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Development of New Product/Process Development Procedure for SMEs

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The result of our research is a developed and implemented set of activities for new process or product development (NPD procedure) for SMEs environment in the plastic processing industry, which enables the production of products and services with a high value added.
The developed NPD procedure consists of five consecutive and overlapping steps: attracting orders, designing a project, developing a product, developing a process and zero production series. Each distinct step is further divided into sub-activities supported by adequate methods and managed in an information system. Investigated and included were three different methodologies use for NPD procedure in the automotive industry such as Advanced Product Quality Planning (APQP), Design for Six Sigma (DFSS) and Stage/Gate methodology.
The results presented in the paper show that the developed NPD procedure significantly improved NPD in terms of cost management and time-effectiveness.

Key words: quality management, new product development procedure, project management, cross-functional team, project portfolio

1 Introduction

For SMEs, product development processes are poorly described. Hence, very little information is available on how successfully design, develop, and commercialise a new product in SMEs. Small businesses are constrained by limited knowledge, resources and skills. However, on the other hand they have to continuously develop new products in order to sustain their growth.

Being competitive on the global market, means that a company needs to be better and faster in new product and process development and in designing a development platform for new products. A rapid development of a new platform product development, which meets the requirements on quality, usefulness and minimal costs, are especially important for companies which produce products with a short life cycle. Balachandra and Friar (1997) estimate that almost 90 % of products launched on the market in 1991 did not reach the companies' business objectives. Schilling and Hill (1998) report that between 33 % and 60 % of all new products launched on the US market do not bring positive results in terms of economic success. Thus, the competitiveness of a company is mostly dependent on its ability to perform well in dimensions such as cost, quality, delivery dependability and speed, innovation and flexibility to adapt itself to variations in demand (Carpinetti et al., 2003).

Nilsson-Witell (2005) highlights the continuous improvement as an important strategy in improving organisational performance. With the purpose of preserving competition capabilities, an organisation needs to focus on timely delivery of high-quality products. Given that the time of NPD is becoming an important competitive advantage, it is essential for the production companies to constantly introduce improvements, not only in the process of NPD but also in the production processes. An organization adopting a continuous improvement programme in product development will have several improvement programmes working in parallel. Some of them might be focused on improving the products, while others might be aimed at improving the performance of the product development process. Each of these improvement programmes will be based on a number of quality principles (Nilsson-Witell, 2005). Therefore, the capability of rapid adjusting and implementation of strategies for increasing product development effectiveness is just as important as an innovative product (Schilling and Hill, 1998).

In the current business environment, organizations strive towards exceeding the customer's expectations. As a match between product features and customer expectations and needs, quality of design is a market, or externally oriented

aspect of quality (Meirovich, 2006). According to Widrick et al. (2002), quality of design is determined by three factors: a deep understanding of customer requirements, translation of these requirements into a product and continuous improvement of the design process. Such an improvement is based on close cooperation among marketing, research and development, and engineering (Meirovich, 2006). Quality, therefore, can be defined as satisfying or exceeding customer requirements and expectations and hence, to some extent, it is the customer who ultimately judges the quality of a product (Shen et al., 2000).

In developing a new product, we mainly deal with the implementation of a procedure with the help of which a new product is launched onto the market. The process feeds itself from the sources, the first being market research and analysis, and the other, the integration of generated ideas for the new product and their implementation in practise. The fact remains that the procedure of developing a new product may be described with three dimensions, i.e. the speed of launching a new product onto the market, costs arising from product management and the market price a product reaches on the market. (Mascitelli, 2006).

Unlike most business processes, each instance of NPD process differs from the previous ones, its output is not clearly defined and many of the activities to be accomplished are knowledge intensive (Carbonara and Scozzi, 2006). Among them, idea generation, product design, prototype and engineering are the most relevant (Carbonara and Schiuma, 2004). Gomes et al. (2003) suggest that NPD process requires "the capability to obtain, process, and interpret large amounts of market, technical, financial and other information, in order to develop product ideas and evaluate their technical boundness, manufacturability and economic feasibility."

Owens (2007) has identified a number of areas that could accelerate NPD process in SMEs and have significant impact on the NPD process performance in terms of its speed, cost, flexibility, quality, profitability, customer value, etc. Most of these can be grouped into four major categories: (1) senior management support; (2) early integration of functional expertise in NPD; (3) availability of NPD resources and their management; and (4) an organisational environment that supports team work.

From a practical perspective it is important to understand how successful organizations manage their NPD processes. For example, Toyota's development system launches products on the market faster and their products generally reach a higher price for the same quality as that offered by their competitors. Such product development thus adds value. In the 1980s, the development cycle of a new car lasted from 36 to 40 months, while today the cycle only lasts 24 months; however, Toyota is able to develop a new car in 15 months. Advanced companies, including Toyota, have introduced leanness not only in their production process but also in their development, purchasing, technology, finances and human resources development (Morgan and Liker, 2006). The philosophy of the concept »The Toyota Way« is managing three models: production, sales and development (Liker, 2004). Not only Toyota's production system but also its product development enables faster development of new vehicles, development with lower costs and better vehicle prices on the market. Toyota's model of developing new products is thus based on three basic elements, i.e. processes, people as well as technologies and methods (Morgan and Liker, 2006).

New forms of implementing the development process indicate that the NPD processes no longer depend on the technological complexity of a product but on the quality of competence of the management who perform the NPD process (Cooper, 2007). Previous research has primarily focused on NPD technical skills with less attention paid on interpersonal, social, or management expertise (Fredericks, 2005). Additionally, many quality improvement tools have been introduced by academics, practitioners and researchers, to improve the performance of companies in NPD. These tools include quality function deployment (QFD), conjoint analysis, benchmarking, failure mode and effect analysis (FMEA) (Thia et al., 2005) as well as DFMEA, PFMEA and Six Sigma. Of course, activities and methodologies which ensure the quality of final products need to be interwoven into the NPD concept. The basis of planning the quality of product is a structured method which sets forth the implementation of the steps. These steps ensure that the product shall meet the customer's expectations. The objectives of the product planning and product production is facilitating communication between all participants and, at the same time, ensuring that all steps are performed at the right time and at sufficient quality (Morgan and Liker, 2006).

Leading industries recognise the NPD concept as a proactive process whereby new products are constantly generated on the basis of opportunities which these companies recognise on the market. In order to produce innovative products, a more flexible concept needs to be applied, to our own processes, i.e. a concept which is adjustable and enables implementation of modifications during the process of product development itself. Since the process of NPD requires simultaneous implementation of engineering and marketing activities, cross-functional teams are necessary (Cooper, 2007; Metlikovič, 2007). The team is responsible for all aspects of a project, from generating ideas to the final commercialisation (Kahn, Barczak and Moss, 2006; Biazzo, 2009). Eisenhardt and Martin (2000) also suggest that product development should be performed in cross-functional teams that bring together different sources of expertise. They describe product development as a dynamic capability – a process by which a company can integrate, reconfigure, gain and release resources, therefore, product development/process is becoming more integrated process.

It is important to understand that the product development life cycle is a virtual representation and not a sequentially executed process. In other words, the life cycle phases are not chronologically executed, but should be seen as an iterative process, a process moving back and forth between phases as needed, with overlapping stages. Therefore, a life cycle within a life cycle can also exist (Indutech (Pty) Ltd, 2007). The full effect of product design and development is often realised during later stages of the products' life cycle. However, during the later stages, the impact on the company and the product itself is much greater (Dimitrov, 2006).

Each project is actually unique. On the basis of research results on project management in the car industry, we in the

company Polycom, have learned that there is still plenty of space for improving the existing state in the field of managing different types of projects. We established that opportunities arising on the market are lost, particularly those with high value added. The procedure of project management was unclear, definition of quality characteristics failed to integrate adequately the Voice of the Customer enough, forms were missing, work instructions were not designed, and projects were completed with delays and at excessive costs. And when the product entered regular mass production, it failed to meet the quality and customers' requirements, and the production process was unstable.

We require real and successful projects. Therefore, we wanted to research and define the sequence of steps to be taken for the successful implementation of multi-functional projects in the SMEs engaged in plastics material processing, namely with the help of models and methods which shall enable high quality of a product at the lowest possible production costs, as well as the best possible economic effect. A practical solution in the company Polycom is presented in this paper, i.e. a practical solution on a newly developed model of NPD procedure for achieving greater competitiveness of the company. Above all, we wished to shorten the time from product development to market launch and reduce the costs of project management. Our aim was to design a methodology for developing a process which shall be capable of ensuring the lowest possible (in PPM range) long-term capability index (Cpk) not lower than 1.67, as well as cost and time effectiveness. With such a model, we strived to prove that all types of projects – from platform to constant improvement projects – may be performed in the same manner.

2 Methodology and research approach

From the applied methods perspective the project may be divided into a chronological sequence of four steps.

The first step is a study of available literature by establishing the state of the art. In this phase of the project we analysed good practice in the car and aeronautical industry and highlighted two models: Toyota's and Boeing's model, which is the application of Toyota's concept with the elements of small-scale production. We also examined well- described methodologies such as APQP, DFSS, and Stage/Gate.

In the second step a benchmarking of the existing state of managing development projects in the company was performed, namely by recognising parameters influencing the procedure of developing new products and processes, management of influencing parameters, NPD process and application of process in actual current projects.

Projects from four project managers in Polycom company were investigated, their advantages and disadvantages noticed, together with the estimated impacts on time and cost relevance. Analytical research approach was performed for estimating the effectiveness of finished projects, comparing two sets of measurable characteristics such as time and cost relevance. Ten finished projects, five with the best outcome and five with the worst outcome were analyzed activity by activity in order to evaluate them regarding the two criteria.

By investigating former methods of project management, advantages and weaknesses of were recognised, namely by applying »Value stream mapping« methodology and by analysing achieved/non-achieved target values for PPM, Cpk, exceeding of project deadlines, project cost management and the final results of the project, all on the basis of the actual data. Finally, an assessment of the adequacy of the applied methods was performed (APQP, PPAP, MSA, SPC, etc.).

The third step encompassed the selection of methods developed with the purpose of eliminating or reducing unconformities and improving work results, as well as the study of individual steps which would have a positive impact on developing the procedure of NPD and on result in the mass production.

A NPD procedure which integrates different well known methods was developed. The study on the sequence of steps was run following the methodology of process course diagram and the use of MS project model for planning and terminating the activities. In order to always apply good practice for the user, it is not only the initial setting of methodology but also subsequent improvements that are being constantly amended and modified.

The fourth step was validation of the implementation of NPD procedure in real life. The results are given in Chapter 3. The main purpose of this step is to identify appropriate measures to evaluate the progress achieved with the new NPD procedure. In the following, *we* propose simple *measures*, performance *indexes* (PIs), to quantify the differences between observed projects. Two PIs were used to measure the effectiveness as described in Table 1. With respect to the indexes, we estimated 50 projects completed in the year 2008 and 9 projects completed in the year 2009 (after the implementation of the new NPD procedure).

Besides the aforementioned, the following methods/tools of quality management were also applied: brainstorming, fishbone diagram, "five times way" analysis, course diagram, »lean production«, histograms, Pareto analysis, PDCA cycle and other different simulation methods.

Figure 1 shows concept and timeline of research approaches.

Table 1: Performance Indexes (PIs) with evaluation approach

Code	Performance Index	Evaluation approach
PI-1	Project time performance	achieved time/estimated time
PI-2	Project cost performance	(sales revenue/sales) x 100

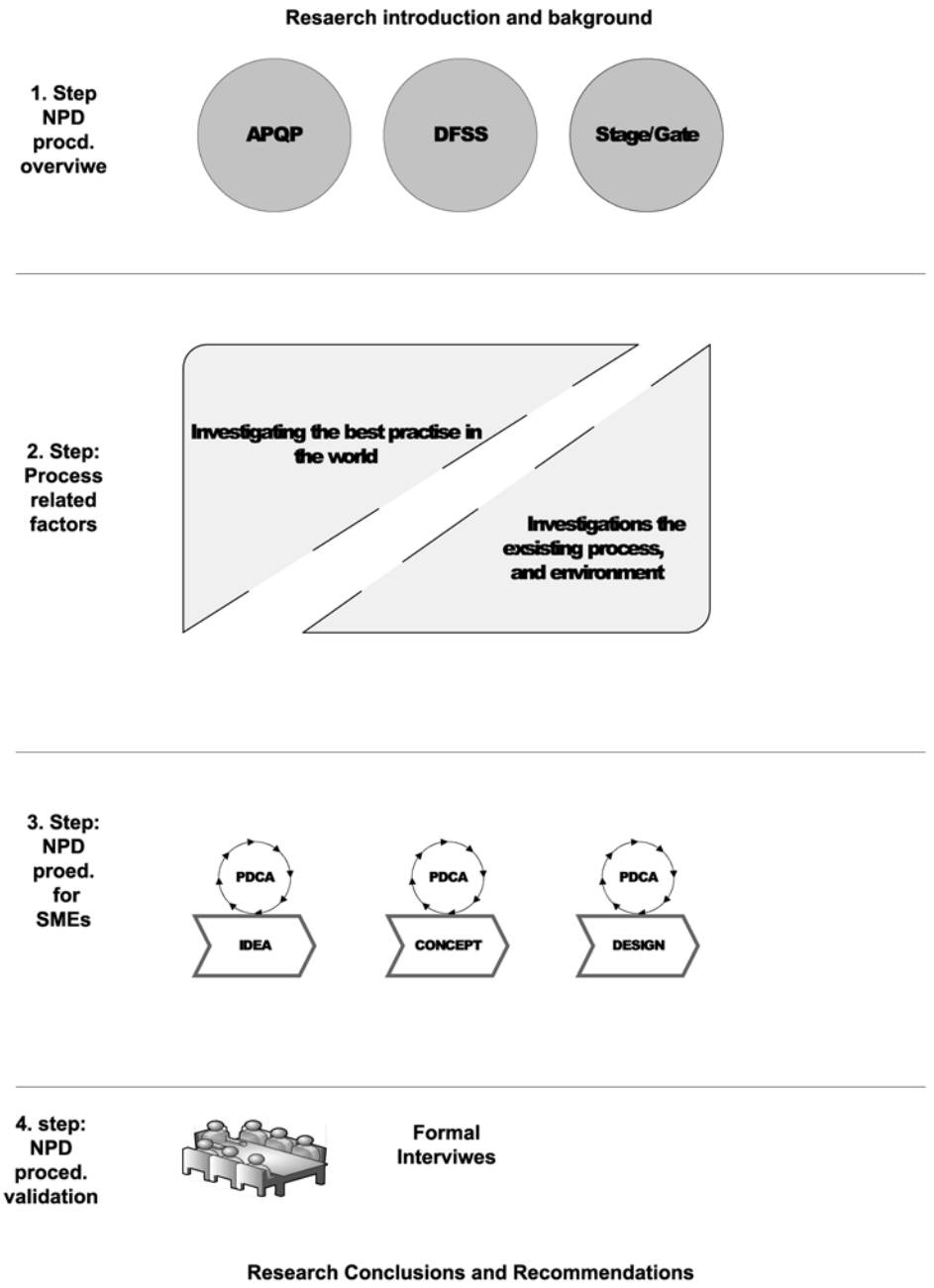


Figure 1: Development of the NPD procedure for SMEs

In Table 2 the research method, other considered and relevant methods to the project are described.

3 NPD procedure and results

The framework of NPD procedure depicts a combination of principles of best practices and critical success factors. A structured process provides a common basis that guides the development. The structured process makes development transparent and easy to follow and also fosters more effective communication.

The structured development plan breaks down the process phases into smaller steps. This helps to determine the reassured time estimates and cross-functional interaction for different phases of the project.

NPD procedure implementation plan was performed following the diagram showed in Figure 2. The first step »Project Launch« encompassed definition of research objectives, setting up of a research team, preparation of research implementation plan and preparation of research documentation. In the second step an analysis of strengths and weaknesses of the previous projects was performed. Many opportunities were recognised, particularly in process standardisation, IT support and standard manner of management integration. This was

Table 2. The research method, other considered and relevant methods to the project

ISSUE	Research method	Description	Key principle/result
NPD procedure overview	Literature study; case studies	Investigated were three principles for NPD procedures which are implemented in large companies	APQP, DFSS, Stage /Gate methodology
Process related factors	Checklist summary (paper, electronic, verbal) Cross- functional research teams	NPD experiences, working practices, customers, market, competitors, suppliers, skills and expertise available, quality and tractability procedures	Research of the existing methodology in Polycom company, consideration of competitors, customers and suppliers
NPD procedure for SMEs	Working practices Brainstorming Ideas introduction Initial procedure definition	Well – defined plan that determines the execution of the process. It indicates development phases, milestones and subsequent steps.	Development of the new NPD procedure for SMEs for plastic processing industry
NPD procedure validation	Evaluation of the production processes (PPM, Cpk, cost and time effectiveness)	Evaluates NPD projects and optimises the portfolio. At milestones evaluation and approval of the new developments.	Implementation of the new NPD procedure at the Polycom company

followed by the definition of indicators for measuring project effectiveness, i.e. cost and time effectiveness as well as efficiency of a project.

In the fourth step a research implementation plan was designed, encompassing also the selection of a concept of best solution, test introduction of the system, testing and modifications of the system as well as user training.

With the help of the aforementioned methods, a uniform methodology for managing all types of NPD projects was developed, even for managing platform projects. The methodology encompassed a sequence of steps, each of the steps supported by a specific method which enables the implementation of a project with the lowest possible amount of errors. The team follows methodologies which are conceptualised on the basis of knowledge and experiences learned from the preceding projects and our own research work.

The result of such work is a developed process composing of five steps as demonstrated in Figure 3. In the step "Attracting Orders" a provisional team is formed after a customer's enquiry is received (VOC). The team prepares a calculation and economic analysis of the project and delivers the offer. It is important in this step to recognise and assess the customer's requirements, check and assess the risks and perform the analysis of eventual production, examine input data, standards and legal requirements. The introduction of the method for checking input data and recognition of product and process requirements prove to be essential in this step.

In the second step "Project Design" a project team is defined, project documentation is prepared (project business plan), preceding projects are analysed and a project time schedule is prepared. Among the most important activities is recognition of the product and process requirements which have been already estimated in the first step and adjusted in the second step.

In the third step »Product development« DFMEA is designed, product construction and prototype tools are produced and the testing of prototype products is performed.

In the fourth step »Process Development« PFMEA is designed, process is planned, mass tools are produced, product testing and measurements as well as optimisation are performed. In this step the entire production documentation for a pre-mass production is prepared.

In the fifth step the process is validated and the product transferred into production. The technological and the quality control documentation is prepared, product and resulted documentation are presented to everyone participating in the production process.

In general, the process has five successive and overlapping phases: idea generation, evaluation and selection of the best idea, development of the concept of product construction, entrepreneurial idea testing, technical implementation and product commercialisation. In order the company to reaches the market with the new product faster, individual phases are performed in parallel. Time to market is thus shortened.

A new form of organisation of the project office was introduced as well, the head of the project office was appointed together with the part-time and full-time project leaders. The head of the project office is superior to the project leader and reports to the director (CEO). Furthermore, the head of the project office is responsible for the development of methodology, best practices and standards for monitoring instructions, forms and other documentation, IT support, archive of previous and current projects as well as for the coordination of quality standards among the project leaders, and for monitoring the project portfolio for the needs of prioritisation at weekly and monthly meetings. Additionally, the head of the project office is responsible for the training of project leaders

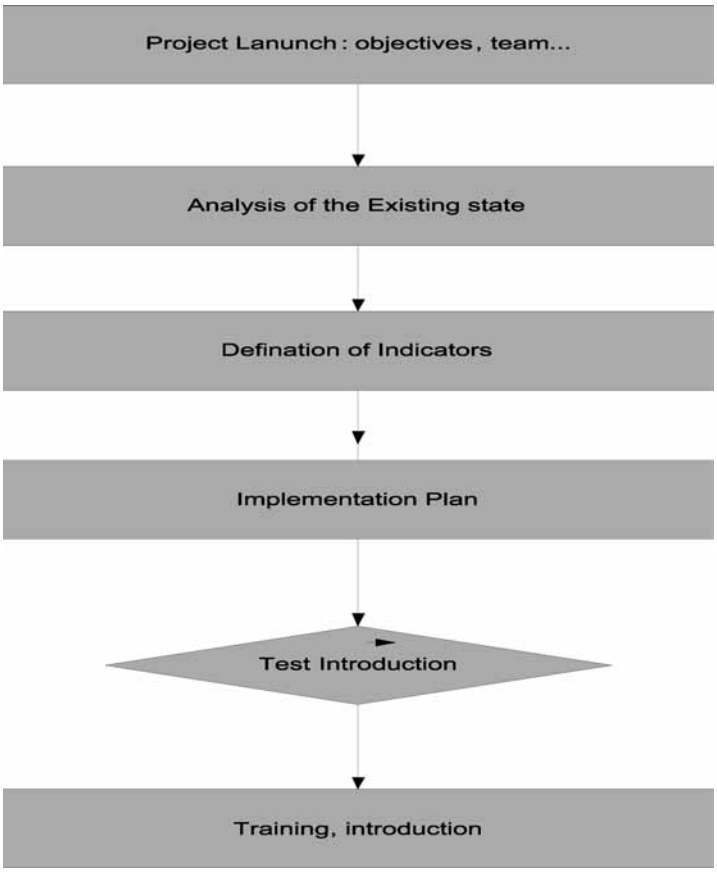


Figure 2. Diagram of the NPD course

and manages mentorship and the system of training for young project leaders.

A joint project portal enables review, preparation of reports for weekly and monthly meetings, review of discrepancies and reaching decisions on priorities. The project portfolio is annually aligned with the company's strategy.

The projects are performed by a cross-functional team which, besides a project leader, also consists of experts in different fields. A project sponsor, who, by default, is a member of the company's management, is assigned to each project. The role of the "project sponsor" is to supervise the course of the project, to ensure sources and co-decide on priorities.

The team is composed of process experts who have knowledge of process technology, production processes, requirements which a product needs to meet, on methodology of product implementation and who participate in the project from the planning phase to the final completion of the project. The project leader prepares the project, composes and heads

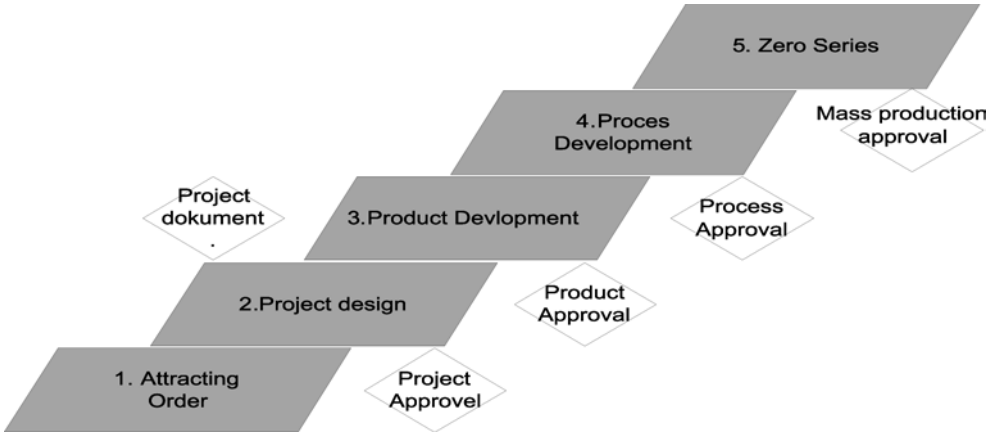


Figure 3. The NPD procedure diagram

the multi-functional team, and manages the projects until its end.

The project team includes people from different services and professions. The project leader is in charge of the project. However, the project leader does not have any executive power to eliminate obstacles arising during the preparation and implementation of the project such as production priorities, and does not have a decisive impact on the team members or the power to approve purchase orders. Consequently, the project sponsor appointed is from the company's management and he/she is the first person to be addressed by the project leader turns to in the event of problems.

Some important points identified by the research include:

1. Good practice study and visits to companies proved an excellent starting-point for the analysis of the existing system and for the planning of improvements.
2. Training of employees has an important role in the search for a solution and in the introduction of process improvements in the NPD. During the preparation phase we formed a group of 20 colleagues who participated at many day-long workshops and who were motivated to design the new system. Training began with an exercise on bonding with the customers and understanding the customers' needs.
3. Customers were visited by small groups of company employees and the results gathered in a summary report as the Voice of the Customer approach. Training then continued with workshops on project management, methodology of selecting the optimal construction pursuant to customer's requirements, analysis of preceding projects, economic analysis of a project and the use of standard process of project management.
4. The implementation of IT support into the project management has, together with the introduction of implementation methodology of development projects, improved the effectiveness of project management. IT support enables project leaders to plan work, to plan and reserve resources, to monitor implementation of tasks and to communicate with the central base of all project documents more efficiently. Furthermore, IT support enables the management to regularly review the entire project portfolio, align needs with available resources and act rapidly when unconformities or problems arise. Besides the project leader and the team, each project also has a sponsor, i.e. a member of the management is put in charge to monitor the state of the project and eliminate any obstacles which may arise. Since the beginning of 2009, all projects have been run pursuant to the standard manner which facilitates greater effectiveness and ensures achievement of set deadlines.
5. Concurrent to the main project, two very important methodologies were integrated during the phase of designing the project management system. The first being the Voice of the Customer for timely and appropriate definition of product quality characteristics which is interwoven in the first two steps, i.e. the phase of attracting an order and the phase of designing a project. The other important achievement is the economic analysis of the project. The method enables the calculation of the breaking point and economic justification of the project.
6. As a supplier to the car industry, we checked the impact of the applied methods, i.e. APQP, PPAP, MSA, and SPC on the NPD model in the Polycom company.

3.1 The NPD procedure results

NPD procedure implementation was examined using data from real life projects after their completion. Table 3 shows the difference between the year 2008 and 2009 according to the project time performance. The results in table 2 indicate that the projects performed during the year 2009 were more time-efficient than the projects performed during the year 2008 (the value below 1 means that projects are completed before their predicted schedule).

Table 3: Project time performance (PI-1)

Year	PI-1 mean value	Standard deviation
2008	1,07	0,95
2009	0,60	0,23

Expressed as a percentage of delay it may be concluded that project time of all projects completed in the year 2008 exceeded the estimated time for 7 %.

In 2009, after the implementation of the developed NPD the index PI-1 improved considerably and reached the value 0,60. These results show that the projects ended in much shorter time periods than estimated time periods based on the "old" evaluation criteria.

Comparable to the time performance, the cost performance increased as well (Table 4). Higher average percentage of sales revenues corresponds to the projects that were completed in the period after the new NPD procedure was introduced, i.e. during 2009.

Table 4: Project cost performance (PI-2)

Year	PI-2 mean value	Standard deviation
2008	36,97	59,23
2009	39,81	13,77

Furthermore, low standard deviation during the year 2009 (Table 4) indicates that these results are more consistent with the results than during the year 2008.

The proposed methodology was tested on projects completed during 2009, namely one platform project, one project of continuous improvements, two projects of substantial or minor product adjustments and eleven projects of product and process development. Since the sample representativeness is not given for the first two types of the projects, only the results of the projects of substantial and minor adjustments and the projects of new product and process development are taken into consideration.

4 Discussion

The present paper describes the design of methodology of a NPD procedure which fulfils the criteria of success and effectiveness of product development and production. We established that by applying adequate methodology of implementing the NPD procedure and by introducing adequate tools, methods and techniques, we can contribute to the success of projects, not only from the time- and cost-effectiveness perspective but also regarding the required quality level. The success of applying different NPD tools in the process of product development procedure was reported by Thia et al. (2005), who indicate that an effective use and implementation of NPD tools and techniques has been an important element of managing integration in the NPD process. Moreover, Nilsson-Witell (2005) points out that one of the possible ways of improving the process is by introducing new methodologies such as QFD, design for assembly, and design for manufacturing. Larger organizations implement these methodologies in one project or location and then, if the attempt is successful, incorporate them into the product development process. Consistently with the aforementioned findings, we identified a number of opportunities for improvement of NPD procedure which relate to the introduction of different methods and approaches. We thus assess that the effectiveness of introducing the methods in the first step is crucial, i.e. when the team recognises the customer's requirements. The fact is that when the essential requirements expressed by the customer or dictated by the market are overlooked, a product, in order to meet the requirements cannot be developed or the project realised without multiple feedback loops followed by improvements, and repeated sampling cannot be implemented. These actions, however, require time and money and cause customer dissatisfaction.

The findings of this research highlight the importance of cross-functional involvement as a prerequisite for effective implementation of a NPD procedure. Thus, an important contribution to the effectiveness of project development may be related to the introduction of cross-functional teams. Authors Jassawalla and Sashittal (1998) indicate that the concern for improving new product performance is closely associated with the search for innovative ways of conceptualizing cross-functional linkages that address the emerging contingencies of new product related task environments. It has been noted in the context of NPD, that information must be shared between multiple departments over the course of a project and at appropriate times as successful development requires the communicating and integration of information (Griffin and Hauser, 1996). These findings are consistent with the work of Valle and Avella (2003) who suggest that the use of cross-functional teams has positive impact on the success of the NPD process.

With regard to the production process, the study provides evidence to support the effectiveness of the implemented NPD procedure. All four parameters used for measuring successfulness and effectiveness of the process implementation reach planned results, i.e. 10 PPM, Cpk $\geq$1.67 (process capability) and also a reduced time to market cycle and cost effectiveness. We thus believe that understanding of the process requirements is essential for the success of production process development.

Research done by Owens (2007) indicates that the NPD process can be delayed due to poor understanding of customer requirements, and insufficient knowledge of a product's technology and market forces such as competition, suppliers, market forces, distributors, etc. Sun et al. (2009) found a positive correlation between quality management and the speed of NPD. This implies that quality seems to be an important factor in the effectiveness of NPD process.

After a six months period an evaluation of the introduced NPD was performed. Few project managers reported different complaints regarding the complexity of the procedure; too many steps and not ideal communications with other areas within the company. A need to improve the implemented NPD procedure was expressed. This is consistent with the findings of Nilsson-Witell (2005), who states that striving for success might include organizations trying to create lean product development processes. This can be done by the elimination of non-valued activities and by attempting to decrease the number of iterations before convergence to a solution. The author further establishes that a clear and rooted process encourages the product developers to structure their administrative work and other routines, which will hopefully result in more time for creative work. As a consequence, instead of viewing the continuous improvement of product development activities as something that limits the freedom of the developers, it can be viewed as something that creates even more flexibility and liberates creativity.

However, different product development projects often represent quite different patterns of success: one project may perform very well in financial terms, another may be unprofitable but, in a technical sense – by meeting the state-of-the-art technical requirements – may be a big success story, while yet a third project's outcome may be poor almost in every respect but the project management has been efficient and well organized, thereby providing the company with a good example of outstanding R&D project management also for the future (Suomala and Jokioinen, 2003).

5 Conclusions

The initial literature study indicated the importance of managing the NPD processes in SMEs. It was noted that poorly managed process could be disadvantageous to overall product success.

Since the concept of success is itself difficult to define, it is a difficult task indeed to try to describe the road leading to success in NPD. Therefore, on the basis of this study, it would be questionable to present any standardised way to achieve a successful new product. However, consistently with the findings of this paper, it may be concluded that the presented methodology for the NPD procedure implementation delivers good results for project management in terms of cost- and time-effectiveness and particularly good results of long-term process capability.

On the basis of the results obtained we concluded that the development and implementation of the NPD procedure into the Polycom company improved considerably NPD in terms of time-effectiveness (Table 3) and cost management (Table

4) and as well as quality improvements and, process capability improvements.

The main research objectives have been met; compatible tools and methods have been identified, validated, and integrated within the overall NPD procedure. This paper thus illustrates a structured approach to product development process within a multi-project environment.

The literature indicates that there is a general lack of emphasis on the role of new product development in SMEs. The overview of the various sources creates the perception that the NPD procedure is not seen as crucial when considering new business developments. The developed NPD procedure could help SMEs to better understand how main aspects related to the NPD procedure are linked and interdependent.

Future investigation and research should be focused on development of NPD procedures for SMEs in various branches as well as on NPD procedures for small-scale production.

6 Glossary

NPD – New Product Development
APQP- Advanced Product Quality Planning
DFSS- Design For Six Sigma
SME- Small and Medium Enterprises
PPAP- Production Part Approval Process
PI - Performance Index
FMEA- Failure Mode and Effects Analysis
MSA- Measurement System Analyses
SPC –Statistical Process Control
PDCA –Plan- Do- Check-Act
PPM – Part Per Million

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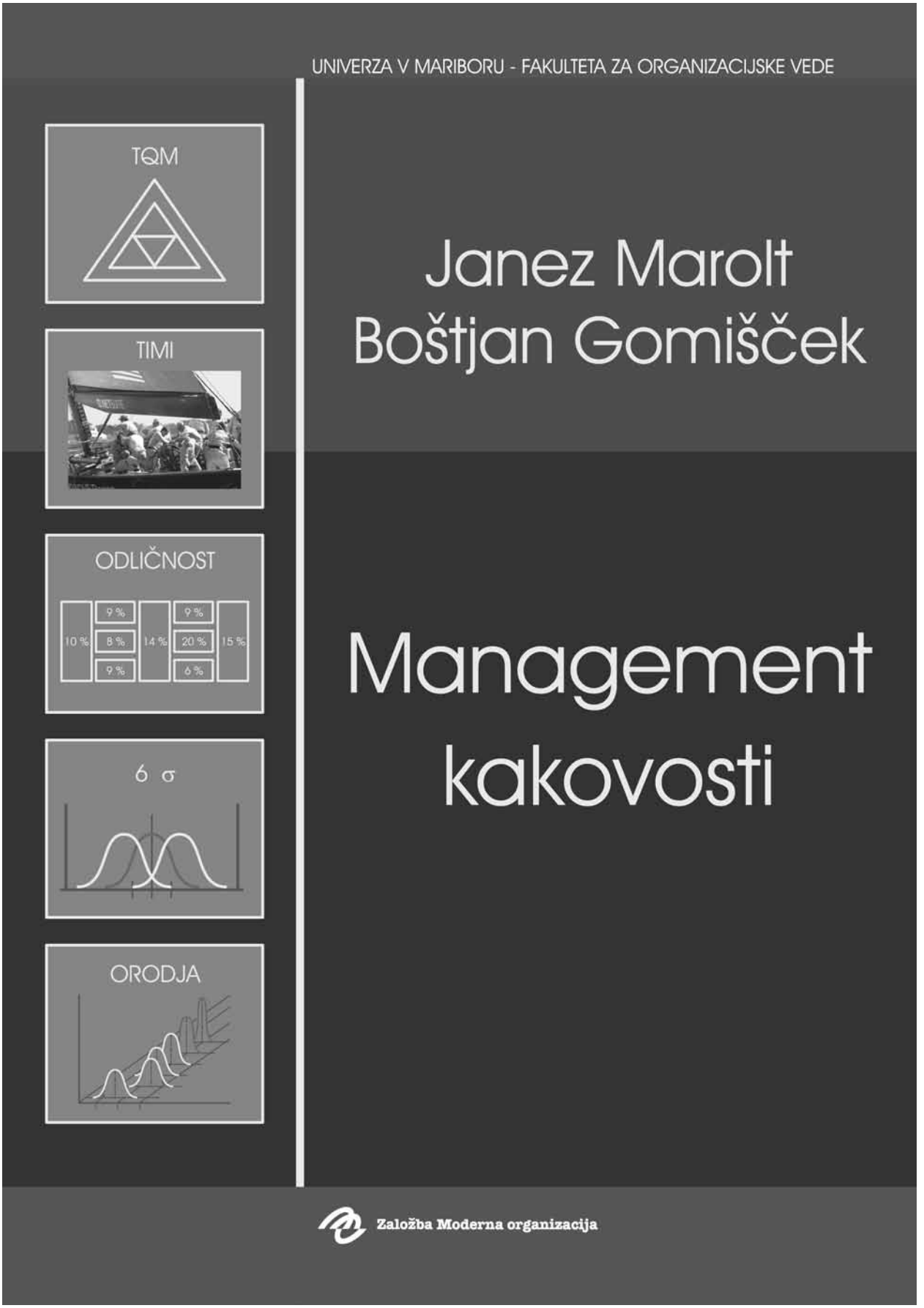
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