

PRODUCT INNOVATION PROCESS – A LITERATURE REVIEW

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Companies across the globe are trying to achieve an edge, whatever small it may be over their competitors. In the current scenario, a product's success depends not only on the technology by which it was developed or on the marketing that was done for its promotion but also on the emotional value that it adds to the customer's daily life. This demands a very complex yet flexible approach towards product development.

This complexity has led to the employment of various product development methodologies by organizations. The product development methods have evolved over time which has significantly affected organizations to change themselves and their internal processes.

Research Aim:

This paper focuses on analyzing the product development process that takes place within organizations. A classification of product development methodologies by using previous literary work is performed. Out of these methods, *Market Driven* and *Technology Driven* are further investigated. An analysis of the role of customers, the success factors common to different product development methods and their management implications is provided. A brief discussion on a user driven product innovation is also present.

Categorization:

There are many ways by which previous researchers have categorized (and coined) the process of product development. A lot of researchers have considered this process as innovation process of which development is a part (Vogel, C. M., Cagan, J., & Boatwright, P., 2005), (Holt, K., 2002). Holt has taken a conceptual approach towards categorization. He suggests that product

innovation can be done either “by-chance concept or a technology concept or a marketing concept and finally by product concept”.

Ettlie and Subramaniam (2004) have classified product innovation as incremental and radical. Though there are different ways to categorize the innovation process, the two common ways that has been used are Market Driven or Market Pulled and Technology Driven or Technology Pushed.

This paper defines Market Pull Product Development as the process in which user demand is the primary factor and that markets, users and applications are, or should be, the key drivers of innovation. (Chidamber, S. R., & Kon, H. B., 1994). This means that whenever a product is developed by focusing on the needs of a user and not on the technical aspects of how it will be produced, it is a market lead process. The Technology Pushed Product Development is defined as a process where an emerging technology or a new combination of existing technologies provide the driving force for an innovative product and problem solution in the market place (Herstatt, C., & Lettl, C., 2004). In other words, when the technology is the governing factor of the product development process rather than the user needs, it is suggested to be a technology pushed process.

Technology Driven or Technology Push Model:

This section throws light on some of the technology push models proposed by various authors.

The most basic model of product development is considered to be a liner model (Figure 1) that was employed in 1950s (Rothwell, R., 1994). Rothwell mentions that the main reason for the evolution of this model was because of the technology led rapid industrial expansion.

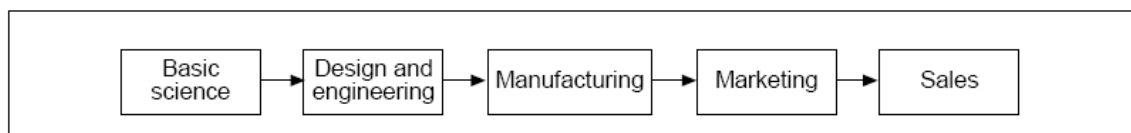


Figure 1- Rothwell’s Linear Model

The model suggests that innovation started with basic science which got transformed into design and engineering phase. The product developed during the design phase was then manufactured, marketed and sold.

Another model was developed by interviewing successful push model based product development companies (Souder, 1989). Souder developed a flowchart of technology driven product innovation (Figure 2).

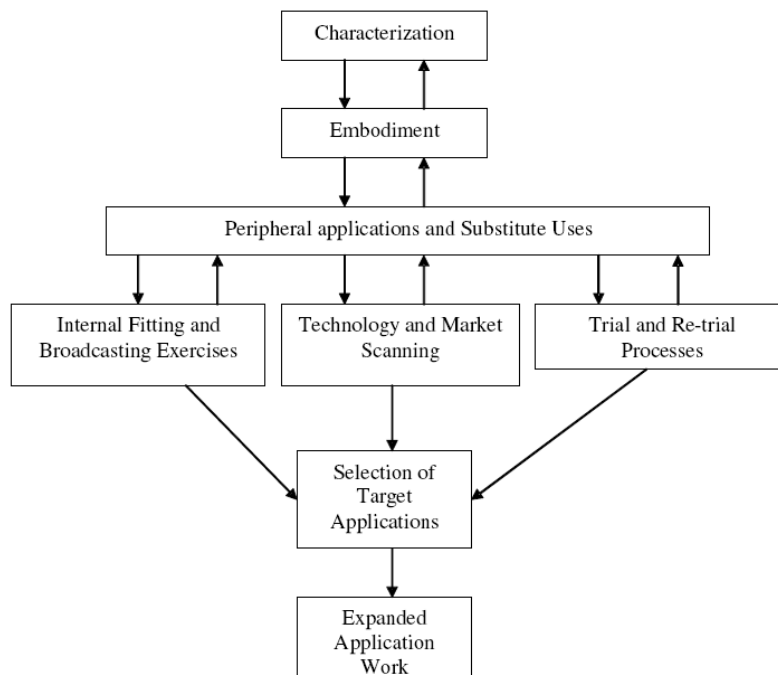


Figure 2- Souder's Flow Chart

Souder described the first step as characterization where the newly developed technology is compared for an edge over the current in-use technology. The next step 'embodiment' is considered to be "a way to facilitate a connection between what it is, what it can do, and some potential need". After embodiment, this framework suggests to take various approaches towards identification of potential market like scanning, iterative trial and re-trial processes. This helps in identifying more than one market of the technology. Of the identified markets, the most potential market is selected and the technology is developed specific to the market specific application. Though this framework provides a logical way of innovation, Souder has not given some practical example where this framework worked.

A model similar to the Rothwell's model was also developed by Paul (Paul, R., 1987). This model (Figure 3) implies that all the phases are clearly defined and there is no ambiguity present in the process. This method gives emphasis on testing the product before its launch. However, Rothwell encompass the last two steps, test and launch as sales in his model.

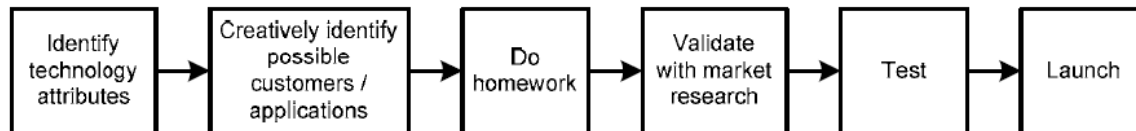


Figure 3

Paul also suggests that the new product is technology driven, however, should be appropriately priced and should meet the needs of the customer. He also suggests that a new product will take time to succeed and the organization should have patience.

Another model, “Model of Technology Movement (MTM)” congruent to above mentioned models was developed for studying the coordination of technology transfer (Spivey, W. A., Munson, J. M., Nelson, M. A., & Dietrick, G. B., 1997). The seven steps that this model suggests when a product innovation takes place are as follows:

- Disclosing technology
- Linking technology with needs
- Assessing technology
- Matching technology with functional need
- Refining technology for specific needs
- Preparing to launch into the user's world
- Managing a technology over its life cycle, especially at introduction.

The unique feature about this model is that it is technology driven but is still taking the user needs into consideration during the earlier phases of the innovation. Spivey also mentions that

“this model of technology movement is parsimonious and helps ensure that those involved with innovative technology keep their focused on the “bigger picture””.

Market Driven or Market Pull Model

A different approach that many companies employed towards product development was Market Driven or Market Pull based. This section discusses various literary works on market driven product innovation.

Rothwell along with the technology push model discussed in previous section, also talks about the market pull model and an integrated model. He implies that market pull model (Figure 4) was the result of the competition that companies started facing in 60s. He suggests that an increased focus on marketing was the main reason for the companies to use this model. This market model can be considered as the most basic market pull model where the market need identified by market research leads to development, manufacturing and sale of the product.

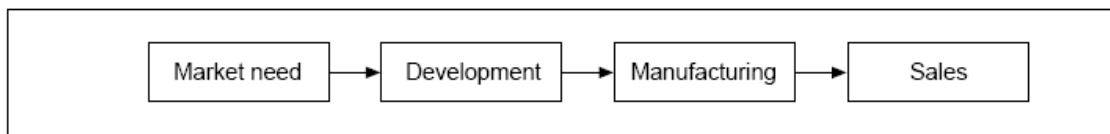


Figure 4

Rothwell has proposed an integrated model (Figure 5) that he suggests was a result of the resource constraint that companies faced during the financial crisis of 70s. This constraint led company to decrease the wastage of resources and therefore take a dual approach by focusing both on technology and marketing research to innovate.

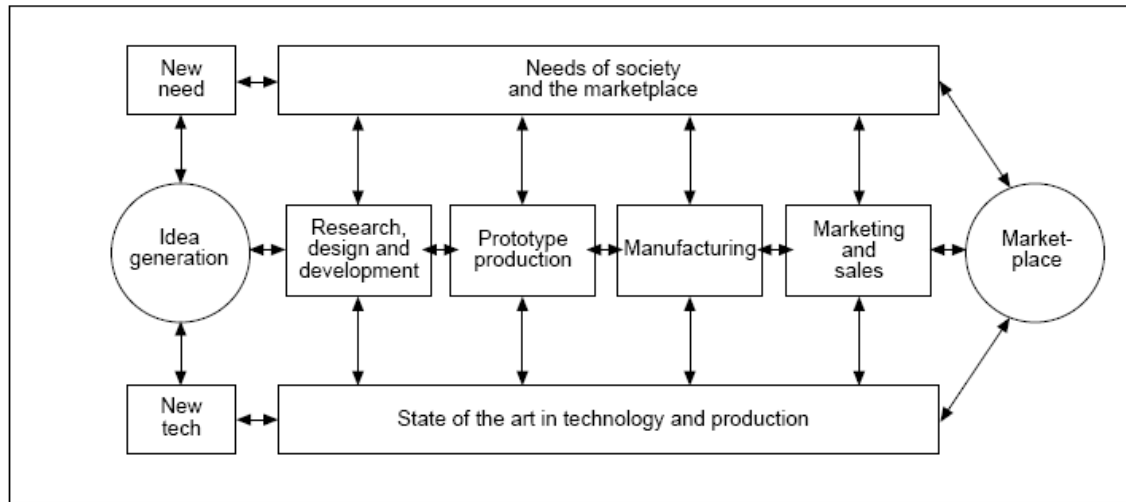


Figure 5

As can be seen from the above model that it is sequential but it still encompasses the newly developed technology and identified market need in the model. Another unique feature of the model is the feedback from the marketplace that was missing in the earlier model. This model gave more flexibility to organizations to fine tune their product before and after launch.

A model in accordance with the Rothwell's model was presented by Twiss (Twiss, B. C. 1974). Twiss's Model (Figure 6) has a similar sequential approach but the uniqueness comes from the emphasis on the collaborative work between the scientific knowledge of research group and customer research from marketing department.

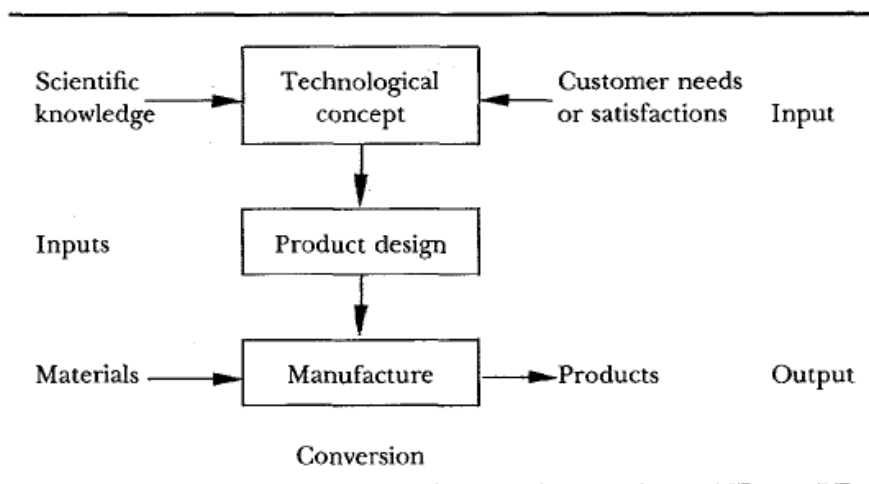


Figure 6

Walker (1979) also described the market pull model in his model (Figure 7). He has explicitly mentioned the outside knowledge and the market stimulus to emphasize on the market pull aspect. This knowledge along with the advice combines with the organization's internal forces in the innovation process.

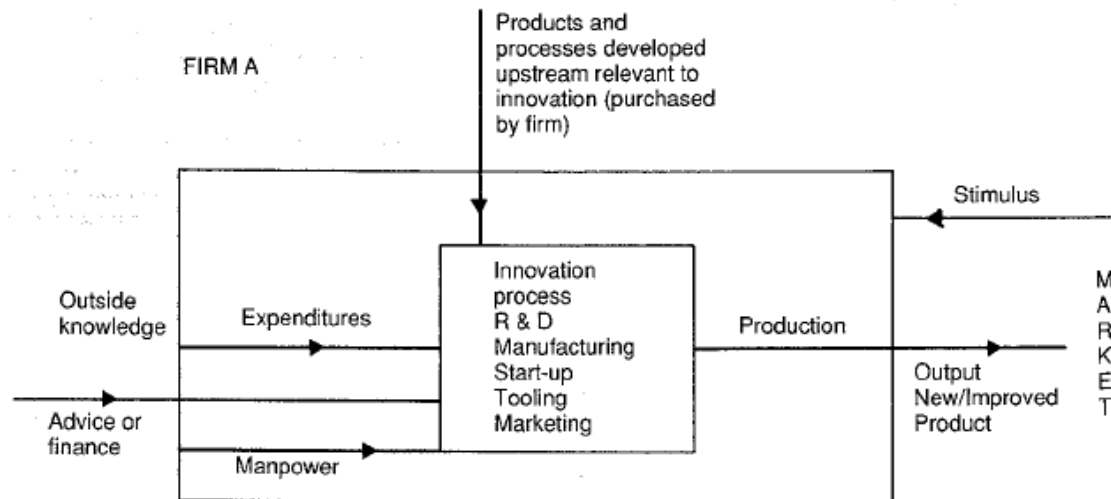


Figure 7

A widely cited research by Cooper & Kleinschmidt (Cooper, R. G., & Kleinschmidt, E. J., 1986) also provides an insight into the market pull innovation process. They came up with a set of steps for innovation in companies. As we can see from the following steps, it also consists of preliminary market and technical assessment but still has more focus on market studies as compared to technology.

- | | |
|---|---|
| ▪ Initial screening | ▪ In-house product testing |
| ▪ Preliminary market assessment | ▪ Customer tests of product |
| ▪ Preliminary technical assessment | ▪ Test market/trial sell |
| ▪ Detailed market study/market research | ▪ Trial production |
| ▪ Business/financial analysis | ▪ Pre commercialization business analysis |
| ▪ Product development | ▪ Production start-up |

- **Market launch**

Cooper used these steps to investigate the new product development process (NPDP) in organizations across various domains. The investigation resulted in identification of the fact that companies “omit the critical activities from NPDP and other key activities are weakly undertaken”. They conclude that this omission results in the failure of products.

Customer involvement and push/pull models

After the analysis of the above models, it seems appropriate to assume that the product end users have a different role in the two models. Technology push based model works on the fact that the costumers are unaware of the uses of the products that are developed using new technology. This unawareness makes the technology push focused companies to work on developing the whole new market segment. In other words, there is no target market segment for these products as generally; customer cannot have the “out of the box” understanding of the solutions to their daily problems.

On the other hand, the market pull based models work closely with the marketing departments where the customer needs are identified by doing focus groups, administrating survey, user studies etc. User in this case acts as an agent for the incremental innovation. There appears to be a fundamental similarity between the customers’ role in the push/pull models. They are basically the change agents. Customer becomes the agent of change for radical innovation in the technology push models while the same customers becomes an incremental change agent for the already available products in the market push base models.

Success factors for product development

Cooper discusses eight critical success factors for the product development (Cooper, R. G., 1999). They are as follows:

- Solid up front homework
- Voice of Customer
- Product advantage
- Sharp, Stable and early product definition
- Well planned launch

- Proper decision points
- Top executive support
- International Focus

For products to succeed, they have to be true to the above mentioned points. However, their implementation varies on the basis of the product development methodology.

An example of a successful product innovation is the USB flash drive. Before arrival of flash drives, the most widely used way of transferring data between computers was using a floppy disk. However, the reliability of the floppy disk dependent on proper handling and climatic conditions. Furthermore, the size of the data that could be transferred was also less and the files were required to be partitioned before transferring. This led to the invention of new flash based technology for storing data was led to development of USB drives. This example gives an insight of the market pull based model, as there was a well known need for a device which can store the massive chunks of data reliably. It can be said that market pull model will be successful over technology push whenever a customer need is known and the already evolved technology can be used as an answer to this need.

The invention of first personal stereo can be considered as an example of technology push model. Before, its arrival there was no market where it was possible to identify the customer need. The development of a small stereo which was light that did not affect the privacy of others while providing the great music experience at the same time can be considered as a radical innovation. This example suggests that a technology push model is successful whenever the technology invented is capable enough to develop products that were not demanded explicitly by the customers.

Management implications of the push/pull model

To succeed in any product development process, the managers have to employ a strategy which involves user through out the development process. The user involvement is important regardless of the pull or push model involved. In case of the push based model, once the application area of the technology has been identified, the product information should be shared to different departments. This sharing of information will help in identifying new market segments and new features. In case of the pull based model, the users who will be on the receiving end of the

development cycle should be given opportunity to see the product upfront. The suggestions by the users will help in identifying the product shortcomings which in turn will help in correcting them. The managers should encourage the use of cross functional teams that will help in understanding the consumers and their needs from different perspectives. An organization wide vision about the product development process that is consistent with the business goals and with the environment in which the organization works (this involves industry verticals and cultural aspects) should be communicated deep and wide. This will help in getting the support from various stakeholders within the organization.

User centered innovation

This paper has discussed a manufacturer centered innovation process which includes the technology pushed or market pulled methods. However, there is an innovation process that has evolved in recent years which has given an ability to users to create products on the basis of how they like it. Hippel (2005) has coined a term “Democratizing Innovation”. He states that in the manufacturer centered process “a user’s only role is to have needs, which manufacturers then identify and fill by designing and producing new products”. He implies through out the literature by giving examples that providing the end user a capability to create product of how s/he wants is the current trend. The current innovation process employed by the technology companies like Google and Apple in the phone development can be taken as a great example of the user generated products. Both of these companies have given the development Tool kit to the users to develop the applications for their respective phones Android G1 and iPhone. This has given users an ability to fulfill the needs that they and not company think are important. These companies have identified that the fulfilling the user needs by providing a platform and tools that are easy to use to create applications will not only give users an ability to get what they want but will attach themselves with the product. This emotional attachment with the product provides a feeling of delight that might not be achieved by the manufacturer based innovation.

Summary

This paper can be considered as a literature review of the available research in the area of product development or innovation. Though not comprehensive, this review gives an insight of the evolution of product innovation process. Further research should focus on the analysis of the

applications and case studies of the various frameworks that have been discussed through out the paper. It can be summarized from the review that the process of innovation is highly complex and there are no single variable i.e. user, technology or market are responsible for the success of a product (Hippel, 2005). An organization has to take into account all the above mentioned variables along with the internal environment before embarking on the product development process.

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