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THE ROLE OF INFORMATION COMUNICATION TECHNOLOGY IN SIX SIGMA APPROACH IMPLEMENTATION

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Abstract: *The article discusses* ***Six Sigma Methodology*** *as business philosophy assuring excellent product or service quality and continuous process improving to realise highest customer satisfaction level. There are analysed methodology advantages allowing defects and costs reduction and customer satisfaction improvement. Also, authors discuss methodology successful implementation according to gathering data on business processes* ***regulation indicators*** *values variation, and issued products or services performances.*

The results of implementation process of the Six Sigma Methodology in business system depend on prompt and correct data needed for statistical analysis, and its accessibility via organisation' ***information system****. Correlation between implementation of Six Sigma Methodology and information system development is so strong that non-conformances could cause the Six Sigma Methodology implementation fall.*

Key words: *Six Sigma methodology, quality, information system aligning.*

1. INTRODUCTION

Westside business world today is impressed with results reaching by companies implementing Six Sigma Methodology (*6δMeth*) to their business technology. Journals and societies in almost all west countries offer literature and education on *6δMeth,* organise presentation and seminars in fabulous castles and exotic places, run *6δ*-academies. Companies implementing *6δMeth* share experiences and discuss resulting significant income. What is going on? What is methodology spell? Could this methodology be applied in our business environment?

Before answers on such questions are discussed, it should be meant the way of *6δMeth* development. Late Bill Smith, Motorola reliability engineer, considered as

6δMeth author, successfully presented his approach to legendary Motorola[1] general manager Robert Galvin seeking for cause of continuous stagnation on concurrent market [Pande, 2000]. Bill Smith offered tool for higher Motorola product quality followed by cost reduction. It meant to switch company to new business philosophy based on **measuring**, to *6δMeth*.

Thy *6δMeth* is strongly influenced by Deming's philosophy [Deming, 2000] over DMAIC[2] process. According to Japanese success, he used to point out the need for new "quality religion" in America. Americans find original way for significant quality improvement. They pushed statistics in all economy aspects, and, as answer to Japanese success, they find the tool for measuring - *6δMeth* – the new approach to improve quality and reduce costs. *6δMeth* is proper and applicable to all fields of human life. So, the only question needed answer is: **How to implement** *6δMeth*? Special care should be put on **object attributes measuring** and **data collecting** for the correct statistical conclusion which is the success topic of the *6δMeth* project implementation.

2. SIX SIGMA METHODOLOGY CONCEPT

6δMeth is a business strategy tending to 0-defects followed by cost reduction and applying to each product, service or process. Statistically explained, *6δMeth* recognises customer's request as significance interval of 12*δ*. Although, *6δMeth* is originally dedicated to production processes, today it is implemented to processes as marketing, order and supply management, finance, servicing or information processes. Tools used in *6δMeth* are known, but there are two new key aspects that differentiate *6δMeth* from other quality improving methodologies. The first aspect is focused on the final result stated in financial value, and the second – systematic and structure approach to statistical methods and tools implementation.

6δMeth authors are focused on standard deviation *δ* as scattering measure, and, based on the assumption that process nature follows normal distribution, *δ* represents capability of process under analyse. According to this concept, *6δMeth* follows Taguchi's philosophy [Taguchi. 1988]: *Decreasing process variation (scattering), costs could be cut. In the case that this requirement is fulfilled, quality would automatically increase*.

6δMeth is focused on the scope of relatively low lose level[3] (C_p=2) in relation to conventional approach *3δ* with significant level (C_p=1) although process is inside specified deviations.

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[1] In that time Japanese took over one Motorola company producing televisions and in a short time they succeeded in producing televisions with 20 times less defects, with the same employees and equipment.

[2] DMAIC: Define – Measure – Analyse – Improve – Control.

3 Cp –**C**apability of **p**rocess

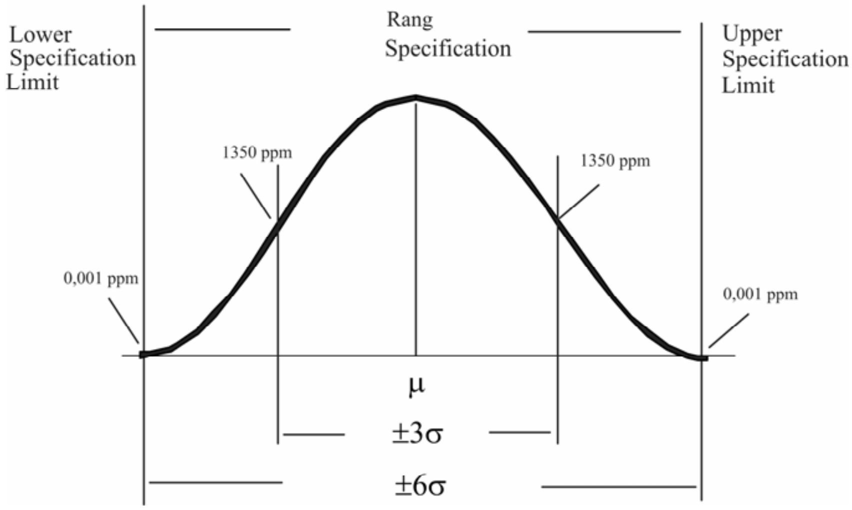

Figure 1. Normal Distribution and 6δMeth Base Metrics Concept

Common statistical *6δMeth* definition supposes 99,9996% of successful entries. This is equivalent to 3,4 defects per million possibilities (DPMO). Interpretation of 3,4 DPMO related to 1,5*δ* of process shift is shown on *Figure 2*, and in *Table 1* according to different DPMO.

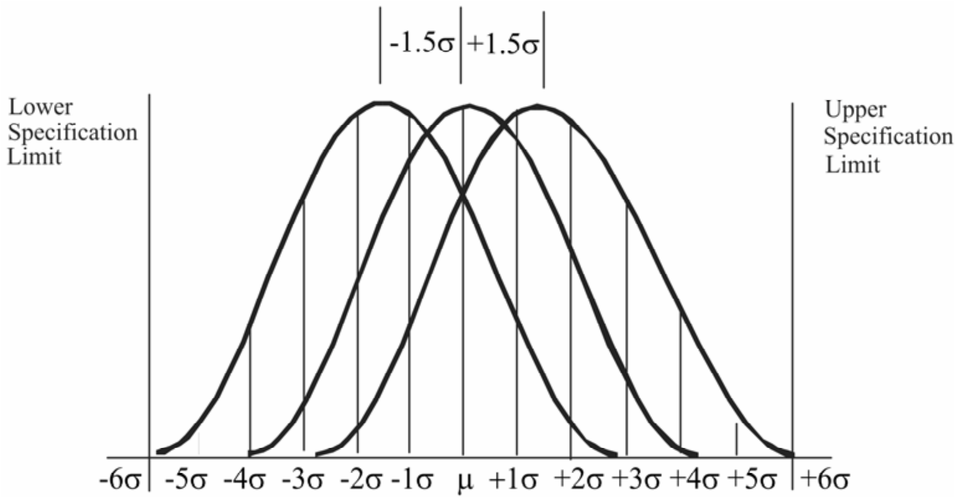

Figure 2. Effects for 1,5 δ Process Shift (3,4 DPMO)

Table 1. Effects of 1,5 δ Process Shift for Different DPMO

Specification limits range (USL-LSL)	**Probability (%)**	**DPMO**	1,5σ process shift	
			Probability (%)	**DPMO**
±1σ	68,27	317 300	30,23	697 700
±2σ	95,45	45 500	69,13	308 700
±3σ	99,73	2 700	93,32	66 810
±4σ	99,9937	63	99,3790	6 210
±5σ	99,999943	0,57	99,97670	233
±**6**σ	99,9999998	0,002	99,999660	**3,4**

In the case of decentred process with 1,5*δ* shift and specification limits related to process capability C_p=2 (±6*δ*) all DPMOs, except DPMO=3,4, are in the specification level range (quality level). Process with such characteristics reaches so cold 6*δ* quality level, indicator showing process defect frequency. For 6*δ* quality level DPMO should be less than 3,4. According to 6*δ* all defect all entries are outside the user's specification limits range. From the 6*δ* aspects, as almost perfect result, companies could be differentiated in the range[4] of:

- Companies with average quality – 3*δ* level, and
- Companies with the highest quality – 5,7*δ* level.

3. SIX SIGMA METHODOLOGY IMPLEMENTATION

The key condition of methodology success is modern management approach, specially leadership involvement, including top management commitment, initiative and acting. *6δMeth* runs beyond statistical orientation. It requests higher social and cultural behaviour level and development of company cultural infrastructure. Important aspect is employee satisfaction and communication, and team work. There is the most important difference between West and Japanese approach: *the employees' motivation based on different cultural ground*. Of course, the other principles should be applied to reach success implementation as: process approach, continuous improvement, work remuneration, system approach, customer inclusion, costs reduction.

As it was pointed out, statistics acknowledgement during *6δMeth* implementation is prerequisite, but the most important aspect is management capability to exploit *6δMeth* in all business segments, that is the new philosophy in

[4] For example air traffic mortality level is 6,2*δ* and doctor's prescription handwriting recognition level is 2,9*δ*.

organisation management gaining products or service quality according to customer's requirements.

Tom Pyzdek [Pyzdek, 2003], one of the most cited author according to *6δMeth*, points out drastic enlarging of the term *statistical control* old meaning, and defines *6δMeth* as *quality management program* in spite of primary technical program. This methodology requests high disciplined processes directed to production of almost perfect products and services and has great influence to three key organisation elements: process, employee and customer, followed by total top-management involvement and high organisation culture (and needful changes).

Process network recognition is the crucial *6δMeth* implementation item in practice. Process interference on completed product or service is base for process efficiency measuring and improvement decision making based on statistical approach. Resulting priorities of improvement fields should be based on financial savings and success perspective. Project priority level for each project from the approved improvements list is a product of those two factors. Next two significant factors are project organisation importance and realisation time followed by measuring, evidencing and accessibility to all interested parties. High personal capabilities for *6δMeth* in combination with process approach are prerequisites for successful implementation.

There are some *improvements models* developed since quality management has been in focus. The most of them are established on Deming's PCDA[5] cycle. For *6δMeth* cycle is adopted and enlarged in five elements frame DMAIC[6] (*Figure 3*).

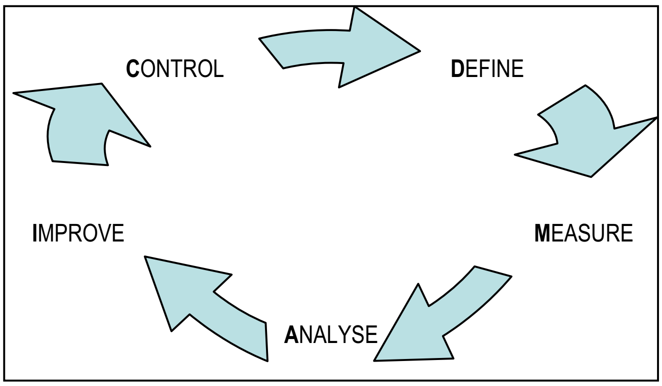

Figure 3. DMAIC Cycle of 6δMeth Implementation

In **D**efinition phase goals and project scope should be defined based on customers requests recognition and organisation improvement capabilities to reach *6σ* level. The most used tools in this phase are Project charter, Stakeholder

[5] PDCA: Plan – Define – Check – Act.

[6] DMAIC: Define – Measure – Analyse – Improve – Control.

analysis, SIPOC[7], Rolled throughput yield, Voice of the customer, Affinity diagram, CTQ[8] to determine project importance, goals, key project stakeholders, process limits and profitability, and customer's requests.

Measuring phase should investigate the problem essence and process providing conditions. The most used tools in this phase are Dana collection plan, Dana collection forms, Control charts, Frequency plots, Gage R&R, Pareto charts, Prioritisation matrix, FMEA, Process capability, Process sigma, Sampling, Stratification, Time series plots to define actual problems and its cause conditions, prioritised them and sited them to inputs, process and output variables frame, and to determine the actual process capability.

Analysing phase investigates collected data and investigated indicators to recognise problem essence. Useful tools are Brainstorming, Cause and effects diagrams, Flow diagrams, Design of experiments, Hypothesis tests, and Regression analysis in combination with earlier listed tools.

Improving phase should develop and apply solution based on approved patterns to present chosen variant as real problem solution. Useful tool in this phase are already listed Flow diagrams, FMEA, Hypothesis tests and others. Interesting tools are also some planning tools and creative techniques. In this phase should be define and approved key variables and their influence level on quality to improve process efficiency. Improvement results should be checked over statistical methods.

Control phase is project phase for statistical and other tools implementation to control key variables of improved process.

4. INFORMATION SYSTEM PLANNING & DEVELOPMENT IN *6δmeth* ENVIRONMENT

The usage of modern information technologies will be successful only if information system (IS) development is aligned with business system development strategy. Such approach is usually regarded as strategic planning of information system (SPIS) [Brumec, Dušak, Vrček, 2000]. As *6σMet* means the crucial change in strategic goal definition, information system should incorporate all *6σ* quality level requests to maximise support to business processes.

Strategic planning of information system is long term planning of useful effects of information system and appliance of information technologies aligned with strategic planning of overall business system development. The result of this procedure should be documented project that contains:

- Organisation model of existing and reengineered organisation,
- Business process model,
- Business data model,
- Technical resources model, and
- Activity plan for information system development.

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[7] SIPOC: Suppliers, Inputs, Process, Outputs, Customers.

[8] CTQ: Critical to Quality.

Project of information system strategic planning is complex project that should perform four stages containing work-packages as follows:

- Future business model formalisation:
  - Description of business system and its development strategy,
  - Evaluation of new IT effects to business system,
  - Redefinition of business system processes, and
  - Business process reengineering (BPR);
- Information system conceptual model designing:
  - Definition of critical success factors and information for system management,
  - Definition of IS optimal architecture,
  - Logical modelling of business system processes,
  - Physical modelling of business system IS processes, and
  - Evaluation of new IS effects;
- Detail information system designing:
  - Software design,
  - Business data modelling,
  - Detailed designing of specific programs and procedures structure and function,
  - Data model development,
  - Software development;
- New information system implementation:
  - Implementation and new IS validation,
  - Evaluation of new business system performances,
  - Integration and IS complexity evaluation.

Investigation of *6σMeth* implementation phases and SPIS providing phases generates all sophistication and complexity of those methodologies and their interference. *6σMeth*, as modern company philosophy to reach strategic goals, needs adequate information system allowing *6σ* quality level, which should involve *6σMeth* principles and requests. That should assure that all strategic planning of the organisation and defined risk factors (as is requested in Definition phase of *6σMeth* implementation) should be based on customer's requests and organisation capabilities strength to realise those requests and provide them over BPR.

For chosen process (which needs redefinition and reengineering), product or service should be determined *6σ* quality level for all characteristics, methods and indicators assuring customer's requests are satisfied. This is part of Measuring phase. In this phase should be investigated chosen processes, products or services. Quality level determined by customer's requests should become measurable. That is crucial for system formalisation and later monitoring and control. Also, measurable points, the way of measure, and collecting measured data variations determine interfaces for monitoring process, what is crucial for information system conceptual model designing.

Analysing phase should explore all dependencies, sequences and variations according to organisation system items influencing to determined quality level, their intersections and way of acting. This includes all data important for determined quality level (*6σ*) and statistical methods for analysing them. This point is millstone for database design and way of exchanging data between IS and special *6σMeth* tools. That is the point when IS should be evaluated on *6σMeth* requests: how does IS react on collected data and what is its capability to report management on variations of quality level from conceptual aspect. In the New information system implementation phase of developing IS, all *6σMeth* requests should be implemented and monitored and, at the end, evaluated as one of IS high important performance. *Only smooth dance of 6σMeth experts and IS developers should provide correct results in controlling key variables of improved process control phase of 6σMeth as it is stated in Table 2.*

Table 2. SPIS Methodology in 6σMeth Environment

SPIS Methodology stages	***6σMeth Requests***
Future business model formalisation	Defining optimal business technology as driver for reaching *6σ* quality level. Risk determination for all business model architecture elements, including requests according to *6σ* quality level (as a customer request). Presuming all measuring points, metrics, methods and tools during business technology designing process. BPR implementation according to aligned requests form the IS and *6σ* quality level aspects.
Information system conceptual model designing	IS architecture model should include methods and tools for measuring, collecting and analysing requested data according to *6σ* quality level for processes, products or services; such as robots performing measuring in dangerous environment. Logical model should assure compatibility between different data representation needed for different purposes and in different environments (for example: data transition between IS database and database for statistical analyse). On the level of physical modelling and new IS effects evaluation, *6σ* quality level request should be predicted and approved on conceptual level. Simulation models are welcome.
Detail information system designing	Should assure involvement of all 68 *6σ* quality level requests as active drivers of new business philosophy.

New information system implementation	Verification and validation of new business system performances according to *6σ* quality level requests. Verification and validation of *6σMeth* successful implementation.

5. CONCLUSION

6σMeth, as a business philosophy, assures highest product or service quality and continuous process improving to realise customer satisfaction level. Focusing on the final result stated in financial value, and systematic and structured approach to statistical methods and tools implementation, differentiate *6σMeth* from other quality improving methodologies. Statistics acknowledgment and management capability to exploit *6σMeth* in all business segments, are key prerequisites for *6σMeth* implementation.

The most of developed improvement processes are established on enlarged Deming's cycle PDCA, in five elements frame DMAIC. Process is not strictly determined. It should be adapted to company capabilities and requested excellent expert acknowledgement, preferences and experience. Tools and methods useful in *6σMeth* implementation are not only hard statistical methods, but also methods of organisation engineering giving *6σMeth* epithet of modern tool for increasing customer' satisfaction and company profit; putting measuring in the middle of the show.

The fact that *6σMeth* is a tool for all business segments improving, does not mean that method is "light" and easy for implementation. On contrary, combination of statistical tools and methods for strategic planning, organisation engineering and managing according to statistical monitoring and analyse, requests very systematic approach, wide acknowledgement and high organisation culture.

The crucial role in *6σMeth* implementation has information communication technology. Planned business system reengineering according to *6σMeth,* and new information system development, should became two parallel and tightly connected projects. To increase synergetic effect of new business philosophy, *6σMeth* assures highest product or service quality and continuous process improving to realise customer satisfaction level. This top-quality level requests adequate information system capable to collect, monitor, analyse and report on quality indicators variations.

6σMeth asks information technologies aligned with strategic planning of overall business system development, capable to communicate with *6σMeth* methods and tools. The efficient network of statistical, economic and organisation tools assure proper support in providing *6σMeth* implementation. Such approach requests systematic process of IS planning and developing according to *6σ* quality level requests.

As *6σMeth* means total change in managing business, there is accent on IS systematic aligning to new managing approach. From the information and communication technologies aspect, SPIS methodology, according to proposed steps and applied methods and tools, *could support implementation of all 6σ quality level requests* according to new modern organisation philosophy.

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