



Innovation process management

K. Pałucha*

Management and Administration Institute, Organization and Management Faculty,
Silesian University of Technology, ul. Roosevelta 26-28, 41-800 Zabrze, Poland

* Corresponding e-mail address: kpalucha@polsl.pl

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ABSTRACT

Purpose: of the article is to present selected problems of innovation management. Indication of the growing interdisciplinary and the complexity of that issue and requirement of having an extensive knowledge from the scope of the management. The other purpose is a synthetic presentation of differences in approach to managing innovations. The additional purpose is to present benefits which are the effect of efficient managing innovations. They are described based on examining processes of preparing the production. The topicality of the subject matter results from the fact that it is projecting to a considerable degree onto the competitiveness of businesses. However the large variability is forcing surroundings to seek organizational new solutions.

Design/methodology/approach: For the need of achieving presented purposes, studies on literature concerning managing innovations were undertaken. Special attention was paid to development processes of new releases. At the same time in chosen manufacturing companies they conducted pilot researches (interviews, conversations with the technical divisions' management staff). Those researches enabled to recognize approaches toward the discussed subject matter as well as to find out solutions applied in processes of preparing the production and effects obtained from this title.

Findings: Studies on literature are showing that there is a number of innovation management models as well as of managing development processes of new releases. It is explicitly hard to show better solutions and to recommend them for individual enterprises. All of them have the determined merits and demerits. They are reweighing demand-induced models. A complexity of suggested solutions grows. Examined enterprises apply own models embracing outside organizations, stakeholders and consumers more and more often. At the same moment they require a modern organization.

Research limitations/implications: The preliminary findings introduced in the general form requires systematizing and deepening. Further researches are necessary, particularly in the development processes of new releases.

Practical implications: Both theoretical as well as practical arrangements concerning managing innovations and obtained effects are emphasizing meaning of this subject matter for the structure of the strong competitive position. Therefore building elastic models enabling the efficient management is needed.

Originality/value: The main value of this article is to show issues of managing innovations as the matter requiring parallel apply of modern tools assisting change management, knowledge management, project management etc.

Keywords: Innovation management; Closed innovations; Open innovations; Production preparing; User-Driven Innovation; Product Life-Cycle Management

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MATERIALS MANUFACTURING AND PROCESSING

1. Introduction

Amongst both theoreticians and practitioners engaged in economic problems a common opinion exists that the development processes within the nearest future shall run more dynamically and they shall characterize with high and growing complexity level and thus those processes will demand a specific knowledge and efficient management. Today market characterizes with high variability. Strong competition focuses its actions on reaching advantages by: product, quality, time, costs.

In order to meet these requirements, each enterprise must take actions aimed for ordering and structuring its internal processes. It must make its entire system organization more efficient. Simultaneously these processes due to their complexity and variety must characterize with large flexibility.

Increasing competition, necessity of more efficient customer needs meeting, quick technological development, new materials etc. cause a continuous shortening of life-cycles not only those of products. Therefore the research, development and implementation works must speed-up. It's especially visible in the new products R&D processes, which include a full range of the research and development, design, construction (the product novelty is often proved by application of new materials), production preparing, start-up, realization and commercialization.

Different approaches to the innovation process management enable a large spectrum of the management models for the new product development processes, presented in the subject literature [1,2,3,4]. The innovation problems take special position in the today economy, where large role is played by issues ensuring a balanced development. The modern organization approach feature is the more and more demanded social business responsibility. Significance of this problem increased strongly in the globalization conditions.

Today problems relating to product innovations are connected, in significant part, not only with application of the modern technologies, attractive, functional design, but also with selection of different materials, from which the products shall be made. The centre of gravity is located not only on the economic efficiency side but also on the widely understood ecology one (a/o more and more difficult access to some raw materials). Thus in order to meet the current requirements the organizations acting in the market economy must initiate a wide cooperation (activity integration), creation of different knowledge networks, more efficient transfer of knowledge and technologies from universities, R&D units, design offices, etc. to the widely understood industrial practice.

The article presents the selected, general problems connected with the innovation process management, it indicates different existing models and multi-plot actions taken in different areas.

2. New product and technology development processes

Global economy forces all the organizational units to conduct the development works. They include the product, process (technology), organizational and other innovations, e.g. marketing or management ones, etc. Management of the new product

development process on the enterprise level indicates, as it results from rich subject literature, [5,6,7,8] very wide look to this problem and necessity of use possible best practical solutions (best practices). The whole process can be divided to:

- Identification of customer needs and requirements,
- Identification of the technical progress directions,
- Identification of the competitor action directions,
- Development of the product strategy (a/o introducing of a product into market),
- New product concept generation, review and selection,
- New product design, modeling and testing, documentation up-to dating,
- Development of technological process,
- Design of production system,
- Production start-up,
- Implementation of changes,
- Product withdrawal from market, production shut-off.

Those actions are built into the companies' strategies. The practice shows that the modern innovation process management consists of complicated actions requiring simultaneous solutions in such fields as:

- Project Management - methodology and structure of work aimed at ensuring of efficient operation at complex projects, with special emphasis on the coordination of their structural elements, time management, costs, quality, human resources and risk;
- Change Management - supports the preparation and implementation of any novelty in the company while indicating goals of the changes, benefits and disclosing barriers or sources of obstacles against such changes. The tool is of special importance in connection with currently observed dynamic changes within the business surrounding;
- Knowledge Management - a tool whose importance is growing fast. Various data and information volumes grow rapidly. This is due to the fact that intangible assets become more and more important in the management processes (know-how, patents, unique technologies, etc.). We can see how rapidly grows the knowledge volume and how quickly it becomes obsolete. The processes of technology transfer to companies play an important role. Innovations become more and more complex while the time intended for research and scientific work is shortened, which results in growing needs for various special knowledge. Therefore, it is necessary to develop an effective system that could enable acquisition, development, use, maintaining and localization of such knowledge.
- Value Based Management - a contemporary direction for actions aimed at creation of values by relying on skilful combination of the company's strategy with its economic and financial results. What becomes especially important is the ability to identify the most crucial factors that create the company's value. This is due to the fact that the companies focuses their strategies on maximizing their values. This in turn requires suitable formation of a "value chain". However, regardless of its form, all business models emphasize an important role of innovative processes. Those processes adjust companies to elimination of wastages (by avoiding activities consuming resources, but creating no value) and focusing on a value (specified by the customer and delivered by the supplier at a specific price and within proper time).

The innovation management development is stronger and stronger connected with a knowledge management [9,10]. The growing importance of knowledge is connected with the growing innovation significance and its complication level. The practice shows that it forces creation of different cooperation networks in its structure system. It enables more easy knowledge acquisition from external sources, development of such knowledge and thus acquiring of new skills, sharing with a knowledge, etc. The weakness of the existing solutions is however proved by a fact that the technology and knowledge transfer to companies, not only small or medium ones, is still unsatisfactory. However the success shall be reached by those who are able, in short time, to acquire, process and effectively use the new knowledge.

The innovation development is a complex process. It requires solution of many problems. The theory shows many criteria that classifies innovations [11]. Thus we can distinguish:

- from the innovation subject point of view: the product, process or organizational innovations;
- from the implemented change novelty point of view: the creative or reconstructive innovations;
- from the change initiating point of view: the supply, (technical progress-stimulated) technology-push type or demand (market-initiated) market-pull type innovations.

The especially complicated is the product innovation development process. The theory shows two basic model groups:

- Sequence (serial) models;
- Linked (parallel) models.

The first model group may adopt solutions based on the technology-push concept or on the market-pull one. The other model belonging to the link type ones assumes that the innovations must be formed logically, sequentially but the process itself don't have to be continuous. Therefore it's divided to series of separate but interdependent and linked phases. The example is the model by R. Rothwell and W. Zegveld [12]. They did distinguish: NEW IDEA - DEVELOPMENT WORKS - IMPLEMENTATION WORKS - MARKETING - MARKET. This approach allows close linking of such areas as research and development, production and marketing. The model by Rothwell R., Zegveld W. assumes that the innovations are treated as logic ones, process has a sequence nature but it not necessarily must be continuous. It may be divided to a series of functionally independent but mutually linked phases. These actions are affected by „new technologies” (research part is deemed an integral part of the innovation process) and „new needs”. Such approach allows strong joining of the R&D, production and marketing areas.

Similar to the above presented is the model by Kleine S.J., Rosenberg N. This is the so called “linked chain” model, where the main role is played by a cumulated knowledge resulting from different earlier experience and research. It forms a superstructure for the line innovation process. Large role in this model is ascribed to the knowledge management. It includes: POTENTIAL MARKET - INVENTIONS - DESIGN & TESTS - WORKING DESIGN - PRODUCTION - DISTRIBUTION - SERVICE [13].

Different problems, to be necessarily considered and solved during the new product development processes, allow indication of the stages that demand a solution. These are, e.g.:

- Research of new product ideas,
- Selection of new product ideas,

- Development of new product concept,
- Design of new product documentation,
- New product trials and tests,
- Project realization/production process arrangement,
- Production start-up
- New product marketing tests,
- Introducing the new product into market,
- Economic and financial analyses (carried out at different project stages).

It should be kept in mind that the presented stages have their own internal complicated structure, which demands realization of a large works volume.

The simultaneous model idea in the automotive industry is also a suppliers and customers inclusion into a new product development project. For example, in frames of the SICPARI project, realized under sponsorship of five renown car producers (Mercedes - Benz, Volkswagen, Renault, PSA, Fiat) such simultaneous management of the new product development method was used. It allowed a/o significant shortening of the development process time and process cost decrease, it affected the product quality increase and improvement of solutions applied in production systems. The model-assumed strong development of interaction between different operations depends on information flow, thus it requires an efficient flow of information streams.

Confirmation of the existing innovation management complexity and multi-plot nature is the works of Ms. A.D. Dobrzańska-Danikiewicz [14]. The author presents material science problems and indicates the balanced development problems. Diagnostication and solution of scientific or technological problems requires today a parallel perception of these problems in the aspect of ecology or complex economic processes. When diagnosing basic problems within the material surface engineering area it was indicated a need of simultaneous considering the knowledge from such fields as material engineering [15], organization and management (technological foresight) [16] and computer science (informatics technologies). This approach may be treated as innovative one within the material area, and widely as the designer's production preparing where selection of materials is deemed as one of the most important decision problems, because it affects the costs or technological process type.

The other problem researched by the article author is organization of the new production preparing and start-up processes. These problems are current and important in the aspect of permanent change introducing necessity in both assortment of the offered market products and applied technologies, for instance [17] or assumed organizational solutions, for instance [18,19,20]. The commonly recently used procedures of so called technical production preparing, as shown by the practice, strongly changed. All the approaches to production planning and start-up, presented in a literature [21,22,23], show a clear proceeding chronology. The main problem is their time-scheduling and proper coordination.

The production preparing process today consists of, besides the R&D, the designer's and technological production preparing and moreover the production organization (machinery and production devices types and quantities, layout optimization, material streams flow arrangement, production reserve volume and structure, production capacities, etc.) issues must be decided.

When arranging the production process it's also necessary to make decision relating to material supply system, i.e. a/o selection of suppliers, delivery arrangement, etc. Similarly the product distribution problems must be decided. Thus it can be said that such decisions, in large part, relate to the supply, production and distribution logistics. The conducted literature studies relating to production preparing as well as tests carried in chosen machinery industry enterprises (reviews with the management staff working in the production preparing and managing area) show that the good organization of works realized at the production preparing phase enables a/o:

- maximizing the produced goods assortments,
- better meeting of customer needs,
- quicker implementation of modern products and technologies,
- Full production standardization, unification and typification,
- information flow improvement,
- full use of the gathered knowledge,
- better cooperation arrangement between organizational units,
- more efficient works coordination,
- full use of possibilities created by flexible production systems,
- minimization of the development work cycles,
- minimization of labor consumption for the realized projects,
- minimization of preparing and production costs.

Actions taken during the production preparing today are often a consequence of the formed "event chain". Introduction of new products often cause changes in technological processes and this in turn forces changes in organization of production processes. If it's assumed, according to the subject literature, that each product modification increasing its competitiveness and attractiveness for a customer, shall be deemed as creation of the new product, then each new product being the market offer becomes an innovation, because it characterizes as a rule with higher quality, reliability, functionality, increased user safety, protection of both working and natural environment. In many cases it also make it possible to decrease the operational costs.

The next problem should be presented considering the innovation diffusion issue. Within the production preparing area it's necessary to integrate the marketing approach to the product (customer need orientation) and innovative approach (new discoveries & technologies orientation). This results from the observed new approach to innovation including so called integrated product life-cycle (Product Lifecycle Management - PLM). It consists of the product development and market product life cycles. Thus we have the process that governs all the life-cycle of each particular product, i.e. from generation of a concept, through primarily design works, final project, production start-up, production, introducing to the market, service up to product withdrawal from the market. Thanks to it the Product Lifecycle Management becomes one of the important elements of the enterprise information structure. Such communication systems allow more complex cooperation with other enterprises and more and more often the standard solutions are:

- Customer Relationship Management (CRM)
- Supply Chain Management (SCM)
- Other.

Development works on such type system are in progress, because such solutions allow obtain substantial profits. These are indicated here:

- Time compression due to preparing of the new product documentation.

- Product quality and functionality upgrading.
- Production waste volume limitation.
- Performed elaborations, prototype testing and production costs decrease,
- Savings due to possible re-use of the owned databases.
- Potential savings due to possible complex integration of the processes.

This way the production preparing process arrangement and efficiency affects the enterprise offer market response and efficiency of the technical and technological solutions applied inside the company. Since the preparing works are strongly correlated with scientific research and development works, the research carried out in this aspect show that:

- Research is strongly aimed at meeting the customer needs and expectation,
- Research ordered by enterprises relate mainly to key enterprise competences and skills,
- Requirements relating to research efficiency and result obtainment speed grow,
- Research costs and labor consumption grow,
- Risk of non-obtainment of the assumed research results grows,
- There's a tendency to carry out complex research and obtain original results,
- There's a growing interest of organizations and enterprises in cooperation for common carrying out the research and development works, etc. [24,25].

The enterprise's competitive power depends not only on the owned innovative potential. The enterprise must be able to converse innovations into market products. Therefore large importance is ascribed to combination of the market approach and technological orientation. Such integration makes the product portfolio management possible and more easy. It also allow project management during all the integrated product life-cycle, including the development and market cycles.

3. Demand approach to innovation

Nowadays the larger and larger role is ascribed to so called open innovations. The open approach to innovative processes (open innovation) means that the given organization (enterprise) cooperates with external organizations. Thus they become the external knowledge (information) sources. These sources are treated as the most important. Use of this type approach requires, first of all, good organizational solutions and new thinking. The term "open innovations" is used in the book by H. Chesbrough [26], in which he presents the technological development management model for an enterprise which opens on knowledge acquisition from external sources. Therefore this model assumed use of the concepts/ideas from both external and internal sources, also other is the approach to innovation commercialization. Such approach to the innovation problems differ widely from the earlier one, basing on the own internal reserves. Example of such traditional, „closed" approach to innovation is presented by P. Trott [27].

Open innovations are the contradiction for the closed ones, where the innovative processes are carried out in frames of the organization. The basic advantage of the closed innovations is

limitation of the “knowledge leakage” outside, and moreover there are more chances for introduction of new products into market, more easy solution of the issues connected with intellectual property, etc. Thus consequently, in opinion of this approach followers, strong competitive position can be built. However, followers of the open innovations indicate other factors being advantages of such approach. These are for example:

- Cooperation in a network enables the innovative potential enlarging,
- Duplication of the carried out works is limited,
- Fault risk is decreased,
- Innovation implementation time is shorter, which is important in the continuous product life-cycles shortening aspect,
- Increased number of the organizations conducting the innovative works,
- Increased activity of scientists, businessmen, public authorities and customers,
- Market success not always depends on introducing of new product into the market, earlier than competitors,
- Real possibility of limiting the financial outlays for realization of R&D works.
- etc.

Open approach to innovative processes means more and more practical use of so called “open source” in realization of different innovative processes. The open source concept was a result of evolution in creation of software and then it was implemented a/o in pharmacy, biotechnology, communication, etc. The practice shows that the basic advantage from use of the open approach to innovation was an increase of creativity. Given problem is elaborated by a team of people having deep knowledge in such field. It fosters the work realization speed and risk division, facilitates decision making, etc., and consequently it converts to competitiveness of such organization. It most often indicates to:

- user-driven innovation, i.e. creation of innovative solutions basing on the identified customer needs,
- open source business model, i.e. arrangement of a complex innovative process in the form of open business model.

Rate of the current development processes and all the other conditions seem to emphasize significance of functioning of different, mutually supplementing organizations within cooperation networks. However there are also opinions that some economic subjects shouldn't use this model. It should be also kept in mind that application of the solutions characteristic for the open innovations don't means a necessity of total resignation from the closed ones. The traditional model of the supply, i.e. closed innovations assumes creation of innovative solutions (these are often R&D works) basing on own scientific and research back-up. It requires large financial outlays, work-out of the efficient system protecting the developed solutions etc. Thus this model is aimed at search of novelty solutions, first of all, within the areas of research and development (R&D), design or technological works as well as within the production organization and management areas. Within last years the innovation strategies in many companies the non-technology type innovations have a special position. It results from high dynamics of the changes occurring in their environment. The radical changes, observed at the turn of the century, show that the market success of the new product is decided mainly by customer or rather consumer needs. Such situation forced enterprises or organizations to take other

approach to innovations, i.e. approach based on opening to environment and the interested. Therefore large group of customers and the interested are engaged into innovative processes. Thus the new solutions became a result of cooperation of different groups, interested in solution of the given problem. Such point of view did lead to formation of the sequent model connecting, in frames of the organization, the closed innovation and open innovation approaches [28]. The proposed so called distributed innovation model focuses on knowledge flows inside organization with simultaneous opening to external knowledge sources. This model strongly points out a need of partnership relations with the external interested and it simultaneously assumes existence of equipollent relations between organization members. It should foster increase of confidentiality between partners taking part in the innovation process as well as enforce of mutual relationships. It may also foster increase of the organization's value.

The open innovation model by P. Hobcraft consists of 3 basic areas:

- First area relates to cooperation between organization and the external interested,
- Second area includes actions integrating the knowledge coming from outside with the one created inside the organization,
- Third area indicates different methods of introducing the innovation into market.

The conditions necessary for generation of a new value, by organization using the open innovation model, the author deems: adaptation ability, network creation ability, so called anchoring ability and so called dispersing (distribution) ability.

Special open innovative model is the one called “user-driven innovation”. It assumes an interdisciplinary approach to innovation problems and it uses different methods, techniques, knowledge resources, etc. This model allow better understanding both apparent and hidden consumer expectations, by using information from consumers. Authors of the expert opinion „Increase of undertakers awareness what profits come from the demand approach to innovation (user-driven innovation)” [29] define this term as: “process of using the user's knowledge in order to develop new products, services or concepts, basing on real understanding of users needs and systemic engagement into enterprise development”. This concept distinguishes two theoretical approaches, used in the innovative process, that differ from the traditional one. These are:

- UDI - Consumer Voice - actions aimed at identification of the hidden consumer needs and creative thinking to improve the product functional features, etc.
- UDI - Consumer Leadership - actions in frames of this approach are aimed at search, identification and development of new solutions coming from consumers.

This model, which differs from the traditional, supply one was aimed at, first of all, considering the environment turbulences, enabling use the knowledge coming from a series of subjects interested in the given problem, etc. Additionally development of the new models is fostered by development of modern informatics technologies as well as the globalization process. It may be also stated that development of the user-driven innovation results from evolution of the innovation models and systems as well as from changes within the organization itself. The main advantages coming from introduction of this method, are:

- Orderly approach for acquisition of special knowledge,
- More full identification and understanding of customer expectations and needs,
- Better understanding of a value by customers,
- More complete communication with consumers,
- Modification of organizational structures that fosters a/o creativity,
- Modification of the used marketing solutions, a/o relating to acquisition of different information,
- Change of business model,
- Growth of the enterprise competitiveness,
- etc.

Interesting example of the new approach to innovation are the actions taken by European Technology & Innovation Institute (ETI), which is to be carrying out works aimed at further development and consolidation of the existing Knowledge and Innovation Communities. The Institute shall realize tasks resulting from European Innovation Policy and consequently it shall make the distance between Europe and the most innovative countries shorter. Main Institute's attention should focus, if the European Commission accepts at 30.11.2011 its activity strategic plan, on problems of climate changes and balanced energy as well as undertakings relating to development of the Informatics & Communication Society (ICT). The basic Institute purpose is realization of the research programs joining the scientific and business circles. The task set for ETI shall be realized, as previously mentioned, by so called Knowledge & Innovation Communities - KIC. The first three communities arisen in 2009. These are:

- Climate KIC - oriented for counteraction and adaptation of climate changes,
- KIC Inno Energy - oriented for commercialization of undertakings relating to the balanced energy production and distribution,
- EIT ICT Labs - oriented for commercialization of undertakings relating to development of the information and communication society.

In further perspective the new communities aimed a/o for raw materials (exploration, mining, processing, recycling and substitutes) as well as for development of modern, balanced, environment-oriented technologies shall be created [30].

Currently we can see sequent changes in approach to the open innovations. These changes shall occur continuously, just as new problems appear requiring solution or the needs to be met.

4. Conclusions

The problems presented above, relating to issues of the innovation management process improvement allow formulation of several conclusions of a general nature mainly.

The innovation process management problems should be seen in the aspect of other management fields. These are a/o knowledge management, change management, technology management, value management, project management, etc. All these fields have a wide spectrum of tools suitable for solution of different problems. Approach to innovation and innovative management require a command of these tools.

Traditional, line or parallel based innovation management models allow efficient management of innovation processes. However they are out-of-date if the problem complexity requires an interdisciplinary knowledge. The surrounding variability forces a necessity of shortening the innovation design, realization and implementing time, which additionally complicates such process management.

Production preparing process should be treated as the most important problem areas in activity of production enterprises. It affects on majority of factors characterizing enterprise activity. It forms the enterprise's technical and organizational level as well as its economic and financial results. The properly carried out preparing process decides, first of all: product modernity, functionality and attractiveness for customer, quality, production start-up cycle time, selection of proper production methods, price competitiveness as well as preparing and production costs.

Open innovation concept is relatively new one, developing yet. It includes both approach to innovation and its implementing. The current development of different communication tools shall foster development of this model. This model advantage is a possibility of more wide, as it was before, use of the intellectual capital of other subjects, better adjustment of own market offer to consumer's requirements and needs. It may result from entering into connections with other organizations co-creating the cooperation networks.

Open innovation concept is consistent with the observed tendency to a wide development of external information sources in enterprises. It's made by a/o implementation of modern communication tools with customers or consumers. The implementation processes use a variety of modern management tools.

Open innovation approach, contrary to the traditional approach to innovation, is a total approach. Ability of absorbing of the knowledge and ideas from external sources and creation of new products and services, basing on market needs becomes currently one of the key factors that decide the company development and building a competitive advantage.

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