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RISK CONTROL-DRIVEN APPROACH TO PROJECT MANAGEMENT FOR FAST PRODUCT DEVELOPMENT

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Abstract: *Creating and bringing a new product to a competitive market under constrains of limited budget, strict schedule and competitive quality requirements involves a series of decisions, usually with a meaningful factor of uncertainty. The risk of failure and financial loss of investment and opportunity is growing under present conditions, characterized by global competition, market diversification, as well as environmental and societal requirements. All these factors increase product and project complexity. The window of market opportunity is becoming narrower in time, forcing the project team to shorten the product development cycle, thus increasing the project risk. The paper presents a formalized but flexible approach to fast product development, based on risk management throughout the project, as well as controlling the decision gates of the process through five other critical sets of requirements: project management, quality assurance, design optimisation, environment protection, and knowledge management.*

INTRODUCTION

In the contemporary market environment of global competition, modern strategies of the product development are oriented on shortening the time from the product concept (or from receiving an order for a new product) to production, called the 'lead time', without sacrificing the quality of the product and cost per unit. The level of customer/user satisfaction in three basic requirements defines product quality: timeliness, application performance (including selling performance), and cost. Famous futurists-authors Alvin and Heidi Toffler predicted in "The Third Wave" (1991) replacement of the economy of quantity with the economy of speed. Mass production of the same products is being replaced by growing diversity of customized variants, following the local requirements of culture, taste, price range and legal (usually related to human and environmental hazard) requirements. Such requirements put obviously a tremendous pressure on the product development (PD) teams, which become increasingly global, multinational and multicultural. The demand for speed increased the risk of new product failure in the market, which – according to US sources – exceeds 50%. To provide the needed help, the field of the PD theory became very active in searching for new methods and procedures. There seems to be a consensus that a part of the problem is in quality of the product development (with emphasis on product design) teams. The mass demand for creative and professional engineering resources cannot be fulfilled. Less experienced and talented teams need guidance and procedures, which provide a proper evaluation and timely correction of the process. A good PD process should be useful to every team, and – although the rigors of the formalized procedures imply some limitations to a sort of free-spirit creativity - the real joy of creation can be achieved with the success of the correctly and fast developed product in the market and full satisfaction of the customers.

As a practicing engineer in the PD business the Author draws the following conclusions for the PD process from the characterized above environment:

- Contemporary market requirements demand fast development of new products that are innovative, appealing to the customers, reliable in fully satisfying performance, and winning with a strong and dynamic competition for the market segment For achieving a proper (optimum) quality of the new

product in a fast PD process, the PD team orientation on a product quality as an objective (management by objectives) cannot be sufficient. The attention has to be moved to the quality of the PD process itself (according to the Kaizen philosophy).

- The growing number of the PD project teams and team members (especially design engineers) results in lowering of their average quality and effectiveness, resulting in errors, project delays, cost overgrowth and project failure. The shortage of high quality engineers is even more acute in high-technology fields, which – due to the very fast development of highly computerized design tools; include most of fields, which were considered low-tech not long ago. (Example: bicycles).
- An effective process for fast product development (FPD Process) should provide useful help to more experienced teams and individuals, as well as a reliable guidance to less experienced ones. The process should be computer-based, capable of operation in concentrated (on site) as well as territorially dispersed (virtual) teams.
- The FPD Process has to be based on a sound knowledge-based decision-making in a framework of strongly reinforced rigors, in order to correct the errors or stop the coming failure before it happens.
- The FPD Process has to manage successfully product and projects with different levels of internal (structural) and external (product-user interface) complexity, as well as both static (design improvement) and dynamic (innovative design) concept developments (according to Pugh, 1991)

Integration of the PD and Manufacturing Processes

To shorten the lead-time and lower the cost the contemporary PD process operates in a situation of the advanced integration of the product development and implementation. Many approaches, procedures and tools have been developed and implemented with different degrees of success, to address the demand for:

- Product quality – **CAD, modelling tools, Design for Excellence set of methods, Taguchi Methods**, **House of Quality**, **Total Quality** set of methods,
- Process cycle shortening in time – **Concurrent Engineering CE** (multifunctional teamwork),
- Process quality, cost and effectiveness – **Lean Development and Manufacturing** (Toyota System), Japanese methods **Just-in-Time** (storage and waste control) and **Poke-Yoke** (error-proof), **PD systems**, **Product Data Management** Tools, **Project Planning** Tools, **Cooper's Stage-Gate PD Process**, **PLM Process** (IBM-Dassault),
- Product and process environmental effects control – **Design for Environment**, **Life-Cycle Approach, Rohatynski's PPO (Lean Manufacturing Paradigm) Approach** (replacement of the contemporary raw-materials over-consuming economy with a rational, materials-saving economy for sustainable materials and energy management),
- Process risk management - computerized **Risk Management** tools,
- Product and project optimisation – **standardisation** (using proven solutions), **optimisation** tools, **robust design (Taguchi)**, **predictive engineering**,
- Process fast response to the market demands – **Agile Engineering.**

Throughout the last decade some of the methods proved and enhanced their holding in the most developed countries and companies (CAD, Lean Manufacturing, Life-Cycle Approach), the other were extensively modified to find a more rational and practicable application. For example – the Cooper's Stage-Gate System is a response to the limitations of the CE Method, which was not rigorous enough in the decision process. Although there is in many cases an obvious connection, none of the existing methods or procedures relates directly to the specific problems of the fast product development.

Speeding-up the PD Process

To find out more about the problem of new product failure from the project team perspective, the Author conducted in early 90's a research among American project teams. Dominating reasons of project failure. The results are given in Table 1, arranged according to their perceived influence, as determined by the respondents.

Table 1 *Dominating reasons of project failures (research results)*

Pos.	Reason of the project failure	Percentage of responses
1	Underestimation of the faced problems	87.6
2	Ignorance about the critical problems	82.0
3	Wrong concept of the selected solution	64.0
4	Wrong definition of the problem	59.5
5	Lack of sufficient knowledge about possible solutions	55.0

Analysis of the above given results leads to the following conclusions:

- The first three reasons are results of a poor or not existing **Project Risk Management**. With a proper Decision System, built into the Project procedure, and supported by the Risk Management Technique, these reasons could be at least strongly reduced – if not totally eliminated.
- The Reason #4 results mostly from the poor co-operation with the customer-user. The **Customer's Voice** is not present and loud throughout the Project (or the Customer is unpredictable).
- The Reason #5 results form insufficient knowledge related to the Project, or poor **Project Knowledge Management.**
- Although none of the responses refer strictly to the speed of design or the product development process, the Reason #1 is certainly strongly related – the project was pushed ahead without predictive analysis of the problems, which could be expected.

To achieve a progress in the PD Process, especially in the most needed Fast Product Development Process (FPD Process), the following questions should be considered:

A. What can be reasonably and effectively done to reduce the **Project Risk**, to increase the presence of the **Customer's Voice** in the Project and to make timely available and used the knowledge, related to the project?
B. How the **Project Procedure** should be structured to assure the proper level of decision-making discipline and project execution?
C. How the speed of the Project execution, or the **speed of the Product Development** Process, can be increased, without increasing the risk of the Project and Product failure?
D. Is the **right-the-first-time** approach feasible – and if yes, how it can be accomplished?

The answers to these questions are comprised in the proposed **Fast Product Development Process (FPD Process)**, which will be described below.
The FPD strategy relates to the four typical process elements:

1) Product Development Team
2) Product Development Process
3) Product
4) Product Development Tools

In the ideal case the FPD Process should be able to achieve – through the application of the proper tools, method, knowledge and skills - the goals of the Fast and Right First Time process, as shown in Fig.1

Project Risk

The proposed Project Risk Model (Fig.2) is based on a publication by the New Product Dynamics Company [Smith, 2002]. The elements of the model are: Risk Event (any project action or a project related occurrence, involving risk), Risk Impact (the effect of risk on the event result), Risk Impact Driver(s)

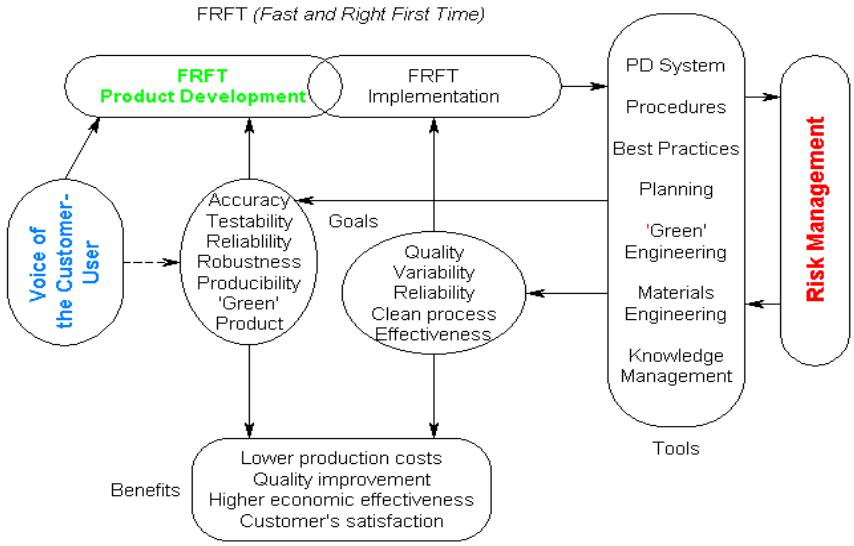


Fig.1. *Tools, goals and benefits of the Fast and Right-First-Time Process of PD*

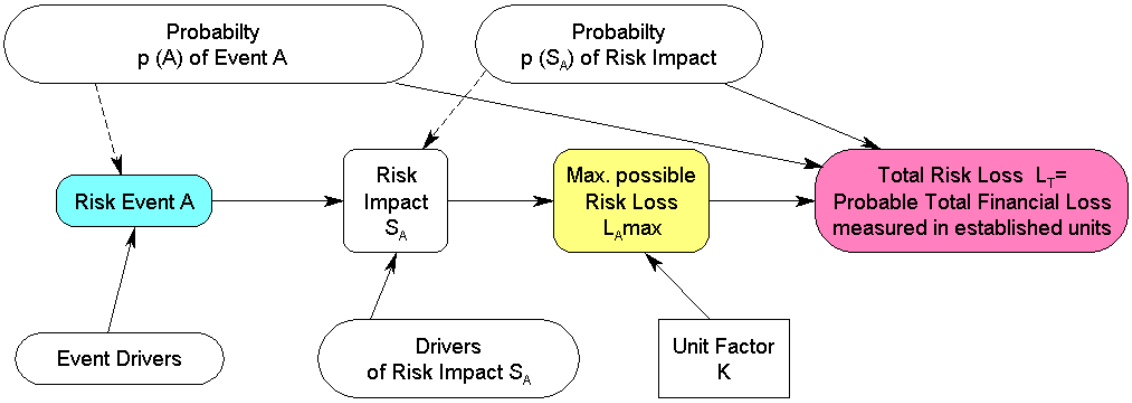
(factors causing directly the Risk Impact), Max. Possible Risk Loss, and Total Risk Loss (the calculated loss due to the Event Risk, with taking into account the Probability of Risk Event and the Probability of Risk Impact. Total Loss can be calculated in monetary units, with a Unit Factor applied.

The big advantage of this Risk Model is in application of Drivers, which help understand the root causes of the particular risk and develop methods of controlling them. The Event Drivers lead to developing way of risk avoidance; the Impact Drivers may suggest how the severity of the Risk Impact can be possibly reduced.
The Project Risk in a PD Process for a competitive market can be considered from the point of view of its 'recipient', typically
Project Team – a risk of not fulfilling the Project obligations in time, cost and product quality. This is the Project Risk
Product Manufacturer – a risk for the economic situation and reputation of the manufacturing company, resulting from its responsibility for the product's performance and safety, for the quantity, quality and timeliness of shipments, as well as for the cost control. This the Manufacturer Risk.
Product User – a risk of health or life threatening hazard, usually combined with a financial loss. This is the User Risk.
Society – a risk for the well being of the society, through environmental losses and other losses. This is the Society Risk, which may include the Environmental Risk

The Project Risk comprises four following Risks:

A. Project Schedule Risk
B. Product Concept and Design Risk
C. User Risk/Hazard
D. Environmental Risk

In another approach the Project Risk is divided into Technical Risk (failing PD Process goals) and Market Risk (new product failing on the market). The Total Project Risk is a sum of the Losses, resulting from different Risks, pertinent to the particular project.



Probable Total Loss L due to the Risk Event (or Action) A

$$L_T = K \times p(A) \times p(S_A) \times L_A max$$

Fig.2. *The proposed Project Risk Model*

6-D Process of Fast Product Development

The following features represent the rationality of the proposed Fast PD Process, based on the discussed requirements:

- controllability through a limited set of process variables,
- multidisciplinary teamwork based on Concurrent Engineering and Agile Engineering approach,
- systematic Risk Management throughout the process,
- formalized system of decision filters,
- integration of the customer's voice into the product definition and decision filters,
- optimisation of the product and the processes, to lower the risk through standardisation (using proven solutions as much as possible), and through optimising the design for robustness,
- modular structure, which combines general, higher-level flexibility of the Process with sufficiently rigid lower-level structure of the connecting interface (Decision Filters), having defined entry and exit information,
- possibility of adjusting the Process structure to the particular project,

- effective management and application of the pertained project knowledge and best practices, to assure the product and project quality and high effectiveness of the Process,
- effective Project Management through application of the computerized tools, like PDM, to allow inter-team and global data transfer,
- broad application of predictive engineering (modelling, simulations),
- broad application of 3-D graphic and engineering design tools for the concept and product presentations and evaluations,
- application of rapid prototyping for fast design evaluation.

Fig. 3 shows the modular structure of the FPD Process.

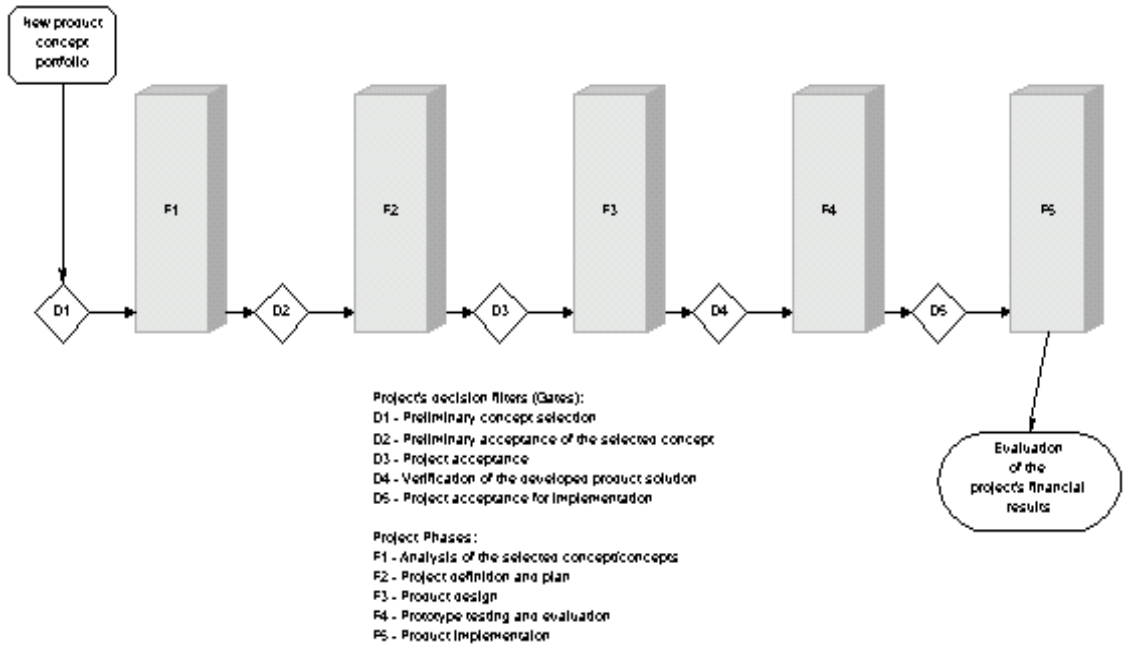


Fig. 3. Typical structure of the proposed Fast Product Development Process.

The structure of the FPD Process is designed from the bottom up (not top down, like for the sequential process), allowing all needed flexibility within the Phases, and even moving particular tasks from one Phase to another. It is the function of Risk Management to evaluate the rationality of such move and the decision power of the Filter Commission to sanction the actions. The bottom up design of the Process and Project Structure is combined with selecting the set of best practices and procedures, as well as defining the needed sets of knowledge. Such tools and Knowledge Resources should be made available for the Project Team.

Decision Filters of the Fast PD Process

The Decision Filters have very important functions in the Process and their performance is critical for the success of the Project. Without them the concurrent process phases a risk of delays or failure due to the fuzzy areas of responsibility. Therefore a proper set and rank of decision makers should be given this duty. Their decisions are extended in both directions: closing the previous, currently evaluated Phase, and allowing the Project continuation to complete the next Phase. The Filter Commission analyses and evaluates the progress of the Project in six critical aspects, marked A, B, C, D, E and F on the drawing.

Fig. 4 shows the structure of the Decision Filter, separating the Phases of the Process

The Risk Analysis is a multi-stage process, as shown in Fig. 5. The scope and accuracy of Risk Analysis depends on the Project complexity and the level of potential loss. The applied probabilities may be taken from historic data, actual circumstances or – for less important cases – estimated in three-level scale: high, medium, low.
A list of available Risk Management Tools can be found on the website www.risksig.com/resource/tools.htm. Palisade is offering RM software @RISK and @RISK for MS Project in standard, industrial and professional versions.

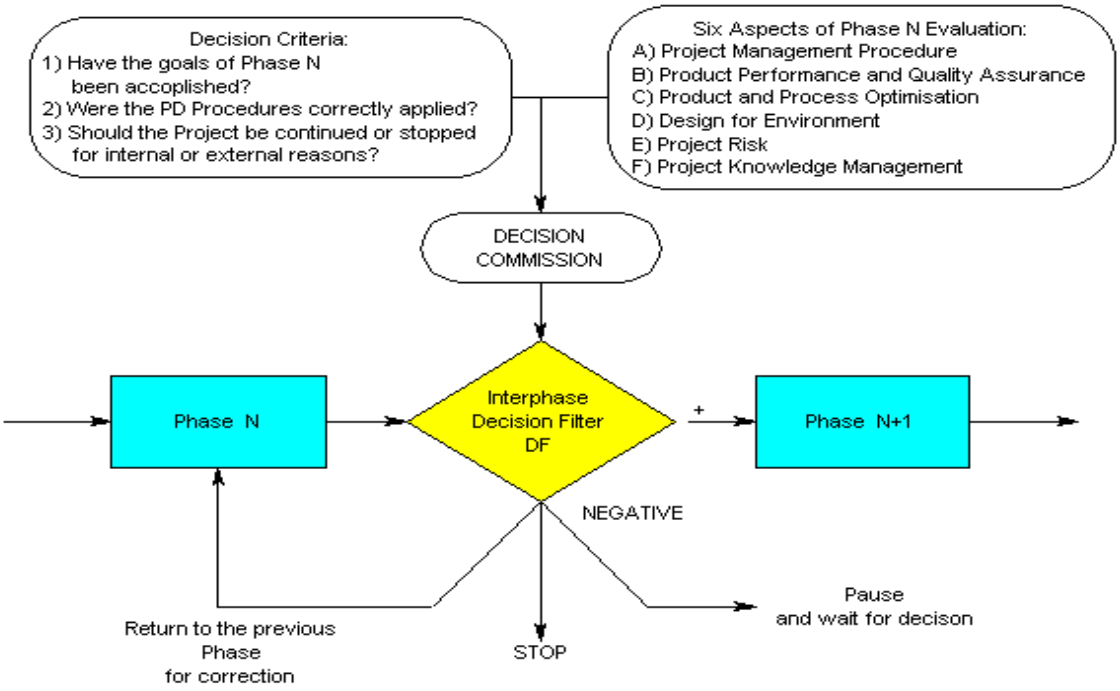


Fig. 4. General Structure of the Decision Filter

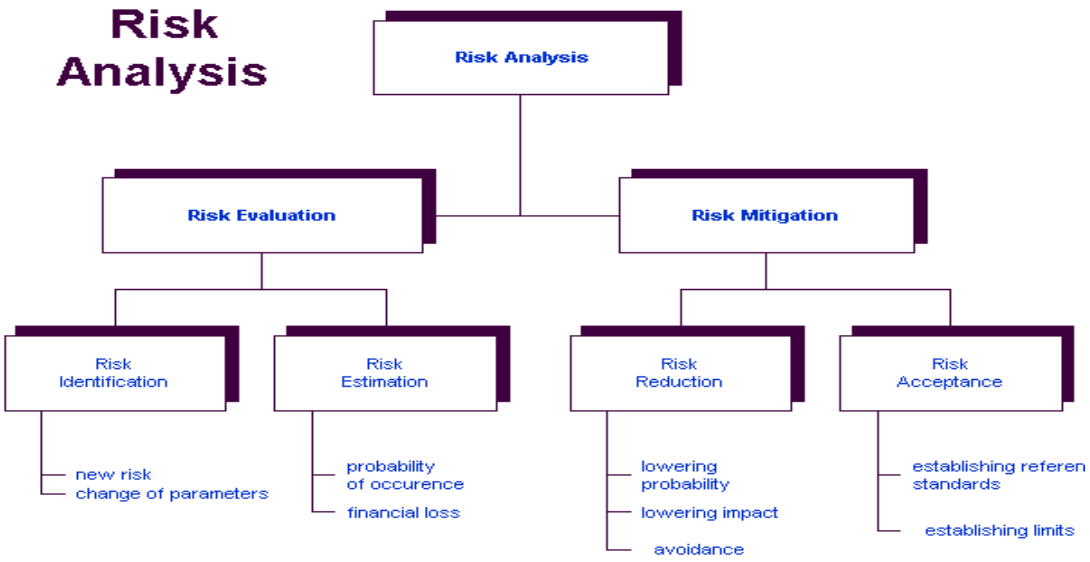


Fig. 5. *Multi-Stage Risk Analysis*

Conclusions

Application of the proposed process of Fast Product Development allows concluding about key factors, critical for speed and effectiveness. They are:

- Properly defined product in close cooperation with users/customers
- Properly defined and planned project, including human and other recourses
- Correctly identified and defined technological and other problems in the project
- Effective access to related knowledge and experience

- Fast and correct decisions about application of proven solutions, where possible
- Effective application of best practices and tools
- Effective application of the PD process, with discipline in decision-making and execution.

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