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## The Maturity Progression of New Product Development Process in the Context of Security and New Product Success

### Summary

Scientific and empirical studies reveal that despite the implementation of new product development best practices, there are still many projects that fail within the framework of new product strategy. It means that costs are incurred by many stakeholders making up a specific network of relations, and not just enterprise. The conditions, under which companies operate, also affect strategic marketing and operational activities of the organisation. It is therefore no surprise that identifying and managing NPD have become increasingly important issues in the product innovation literature and practice. The main purpose of this conceptual article is to show interrelations between the level of the maturity progression of the new product development process (maturity growth of NPDP) and the level of security and success of a new product in the market. The article is to propose the conception of measuring the level of maturity progression of the new product development process in the context of its safety and success as well as managerial implications of the proposed measurement conception.

**Key words:** new product, maturity progression, new product development, process maturity, new product development process security.

**JEL codes:** M31, O31, O32

### Introduction

The environmental and internal conditions under which companies operate, strongly affect marketing strategy and operational activities of organization. The threats to enterprises and their target markets, such as destabilization and declining confidence in their ability to self-regulation, have been identified by the various research, advisory and decision-making institutions, which in response has taken regulatory action aimed at increasing safety of markets, sustainable development. It is therefore no surprise that identifying and managing NPD have become increasingly important issues in the product innovation literature and practice (Cooper 1993; Wheelwright and Clark 1992; Wu Kefan, Gang and Ping 2010; Walker, Russell 2013).

Literatures references about new product strategy, project management, success and failure factors in NPD, already have yielded important findings about critical issues within the new product development process (NPDP). Empirical research indicates that the success rate of major new product development (NPD) projects is still low (Crawford 1979; Griffin 1997; Stevens and Burley 1997; Cooper, Edgett 2008; PDMA 2012; Rutkowski 2007; 2016).

However, for at least two reasons these literatures fail to provide a comprehensive picture of the security and risk factors involved with product development. First, a vast majority of these studies used survey methods across companies, involving only one person in each division or strategic business unit. Secondly, because most of these studies were retrospective, events occurring late in the process have a bigger chance of being recognized as major determinants of the outcomes of NPD projects than events earlier on. Market and business issues dominate in the last phases/stages of the NPDP (Wheelwright and Clark 1992; Trott 2011), therefore the role of technology related security factors might be underestimated and as far as technology related innovation risks are being distinguished in literature. So the focus is more on cost and time aspects than on feasibility of new technological solutions (Polk, Plank & Reid 1996; Branscomb & Auerswald 2001; Urbanowska-Sojkin 2012; Walker, Russell 2013; Wróblewski 2015, PMI and ISO Guide 2016).

### **Problems aimed to be solved by the proposed concept**

The purpose of this article is to find out if maturity progression of NPDP can influence security/risks and success level of new product. This would enable predicting the possibility of project success by determining the impact extent of security/risks factors during the project phases and the integrated risk degree of the entire project. The framework can also propose the optimized responding activities against various risks factors not only to minimize the project time and costs but also to reduce the risks degrees computed in each phase and the integrated risks degree in the entire project.

The main objective here is to identify the level of significance and the level of influence the maturity progression of new product development process (growth of maturity) on the level of security and risks and level of success of a new product on the market (according to the qualitative assessment, as well as the cost and safety of the product innovation process). This is original conception of a new tool for prioritization and assessment of decisions consequences and actions taken in the NPDP according to their relevance and measures the probability level of security and risks factors in each macro phases, phases and stages of product innovation process and market introduction. There are important, therefore, the following scientific problems to be resolved:

- what factors influence the level of maturity of new product development process and the network of relationships?
- whether there is any relationship between the progression of new product development process maturity and market introduction, and the level of risks, and also market success of new product?
- what is the significance and direction of these relationships, what is their nature and hierarchy?
- what methods and tools enable precise progression measurement of process product innovation maturity?
- how to conduct research, measure and evaluate the maturity of these processes?

- what are the current risks, the success or failure factors of a new product on the market?
- what is the level of activity and competence of companies in the area of new product strategy, as part of a marketing strategy?

To solve these problems one should assume the following assumptions:

1. the security and risks of new product development and its market success can vary depending on the maturity progression of new product development process (the level of NPDP maturity and level of intelligent relationships network maturity);
2. the complexity of product innovation process can affect the security and risks of new product development and its market success;

Identifying and taking into account any security or risks factors of the product innovation process, increases the company's security, in particular its technical, manufacturing, logistics, marketing, sales and financial processes. However, this security has its limitations, that is, the criteria that we consider when building security systems (social and psychosocial, situational, financial, marketing and technical related to the product being developed, and ecological and temporal). The security of the new product development process is inter-related with risks level from not only an economic point of view, i.e. with possible losses that the company may incur due to erroneous decisions (e.g. based on incomplete or false information) as a result of unforeseen events errors in estimating the resources needed in the product innovation process, costs, development time, etc (Choi and Ahn 2010). It is difficult to predict the necessary and sufficient measures to reduce the likelihood of negative results and the location of negative consequences of decisions made in the NPDP.

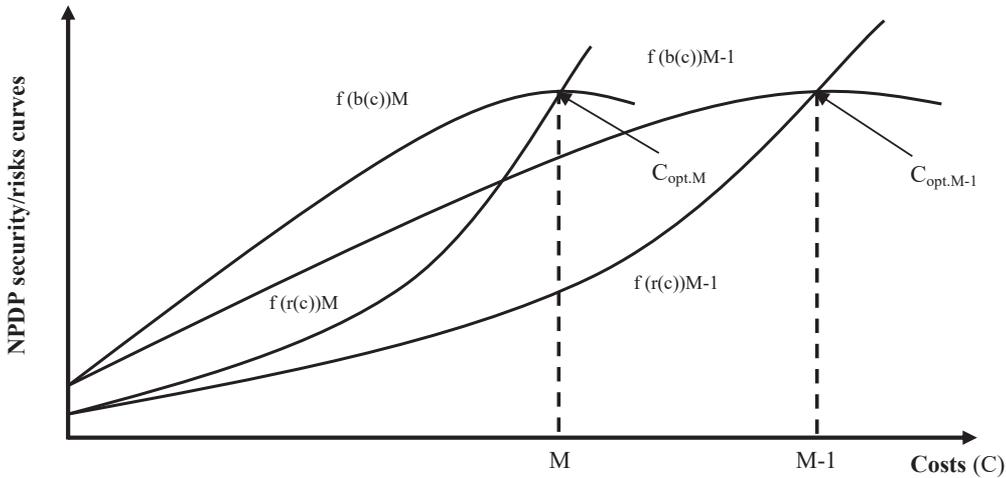
In the field of NPDP management, the procedure for adopting specific decisions closes on the development and evaluation of alternative solutions to selection of optimal projects based on use of a large number of different information to help justify the decisions made by calculating probability of a positive effect or event. However, the results of agreed assessment of decisions will depend on the environment and conditions under which decisions are taken. From the point of view of forecasting the possible outcomes, the circumstances of adoption of solutions are determined by the conditions of specificity degree or uncertainty of NPDP security and risks.

### **Maturity of the product innovation process and the level of security and success of new product**

The project team activities in the area of NPDP management allow not only to implement the made decisions, but also to organize systems for assessing adopted (solutions) decisions. The project risks occurring in individual phases of the NPD can be classified taking into account the decision making process. The application of this criterion allows to distinguish: the risks until the decision is made, when making decisions and after making a decision in the decision-making gate. The risks until the decision is made is related to the quantity, quality and effectiveness of the NPDP information support. At this stage, a well-designed system of information modeling and their use is needed, which is used to formalize and capture the de-

cision problem in line with the adopted assumption. Any actions taken in the area of product innovation management is to a greater or lesser degree related to its security, characterized by specific costs, including risks costs. Figure 1 shows the graph of the NPDP security/risks curve.

**Figure 1**  
**Characteristics of security/risks curves and maturity of new product development process**



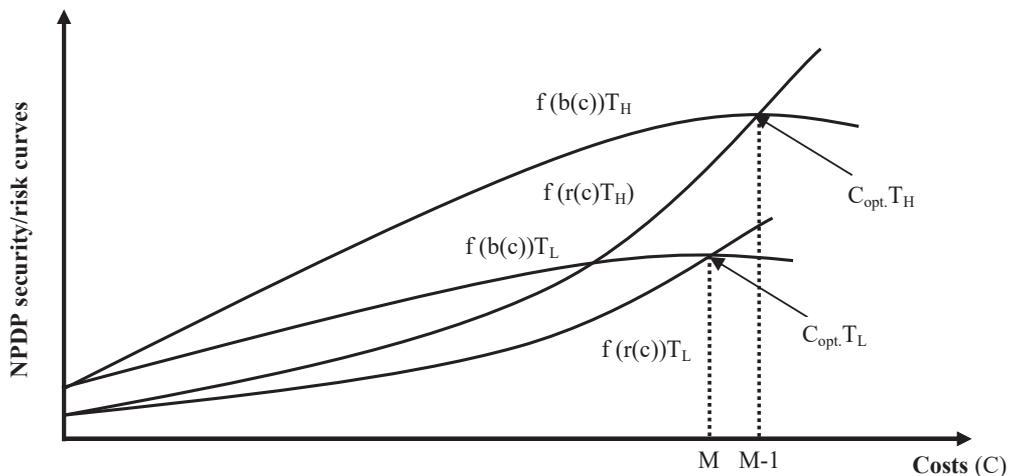
$C_{opt}$  – optimal costs, at which security curve achieves the optimum, at the maturity level of NPDP M or M-1  
 $f(b(c))$  – security curve, at maturity level of NPDP M or M-1  
 $f(r(c))$  – risk curve (risk versus cost) at maturity level of NPDP M or M-1  
 Source: own elaboration.

One can see, that after crossing  $C_{opt}$ , costs of maintaining security are increasing. The cost of risks increases considerably, while the security of the NPDP decreases. The graph also shows the dependencies of the NPDP security curve and cost-of-risk curve. In any case, one can talk about the assessment of NPDP security or new product success and, therefore, the level of risks. One may consider whether to accept or not accept an idea / project / prototype of a new product, however each of these product innovation process effects generate a specific cost share. Adopting a good solution lowers the cost of risk, while adopting a hazardous project (but in the case of success, new product gives significant positive effects), means increasing risks costs and appropriately reducing NPDP 's security.

$C_{opt}$  level may be different depending on the level of maturity of the product innovation process and the maturity level of the intelligent relationship network, the lower maturity level may signify a higher level of optimum costs at which the security curve achieves the optimum and vice versa; at which the security curve achieves the optimum. Also the com-

plexity of the product innovation process can affect the level of  $C_{opt}$ . composite projects - high-difficulty  $T_H$ , may have a higher level of  $C_{opt}$  than projects with a low level of difficulty  $T_L$  (Figure 2).

**Figure 2**  
**Characteristics of economic safety curves and risks versus the complexity of the product innovation process**



$C_{opt}$  – optimal costs, at which security curve achieves the optimum, at the maturity level of NPDP M or M-1

$f(b(c))$  – security curve, at maturity level of NPDP M or M-1

$f(r(c))$  – risk curve (risk versus cost) at maturity level of NPDP M or M-1

Source: as in Figure 1.

The modified formula for determining the economic risks of the product innovation process resulting from the decisions made in this process, in the form of inaccurate unevenness should take into account the following variables (Cygan 2013):  $N1t$  - expenditures on research (creative) activity,  $N2t$  - expenditures on design and prototyping,  $N3t$  - production expenditures,  $N4t$  - expenditures on technology,  $N5t$  - expenditure on testing,  $N6t$  - general costs,  $N7t$  - expenditures on marketing research and marketing,  $P_n$  - unit price of new product,  $S(t)$  - planned minimum number of sales of new products in the period  $t$ ,  $P(t)$  - planned profit,  $C_b(t)$  - costs of removing errors and faults,  $C_u(t)$  - insurance costs,  $C_{sz}(t)$  - training costs of the team,  $C_{ek}(t)$  - costs related to environmental protection and other related to the adaptation to legal requirements. Continuous analysis and evaluation of the value of individual components is indispensable, because in this way sources of irregularities can be identified. In the case of NPDP, for an enterprise to be able to meet the objectives of a new product and development goals, at least inadequate (weak) inequality should occur:  $P(t) \geq P_n \times S(t) - [N1t + N2t + N3t + N4t + N5t + N6t + N7t + K_b(t) + C_{ek}(t) + C_u(t) + C_{sz}(t)]$

Presented here weak inequality, shows that there are certain limitations at a given level of technology, technology and construction as well as those occurring in the company's environment, referring to decisions taken in the NPD, from the point of view of the economic security of this process. Therefore, the risks in the NPDP is the measure of probability that the new product, as the end result of this process, will not meet the expectations of the recipients, will not be prepared in accordance with the schedule and within the adopted budget. The average high failure rate and high costs prove that the development of a new product is a significantly uncertain and risky process. These phenomena or trends should be minimized by properly managing product innovation process in aspects of its security or risks level.

Enterprises should take into account in new product strategies, dynamically variable and difficult to predict technological and legal conditions on the one hand, and on the other hand, demand and competitive, as well as competence variables. Market activity of enterprises in these conditions, makes it reasonable to consider possible sources of security, risks and success of new product on the market as a key condition of organization success.

### **Managerial implications of proposed measurement conception**

While strategic orientation can represent an important antecedent to NPD performance, research suggests that adopting a strategic orientation alone is not sufficient and a better understanding of contingencies is necessary. Based on the dynamic capability view of the company, this study examines the effect of a enterprise's ability to connect with external network partners (networking capability) and the ability of NPD project managers to network with stakeholders within the firm (networking ability). The empirical results indicate that market orientation and entrepreneurial orientation are positively associated with NPD performance when a firm has sufficient networking capability to manage network dynamics and when the managers of NPD projects possess networking ability to successfully mobilize the support and advocacy of stakeholders within the firm. The results also show that NPD performance is highest when market (entrepreneurial) orientation, networking capability, and networking ability are all high, thus supporting the proposed three-way interaction (Mu, Thomas, Peng, Di Benedetto 2017).

R & D, design, prototype construction, testing, marketing research are carried out before new product is launched, and in many cases, a lot of new product development concepts does not even reach the commercialization phase. This means that a new product, which development process has been successful and has been launched on market, must provide not only the cost of its development, but also the reimbursement of expenditure on irrelevant ideas, conceptions and prototypes (Pickshaus et al. 2016).

The main reasons why many companies have failed in development of new products are as follows (Cooper 2002; Cooper, Edgett 2008):

1. an increase in time and costs in all the phases and stages for NPD due to their sequential processes,

2. difficulties in constructing reasonable development schedules and resource distribution plans,
3. failures to respond effectively or efficiently to the diverse security and risk factors that occur in new product development processes,
4. and insufficiency of a comprehensive decision-making system based on qualitative and quantitative information and materials obtained while working on past product development projects.

Another reason is that as the life cycle of products has been shortened, the product types demanded by customers have been diversified, and technology has become more complex, security and risks factors and their degrees, which denote the impact of these factors to NPD projects, have not been able to be assessed. Predicted security and risks factors have not been able to be properly dealt with. These reasons point to the need for systematic NPD security and risks management systems throughout all required phases in NPD.

Identification and consideration in the decision-making process of the security and risk factors of product innovation, enhances overall business security, in particular of technical, production, logistics, marketing, commercial and financial processes (Merrit, Smith 2010). However, this security has its limitations, or criteria that one should take into account, building security systems (social and psychosocial, situational, financial, marketing and technical issues related to the drop-down product, and ecological and time). It can be assumed that the maturity of the process is determined by a variety of factors to identify best practices, between which there are cause-effect relationships to be identified, measured and assessed. In the above statement by the best practice should be understood factor, tactics or method that can be successfully, that is, in an effective and efficient way, used during the actual implementation process.

The vast majority of work exploring issues of process maturity management, on the basis of the theory of the company, focus on one or only a few dimensions. Thus, the proposed approach that the research project opens up new, promising as it does not exploited yet epistemologically, areas for analysis, which can be called integrated network of relationships (Mu et al. 2017). It is possible that in the era of advanced processes of diffusion of information and business knowledge, the power of explanatory so inclined theoretically and empirically test proves to be satisfactory, yet complementary to the rich heritage of scientists locate their interest in the field of management sciences who studies typed into the framework of processes of marketing management company. The organisation should also focus on investing its available resources and competences in the development of new products with strong competitive position, and phase out development projects for new products which are competitively weak.

The competency level in NPDP improvement can be estimated by performing a complete revision, based on the best practices identified on the basis of studies conducted globally, including the activity of various companies in the new product development strategy. The method for matrix-network measuring the maturity of new product development process provides evidence of information to build the strategy and plans for process improvement

(SGMM 2011). This approach helps companies strategically fill the gap (the difference between the way we do and how we should do it).

The following domains are logical collections of factors that determine the maturity of the NPDP and its progression (Rutkowski 2016):

1. Strategy, Process Management and Legal Regulations
2. Organization and Structure
3. Matrix Operations
4. Asset Management and Occupational Competence
5. Technology
6. Customer Needs and Customer Relationships
7. Value Chain Integration
8. Social and Environmental Processes.

This approach to process maturity evaluation and measurement which helps to improve processes using two representations: staged and continuous. The continuous representation uses the concept of process capability levels which the company may rely on to improve specific processes using a pre-defined strong measurement scale. The staged representation provides a roadmap to product innovation and marketing process improvement within well-defined new product and marketing strategy path. Depending on the procedure, the staged representation utilises five or six maturity levels.

When they are put to practical use, these representations can identify business areas that require improvement, modification or modernisation. When changes are made to these areas, the possible outcomes are:

1. an increased likelihood that goals, objectives, and tasks set in the new product strategy are achieved;
2. a greater effectiveness of businesses and other entities involved in product innovation.

New knowledge about the impact of the maturity progression of NPDP on security/risk level and success of a new product on market, in specific situations, can help decision-makers in testing action plans and also identify consequences of decisions and actions to be performed in NPDP. Project teams and new product development managers will be able to take advantage of this concept/model - a tool for prioritization and assessment of the consequences of decisions and actions taken in the NPDP according to their relevance and measures the probability of occurrence. The new approach / method / tool can significantly offset the risks of decision-making, taking into account NPDP security and the maturity progression of product innovation process and market launch.

## Conclusions

The security and risks level of product innovation process and success of new product on market may be significantly dependent on the maturity progression of new product development process (the maturity NPDP is determined by the degree of its define, manage, measure, control, and efficiency - cost of the project, time to market delivery and the quality

of project/new product). The higher level of NPDP maturity, determines the higher level of new product success on market or vice versa. Determinants of maturity of new product development process are similar in different companies and industries, and new product development processes are characterized by varying complexity, the degree of differentiation processes, new product development significantly determines new product strategy and level of technological advancement implemented in new product concept.

Among the trends that are putting pressure on the manufacturers of new products include problems with the commercialization of new products due to high rates of failure, often earning the 50% or more, continuous increase in the number of global and local environmental regulations, emergence of competing manufacturers offering low cost, feature-rich new products. To overcome these difficulties, reduce risks while increasing profitability and quality of products placed on the market, new product development managers should make the best use of development processes and introduction of new products.

As presented above, the product innovation measurement concept have as their purpose to:

- show how new product offering is balanced;
- provide conditions for determining the type and nature of new product strategies;
- reduce complexity and differentiation of new product management process in firm;
- help make structural changes in diversified businesses through appropriate resource and competence allocations;
- focus on strengths and take advantage of external opportunities;
- mitigate product innovation and marketing process risks in strategic decision-making;
- use early warning systems to recognise development threats early and with large likelihood;
- support new product strategy formulation and implementation processes.

Certain priorities in the new product innovation process may require that selected aspects of integrated product development and marketing are used. First of all, management should determine and have an understanding of the business and marketing strategy, and then move on to estimate their competencies. The diffusion process of factor groups which determine the market success of new products (in other words, best practices which describe new product innovation and marketing maturity levels) is observable both within enterprises and across organisations.

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## Progresja dojrzałości procesu rozwoju nowego produktu w kontekście bezpieczeństwa i sukcesu nowego produktu

### Streszczenie

Badania naukowe i empiryczne pokazują, że mimo wdrożenia nowych, najlepszych praktyk w zakresie opracowywania produktów, wiele projektów wciąż zawodzi w ramach strategii nowego produktu. Oznacza to, że koszty są ponoszone przez wiele podmiotów tworzących określoną sieć relacji, a nie tylko przedsiębiorstwo. Warunki, w jakich działają firmy, mają również wpływ na marketing strategiczny i działania operacyjne organizacji. Nic więc dziwnego, że identyfikacja i zarządzanie rozwojem nowego produktu stają się coraz ważniejszymi kwestiami w literaturze i praktyce dotyczącej innowacyjności produktów. Głównym celem artykułu koncepcyjnego jest pokazanie wzajemnych zależności między poziomem progresji dojrzałości procesu rozwoju nowego produktu (dojrzałość PRNP) a poziomem bezpieczeństwa i powodzenia nowego produktu na rynku. Zaprezentowano koncepcję pomiaru progresji dojrzałości procesu opracowywania nowego produktu w kontekście bezpieczeństwa i sukcesów oraz wskazano implikacje menadżerskie proponowanej koncepcji pomiaru.

**Słowa kluczowe:** nowy produkt, progresja dojrzałości, rozwój nowego produktu, dojrzałość procesu, bezpieczeństwo procesu rozwoju nowego produktu.

**Kody JEL:** M31, O31, O32

## Прогрессия зрелости процесса развития нового продукта в контексте безопасности и успеха нового продукта

### Резюме

Научные и эмпирические исследования показывают, что несмотря на внедрение новых передовых практик в области разработки продуктов, многие проекты по-прежнему разочаровывают в рамках стратегии нового продукта.

Это обозначает, что издержки несут многие субъекты, создающие определенную сеть отношений, а не только предприятие. Условия, в которых действуют фирмы, тоже оказывают влияние на стратегический маркетинг и оперативные действия организации. Неудивительно, что выявление и управление развитием нового продукта становятся все более важными вопросами в литературе и практике, касающейся инновационности продуктов. Основная цель этой концептуальной статьи – показать взаимосвязи между уровнем прогрессии зрелости процесса развития нового продукта (зрелость ПРНП) и уровнем безопасности и успеха нового продукта на рынке. Здесь представляют концепцию измерения прогрессии зрелости процесса разработки нового продукта в контексте безопасности и успехов, а также указывают менеджерские импликации предлагаемой концепции измерения.

**Ключевые слова:** новый продукт, прогрессия зрелости, развитие нового продукта, зрелость процесса, безопасность процесса развития нового продукта.

**Коды JEL:** M31, O31, O32

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