

Productivity Framework for Innovative Product Development

Stefan Johnsson

Dept. of Computer Science
and Electronics,
Mälardalen University
Västerås, Sweden
stefan.johnsson@mdh.se

Lars Cederblad

Level 21 Management AB
Västerås, Sweden
lars.cederblad@level21.se

Christer Norström

Dept. of Computer Science
and Electronics,
Mälardalen University
Västerås, Sweden
christer.norstrom@mdh.se

Anders Wall

ABB Corporate Research
Västerås, Sweden
anders.wall@se.abb.com

Abstract

Innovative product development (IPD) give companies the competitive advantage required to be successful in the highly competitive market of today. The natural question is: how do you make your organization as effective as possible in the IPD process? This paper presents a framework to reason about the subject of productivity in the IPD process. The framework is deducted from the definitions of innovation and product development, an effective IPD process contains three parts; Planning (what to develop), Implementation (product realization) and Marketing, Sales and Delivery. Success comes from acknowledging the fact that there are different objectives within the three parts. The productivity of the IPD process can be expressed as a function of the efficiencies of Planning, Implementation and Marketing, Sales and Delivery. This paper is the first qualitative result of research together with seven high-tech industrial companies, with the goal to find what is required to be efficient in the Planning and the Implementation process. The key factors for success as well as some general conclusions are presented in this paper.

Keywords

Innovation, Product Development, Core Competence, Productivity Measures, R&D

1. INTRODUCTION

Every company strives for sustainable growth and improved productivity in order to maximize their output per unit of input. Sustainable growth is the most elusive goal a company faces [6]. The traditional way of increasing productivity is to focus on and improve the processes that are easy to measure in monetary terms like manufacturing. As a result there are plenty of metrics related to productivity in the operation process [15], [25]. However, in innovation and new product development there are not as many productivity measurements available, even though the total R&D spending in the 1000 largest companies in the world in the year 2002, exceeded one quarter of a trillion dollars [20]. Today the stock market has become interested in new product development metrics such as the new product sales of total sales [22].

The difficult task of translating promising ideas of new products into monetary terms has forced companies to view their R&D spending as a cost rather than an investment. Accounting rules require that R&D spending

is treated as a cost; even though in the economic reality it is more of an investment [9]. Due to the same reason, R&D productivity measures are almost nonexistent. Research in the US reveals that only 52 percent of the total spending on new product development is made on projects that are financially successful [2]. If a factory showed similar result it would not last, at least not with the present management. Important to remember is the fact that it is those 52 percent that will have to account for 100 percent of the R&D spending. An increase in the success rate of new product development will therefore increase the future revenues and decrease the cost load, which will be positive for a company's profit.

Peter Drucker, made the following famous observation: "Because the purpose of business is to create a customer, the business enterprise has two and only two basic functions: marketing and innovation. Marketing and innovation produce results; all the rest are costs." [16]. Today, when top management is surveyed, their priorities in order are: finance, sales, production, management, legal and people, missing from the list, marketing and innovation [10].

To be able to reason about innovation and product development productivity in large complex high-tech industrial companies, this paper introduces a holistic framework for innovative product development (IPD) that enables higher productivity and efficiency. Moreover this paper outlines different aspects of what is needed to succeed with IPD. A holistic view of the IPD enables the recognition that there are several different competences and understandings needed for the IPD process to be successful. The IPD framework, proposed in this paper, is developed together with managers within seven international high-tech industrial companies active in Sweden all having genuine experience in developing complex industrial systems within telecommunications, automotive and automation. This research is qualitative and includes workshops and interviews.

The outline of the paper: In chapter 2 is innovation and product development defined and a productivity framework for IPD is deducted. This framework is further developed in chapter 3. In chapter 4, IPD productivity is discussed and the paper ends with conclusions and future work in chapter 5.

2. INNOVATION AND PRODUCT DEVELOPMENT

Innovation and product development are often discussed without proper definitions. The word innovation has its origin in the Latin word *nova* meaning new. In an abstract way innovation can be defined as:

“Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes or services.” [18]

We define innovation as the implementation of a creative idea and benefit from doing it. To be creative means to look at issues in a novel way and an idea can be described as a recipe for dealing with an issue. This implies innovation, to solve an issue in a new way, but the key for it to be an innovation is to benefit from it in some way. Invention and innovation are closely related but with some distinction. An invention is the result of a creative idea or concept, while innovation is the process of turning the invention into a commercial success [19].

The term product development, just like innovation, is often used without proper definition. In this paper we take a holistic view on product development agreeing with the following definition:

“Product development is the set of activities beginning with the perception of a market opportunity and ending in the production, sale and delivery of a product.” [11]

Product development is therefore a process that must involve all departments at a company and not just the engineering as it is traditionally. What is also noticeable is that innovation and product development are similar. In this paper we introduce innovative product development to describe the process of producing new, better and more profitable products that meet the customer’s need and requirement.

3. A FRAMEWORK FOR INNOVATIVE PRODUCT DEVELOPMENT

Innovative product development involves all of the different functions in a company. This insight that all departments must be active in the IPD process for it to be successful is new to many companies. From our definition of IPD there are three different parts that need to be addressed if the process shall be successful, see Figure 1.

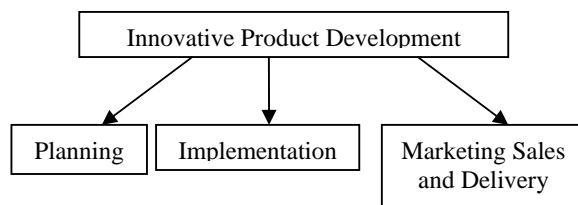


Figure 1. A framework for innovative product development involves planning, implementation and marketing, sales and delivery.

The IPD process involves: *Planning* (what to develop), *Implementation* (product realization) and *Marketing, Sales and Delivery* of the product to the customer. All the three parts require unique specific competence and objectives for it to be victorious.

3.1 Innovative Product Development Planning

The first part in the IPD process is to plan what to develop this is also unrelentingly the most important phase. It is during the planning the boundary for the total success and productivity of the R&D spending is set. The overall objective in the planning stage is to transform customer needs and requirements into something that utilizes a company’s resources in the best way possible that also generates the best possible future profit. There are two main questions to answer during the planning stage; the first question is *what and why* to develop and the second *how and when* to develop it, see Figure 2.

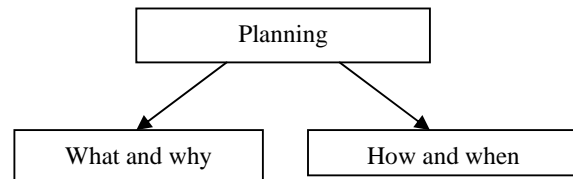


Figure 2. The IPD Planning involves answering the main questions: *what and why* and *how and when* to develop it.

What and why are the most crucial, since it sets the boundaries for both the technical and economical value. When a firm has decided what to develop and why, the value and productivity of the R&D money spent, is limited.

From our research the following is what managers in international high-tech industrial companies active in Sweden consider most important in the quest of answering *what and why* to develop (without mutual ranking):

Table 1. Factor for *what and why* to develop

Market Environment Analysis	Involves different aspects: technology, competitors, the customers’ future business and processes, market knowledge etc.
Customer Needs and Wants	The ability to fully understand the customer needs and wants.
Business Case	Clearly specify what this product will make profit of and why.
Product Roadmaps	A clear plan of how the product will evolve in the future.
Risk Management	The ability to assess risks and work active with them.

The most important determinant of profitability is developing a unique, superior product with real value for the customer [18] [21]. It is during this part and this part only in the IPD framework that this issue should be addressed and it is vital for the whole company that it is done successfully. The market environment analysis is the main action that serves as the foundation for the information input to the company. It is important that the analysis covers all aspects; technology, competitors,

the customer's future business and process, market and more. Market environment analysis is important since the sources of innovation are typically found among users, manufacturers, suppliers and others [8].

On average 70 percent of the product cost is fixed after the specification and design process [6]. The best way to handle this is to have frontloaded projects with adequate competence present when the important early decisions are made in the project. Success comes from improving the understanding and cooperation between different departments in a company, especially between R&D and marketing [1].

The *how and when* questions are more about utilizing a company's resources in an optimal way with project execution as the most important variable. The *how and when* questions in the IPD planning phase were considered to depend on the following aspects (again without mutual ranking):

Table 2. Factor for *how and when* to develop

Technology Roadmap	Develop the technology needed to support the product roadmaps.
Metrics	Different metrics assisting the decision making.
Organization	It shall have clear responsibility, mandate, culture, competence and roles to support the planning.
Ownership from Top Management	It is important that the CEO understands how the IPD process will generate future revenues and profit.
Planning Competence	Understanding all the aspects: technical, market, economic, production, purchase etc. needs and address them.

A key success factor for *how and when* is not to start the implementation project if the firm does not have the key resources available. If a new project is started in an already fully utilized organization it will only slow the other projects down [23]. Many companies start project after project without securing the key competence [3]. Technology planning that will support and speed the product implementation is also a key success factor [24]. The planning ends and the implementation start when the firm decides to launch the development project and realize the actual product.

3.2 Innovative Product Development Implementation

The IPD implementation is all about realization of what is specified in the IPD planning. The ultimate success for the IPD implementation is to deliver exactly what is specified on time with the specified quality. If the key requirements cannot be met or the business case is jeopardized it is important to kill the project if necessary [20]. In the implementation stage there are several different parts involved. Figure 3 illustrates the four main factors influencing the success of the product realization according to our research. Figure 3 is the result of our analysis of the input from interviews and workshops.

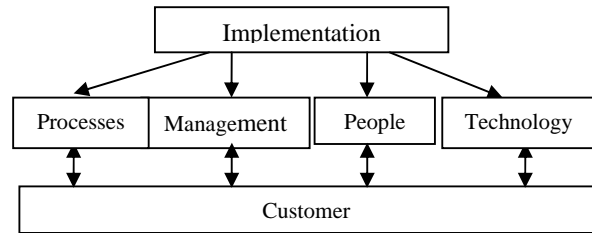


Figure 3. IPD implementation relies on: processes, management, people and technology, and their validation with the customer.

Our research indicates that the following aspect affects the different parts of the implementation stage:

Table 3. Factors influencing Processes

Process Quality	The maturity of the processes
Clear Development Process	That everyone in the organization understands and are able to follow
Tools	Updated tools that support the IPD work the best way possible.
Industrial Structure	Meaning that the right support systems are in place and can be used by the projects.
Clear Metrics	The use of metrics will improve the understanding the performance of the process.
Requirement Management	A structured way of handling requirements.

Table 4. Factors influencing Management

Professional Project Implementation	Important with skilled project leaders the enables effective project execution.
Multi Project / Portfolio management	The company must be able to handle multiple projects and maintain effective project execution.
Risk Management	All risks must be identified and assessed.
Handle Dependencies	Dependencies could involve business, resources, technical issues and project.
Global and Local Development	Find the right setting for what should be developed where.
Clear Objectives / Requirements	Management must be clear of what is expected from the people involved in the project.
Supplier / Partners	The ability to handle suppliers and partners during the development.

Table 5. Factors influencing People

Feedback	Feedback to the people involved in the project to further develop their competence.
Culture / Attitude	In the global world of today it is important to have every one work together as a team.
Organization	Important that the organization evolves with the changes that occur in the firm and thereby support projects the best way possible.
Resources	Important to have motivated and the right amount of resources available for the project.
Competence	Involves securing a diverse and excellent competence in the company
Incentives	Could be in the form of bonuses and other carrots.

Table 6. Factors influencing Technology

Technical Platform / Architecture	Makes it possible to share technology and thereby cost between projects /applications.
Predevelopment of Technology	Shall support the implementation to improve time to market and quality.

The IPD implementation is more of a production stage, since the best possible performance is to deliver what is specified during the IPD planning. In that sense IPD implementation could be compared with manufacturing, but for that to be reality an essential factor is that the *Technology* supports the project with predevelopment and re-use. For IPD implementation it is also vital that the *People* involved understand what is needed from them, because the ultimate success is all about time to market with sufficient quality. In order for *Management* to make the *People* most beneficial it is important that the project members find their assignments: professionally challenging, leading to accomplishments, recognition, and professional growth [12].

An illustrative metaphor to describe the IPD implementation is to relate it to the systems needed for railway transportation. It may be possible to run the train without tracks but it will be a lot smoother using the track and it is the same thing with *Processes*. The train operator is responsible not just for the train running from A to B but also for meeting the timetable, similar to the responsibilities of *Management*. To be able to transport passengers the operator use trains representing the *Technology* and it is important that the train is able to keep the specified timetable. The train operator uses the signaling system to enable safe train rides and the possibility of running multiple trains, similar to handle multiple projects. For the train operator to be successful it needs skilled personnel that understand the passenger needs, in the same way skilled *People* are needed that understands the *Customer* requirements. The success for the train company is all about having the whole system working together, because when the train is moving in the right direction and the *Customers* are sitting comfortably they want to stay on the train and they will use the same train again.

A study by Booz Allan Hamilton reveals that most new products, from automobiles to washing machines, are over engineered as a result from not communicating and managing the customer need properly [5]. For management in the implementation phase it is important to continuously update and communicate organizational goals and project objectives. It is also important for management to illustrate the relationship and contribution of individual activities to the overall product development and business case [12].

3.3 Innovative Product Development Marketing, Sales and Delivery

IPD marketing, sales and delivery are the third part in the proposed framework. It is during this stage that the company transforms its new developed products into revenues and profit. This gives a clear indication of the success not just of IPD marketing, sales and delivery, but also of the total IPD performance. This paper will not develop this part further since there are already well established theories [17] [15], but it is important for the completion of the overall IPD framework. Figure 4 illustrates the involved parts in this stage.

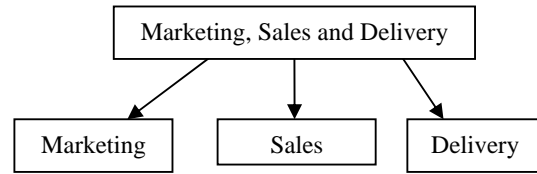


Figure 4. Marketing, Sales and Delivery stage involves marketing, sales and delivery of the developed product to the customer.

4. INNOVATIVE PRODUCT DEVELOPMENT PRODUCTIVITY

As indicated earlier, all the three parts of the IPD framework are needed and it is important to separate and acknowledge what is important for success in each part individually. Especially the differences between planning and implementation must be supported and cultivated to create sustainable success. The productivity of the IPD process can only be established through efficiency in all the three parts. As a consequence a failure in any of the stages will lead to an overall failure off the total IPD process. It is important for a company to reflect on their weakest parts and acknowledge that they exist and secure future improvement. Conceptually the productivity of the IPD process can be expressed as

$$\eta_{IPD} = \eta_P \times \eta_I \times \eta_{MSD}$$

The equation expresses the productivity of the IPD process as a multiplication of the planning, implementation and marketing, sales and delivery efficiencies. As the equation illustrates is the productivity of the IPD zero if any of the three parts is zero, there cannot be any IPD productivity no matter the efficiency in the other two parts. The equation also acknowledges that an increase in the weakest part gives the best increase of the total IPD productivity.

4.1 Innovative Product Development and Core Competence and Capability

In our opinion a competitive advantage arises when companies understand their strengths and weaknesses in the IPD framework. It is natural to compare the IPD framework with the work of core competence and capability; if it is managed well it provides customer benefits in the form of new products, it is hard for competitors to imitate since every organization is unique and it will be leveraged into all new products and thereby markets [4]. Core competence and capabilities constitute a competitive advantage for a firm; they have been built up over time and cannot be easily imitated [7]. If a company manages to turn their IPD framework into core competence and capability they will have the IPD process as a competitive advantage. If this is possible it will transform sustainable growth from an elusive goal to a natural veracity.

There are two fundamental principles when creating core competence and capability; the competence must steer the power structure in a company and the core

competence strategy must be chosen by the CEO [13]. The first part is supported by the IPD framework but it must be used by management in that way. Also as we have pointed out in Table 2 support and understanding from top management including the CEO is a crucial success factor. The best approach for handling this would be to take an evolutionary approach involving implementation and coordinating dozens organizational efforts. This method is fruitful in the sense that it will deliver payoffs along the way even if there is only partial success [13]. Important to note here is that even if a firm initially is successful with IPD the work is not over. Working with the IPD framework is the work of small continues improvement steps and not something that is solved over night, it must always be in a company's focus.

5. CONCLUSION AND FUTURE WORK

Since IPD is a complicated process it is essential to have a holistic framework to be able to understand the different aspects needed, because the IPD process is never stronger then its weakest parts. The IPD framework should be viewed as a foundation to reason about productivity and for improving the company's ability to successfully develop innovative products. We will in our future research attach metrics to this framework to identify and enable a better understanding of weaknesses and strengths in a company's IPD process and thereby make it possible for increasing the overall productivity.

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