulties identified by the surveyed companies in the implementation of Six Sigma (results of 2009, a total and a comparison between the companies depending on market of products; percentage rate)

Difficulties	Target market of products	
	B2B N = 23	B2C N = 7
Low level of awareness and commitment of operational staff	34,78	28,57
Implementation costs (consultations, training)	26,09	14,29
Low awareness of staff	21,74	14,29

Source: own research.

Research results confirm that the Six Sigma projects are increasingly being entered in the plans for achieving specified targets contained in the development strategies of many companies. With the possibility of including them in different levels of the organization and using their potential, they also provide an opportunity to improve staff awareness and involvement in perceiving and solving problems. Often, projects (modifications or implementation of new processes

and/or products) are also impressed in several business units of corporations, which indicate that their implementation is a requirement of the group. Also, domestic business entities implementing good practice by drawing on the achievements of the world's leaders are beginning to use Six Sigma. The results show that the achieved benefits of implementing Six Sigma have been substantially achieved. Analyzing the results of a worldwide research, it is noted that implementation of Six Sigma projects in Poland is in many cases the initial phase of experiments. The data contained in the report of the Aberdeen Group shows that companies implementing the Six Sigma concept take into account the following conditions: improvement of operational processes by reducing costs, improving standardization activities and effective achievement of its objectives, the reduction of internal inconsistencies. The main barriers related to the implementation of this concept are the low level of awareness and commitment of staff and operational staff, as well as the cost of training (especially training for certifying green belts and black belts) and implemented in consultation with projects. However, this requires raising the level of competence by managers of progressively higher level of knowledge about organizational techniques, statistical techniques, and an effective internal communication (vertically and horizontally) and external (with partners in the supply chain) and the implementation of effective motivators shaping engagement and creativity among employees.

To recapitulate, it should be noted that the success of implementing the concept of Six Sigma is clearly in the minds of workers (in the identification of problems) and the improvement of the qualifications and skills in solving practical problems, and also on the active involvement of managers at all levels of management (performing appropriate roles in the implementation of projects) through the transmission of knowledge, or eliminating hierarchical communication barriers with subordinates.

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