DECISION SCIENCES INSTITUTE
Operations Management View of Technology Innovation

ABSTRACT

This ongoing study focuses on analyzing the relevance of various operations management aspects in technology innovation environments, with a specific objective to assess extent of use and importance of operations management decisions and activities to the process of technology innovation. The relationships are investigated for three stages in the process of technology innovation: ideation, development, and commercialization. The study is aimed at addressing the question whether the teams involved in the technology innovation process need and/or actually follow strategic operations management decisions or carry out operations management activities, and if yes, then specifically which ones at which stage.

KEYWORDS: technology innovation, operations strategy, operations management, innovation process

INTRODUCTION

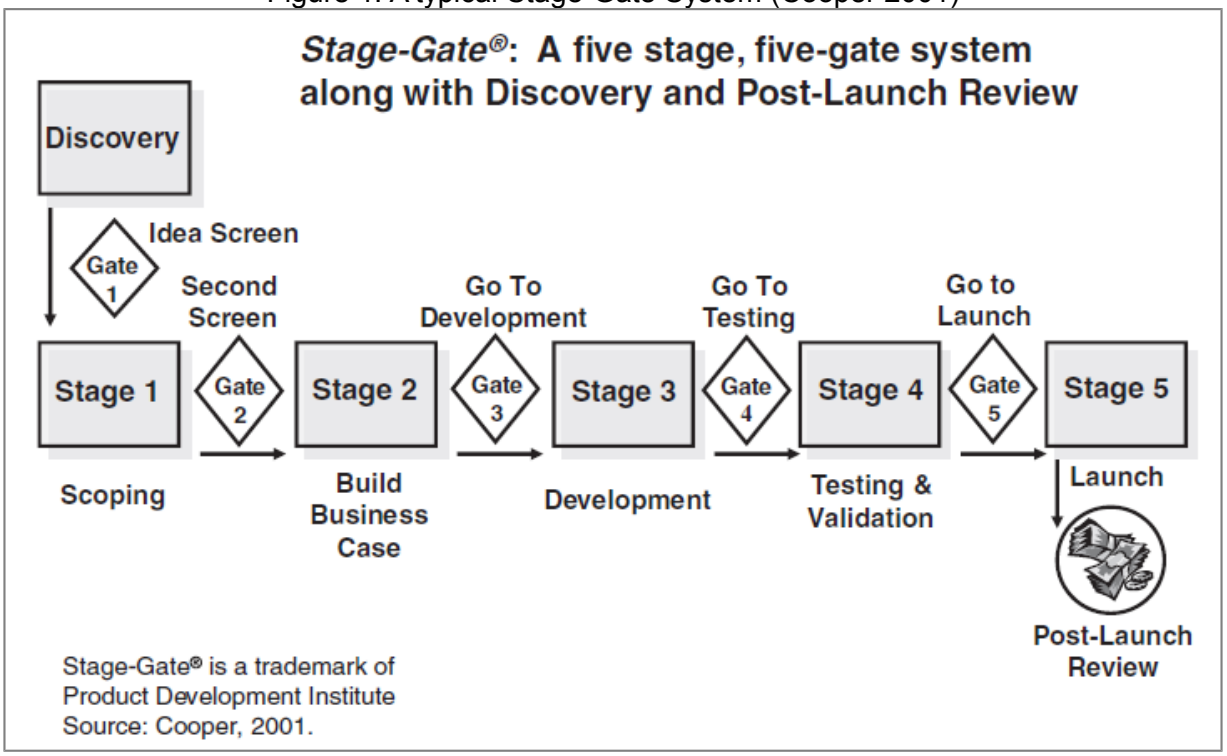
Technology innovators face multiple challenges and tasks to tackle, decisions to make. They operate in conditions of high uncertainty and have to quickly adapt to the constantly changing environment. The very notion of innovation, especially in technology, inherently implies creative and non-standard approaches, breaking stereotypes and rigid rules, acting boldly under uncertain and challenging conditions. Without these attributes it would be innovation no more, whereas the recent immense growth of technologies and associated creation of new knowledge, value and wealth would have been hardly conceivable.

Conversely, operations management is a rigorous, focused and relatively well-delineated discipline, in which creation and delivery of goods/services to customers is viewed as a total system, with all its activities meticulously planned and coordinated vertically and horizontally throughout an enterprise. This includes strategic operations management decisions on such things as supply and value chains, inventory management, scheduling, process and capacity design and management, quality control, etc. Some may argue that most of these efforts are mundane, require predefined and standard approaches likely more applicable in large, well-established operations, rather than flexible technology development teams. For many entrepreneurs and intrapreneurs it might be tempting to disregard or even discard many operations management activities as too soon and/or too costly for technology innovation process, whereas some others might consider those as necessary prerequisites for their success. Perhaps, this is an individual choice based on the personality of the entrepreneur and whatever real-business circumstances, but what strikes as a surprising gap from an academic viewpoint is that this issue appears to have not been studied well.

LITERATURE REVIEW

Literature on innovation and particularly, technology innovation is vast. Intertwined with new product development, the process of innovative technology creation in its management perspective is viewed as a multistage process in most theories, culminating in various versions of the Stage-Gate system first developed by Robert Cooper [see, for example, Cooper, 2001; Cooper 2008; etc.], as illustrated in Figure 1 below.

Figure 1. A typical Stage-Gate System (Cooper 2001)



On the other hand, in modern theory and practice most scholars accept Chesbrough's concept of open innovation, as opposed to closed innovation model dominant in the past [see the comparison of these models two models shown in Figure 2].

Subsequently, Cooper customized Stage-Gate to incorporate open innovation (see Figure 3), showing that companies look inside-out and outside-in, across all three aspects of the innovation process, including ideation, development, and commercialization (Cooper, 2011), and in doing so, much more value is created and realized throughout the process.

Figure 2. Open versus closed innovation (Chesbrough, 2003)

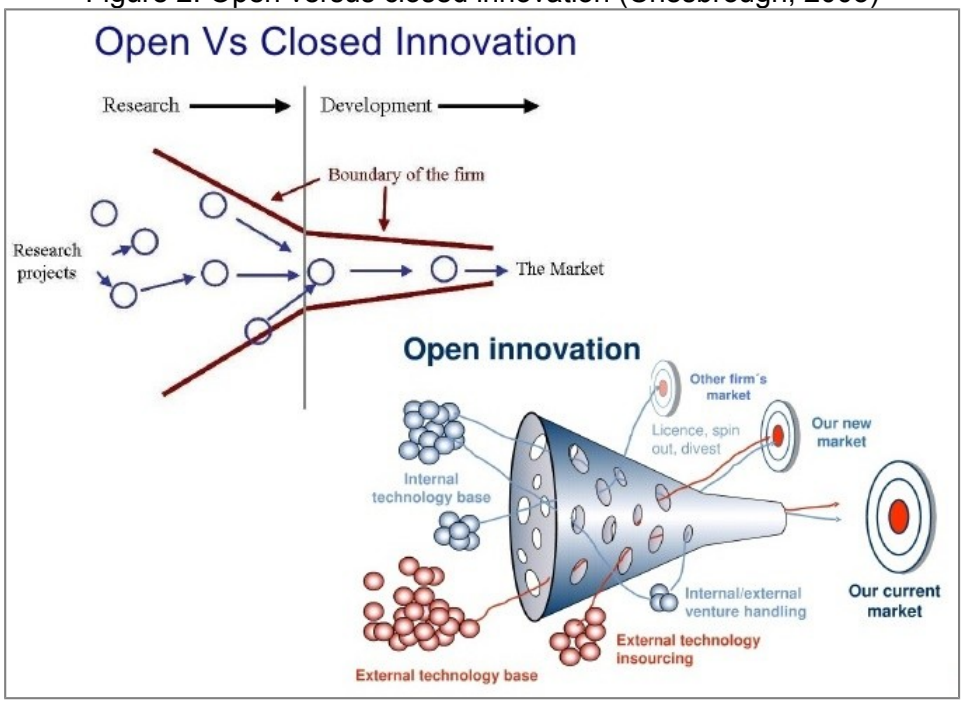
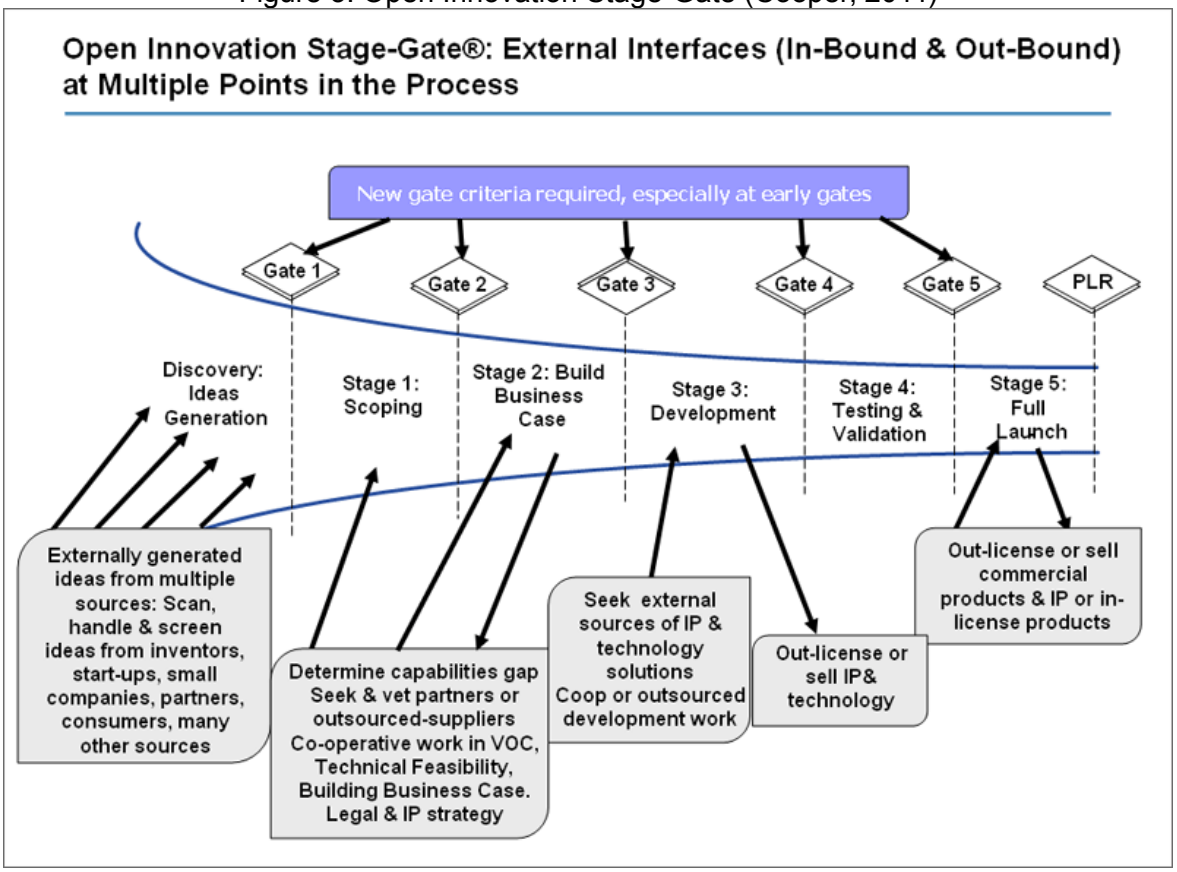


Figure 3. Open Innovation Stage-Gate (Cooper, 2011)



As for operations management, literature indicates ten main decisions/aspects that need to be addressed strategically (Heizer et al., 2016), which include:

1. Design of goods and services: Defines what is required of operations in each of the other operations management areas
2. Managing quality: Determines the customer's quality expectations and establishes policies and procedures to identify and achieve that quality
3. Process and capacity design: Determines how a good or service produced is and commits management to specific technology, quality, resources, and investment
4. Location strategy: Requires judgements nearness to customers, suppliers, and talent, while considering costs, infrastructure, logistics, and government.
5. Layout strategy: Requires integrating capacity needs, personnel levels, technology, and inventory, and inventory requirements to determine the efficient flow of materials, people, and information.
6. Human resources and job design: Determines how to recruit, motivate, and retain personnel with the required talent and skills. People are integral and expensive part of the total system design.
7. Supply chain management: Decides how to integrate supply chain into the firm's strategy, including what is to be purchased, from whom, and under what conditions.
8. Inventory management: Considers inventory ordering and holding decisions and how to optimize considering customer satisfaction, supplier capability, and production schedules.
9. Scheduling: Determines and implements intermediate- and short-term schedules that effectively and efficiently utilize personnel and facilities while meeting customer demands
10. Maintenance: Requires decisions that consider facility capacity, production demands, and personnel, necessary to maintain a reliable and stable process.

With consideration of the above mentioned, a question arises whether the teams involved in the technology innovation process need and actually follow strategic operations management decisions or carry out operations management activities, and if yes, then specifically which ones at which stage. This issue appears to have not been adequately addressed in research literature. Most of the works at the intersection of operations management and innovation are dedicated to innovations in operations management (e.g. Hammer, 2005). However, it appears there are no empirical studies on this intersection or in terms of assessing the applicability and impact of operations management on innovation in general, and in technology innovation in particular.

THEORETICAL DEVELOPMENT AND METHODOLOGY OPTIONS

In this ongoing research we implement a cross-disciplinary work that combines the areas of operations management and technology innovation. The research efforts focus on analyzing the relevance of various operations management aspects in technology innovation environments both in startups and teams in well-established corporations, with a specific objective to distinguish the operations management decisions and activities in such enterprises, assess their extent of use and importance to the process of technology innovation. These relationships are investigated separately for three stages in the process of technology innovation: ideation, development, and commercialization (which roughly correspond to Koen's three parts of innovation process Fuzzy Front End (FFE), new product development (NPD) and commercialization (Koen, 2007)).

To test the links of the operations management strategic areas to the mentioned three stages of innovation, hypothesis or propositions are developed depending on whether survey and case study will be used for in this study, which is yet to be decided.

Obviously, survey provides more rigorous approach, statistically significant results of which are considered objective and reliable. However, surveys are inflexible in that they require the initial study design to remain unchanged throughout the data collection, which is a shortcoming in researching new topics, such as the proposed one. Also, in survey methodology the questions developed should be general to minimally fit respondents, thus missing what is relevant to many respondents with different backgrounds. Case studies, on the other hand, offer the most appropriate way for understanding the how and why of phenomena in their natural setting (Yin, 2013). If decided to proceed with case studies, a strong endeavor will be made to report all case evidence fairly, try to find the general patterns and avoid collecting anecdotes. It will be clarified beforehand who should be interviewed and what type of information would be required, so that replication, contrary replication, “polar types” and other attributes of good sampling for case studies are ensured (Eisenhardt & Graebner, 2007). It is possible that some scientific rigor will be lost, but the richness in identification of relevant details will be gained. In turn, these gained insights into the operation environment of technology startups may prove invaluable for creating a solid opportunity to extend the research globally and develop a universal theoretical framework. Considering the above mentioned circumstances, the final decision regarding the research methodology will be made after extensive consultations and possible “dry-run” of both suggested methods with representatives of several companies, with subsequent review and analysis of results.

It is planned to use US technological enterprises as data collection sources, while trying to make the research extendible in an international scale. For any of the two said research methodologies appropriate questionnaire and research protocol will be developed, and interviews will be conducted among the management of technology innovation teams, including both startups and established companies.

Total 30 hypotheses/propositions were developed for this study divided into 10 most critical areas of strategic operation management decisions, specifically applied to the context of three main stages of technology innovation process. These areas and their respective hypotheses/propositions are as follows:

Area 1. Design of Goods and Services and Technology Innovation

1.1. Decisions on design of goods and services in operations management have major influence on technology innovation process in the stage of ideation.

1.2. Decisions on design of goods and services in operations management have major influence on technology innovation process in the stage of development.

1.3. Decisions on design of goods and services in operations management have major influence on technology innovation process in the stage of commercialization.

Area 2. Managing Quality and Technology Innovation

2.1. Quality management has major influence on technology innovation process in the stage of ideation.

2.2. Quality management has major influence on technology innovation process in the stage of development.

2.3. Quality management has major influence on technology innovation process in the stage of commercialization

Area 3. Process/Capacity Design and Technology Innovation

3.1. Process and capacity design decisions of operation management have major influence on technology innovation process in the stage of ideation.

3.2. Process and capacity design decisions of operation management have major influence on technology innovation process in the stage of development.

3.3. Process and capacity design decisions of operation management have major influence on technology innovation process in the stage of commercialization.

Area 4: Location Strategy and Technology Innovation

4.1. Operations management decisions on location strategy impact significantly the technology innovation process in the stage of ideation.

4.2. Operations management decisions on location strategy impact significantly the technology innovation process in the stage of development.

4.3. Operations management decisions on location strategy impact significantly the technology innovation process in the stage of commercialization.

Area 5: Layout Strategy and Technology Innovation

5.1. Facility layout strategy has major influence on technology innovation process in the stage of ideation.

5.2. Facility layout strategy has major influence on technology innovation process in the stage of development.

5.3. Facility layout strategy has major influence on technology innovation process in the stage of commercialization.

Area 6: Human Resources, Job Design and Technology Innovation

6.1. Operations management decisions on human resources and job design impact significantly the technology innovation process in the stage of ideation.

6.2. Operations management decisions on human resources and job design impact significantly the technology innovation process in the stage of development.

6.3. Operations management decisions on human resources and job design impact significantly the technology innovation process in the stage of commercialization.

Area 7: Supply Chain Management and Technology Innovation

7.1. Supply chain management is a major factor in technology innovation process in the stage of ideation.

7.2. Supply chain management is a major factor in technology innovation process in the stage of development.

7.3. Supply chain management is a major factor in technology innovation process in the stage of commercialization.

Area 8. Inventory Management and Technology Innovation

8.1. Inventory management is a major factor in technology innovation process in the stage of ideation.

8.2. Inventory management is a major factor in technology innovation process in the stage of development.

8.3. Inventory management is a major factor in technology innovation process in the stage of commercialization.

Area 9: Scheduling/Sequencing and Technology Innovation

9.1. Operations management decisions on scheduling and sequencing have major influence on technology innovation process in the stage of ideation.

9.2. Operations management decisions on scheduling and sequencing have major influence on technology innovation process in the stage of development.

9.3. Operations management decisions on scheduling and sequencing have major influence on technology innovation process in the stage of commercialization.

Area 10: Operations Maintenance and Technology Innovation

10.1. Operations management decisions on maintenance significantly impact technology innovation process in the stage of ideation.

10.2. Operations management decisions on maintenance significantly impact technology innovation process in the stage of development.

10.3. Operations management decisions on maintenance significantly impact technology innovation process in the stage of commercialization.

CONCLUSIONS

The study is not completed yet, although a plan of future actions is well defined. We believe this study will provide a better understanding of operations management decisions on technology innovation process. It is expected that at least some of the hypotheses/propositions will be confirmed, while others rejected, thus helping determine the importance of various operations management aspects in innovative technology development settings, which clearly are very different from those in companies or business units that are involved in more conventional types of business activities.

The theoretical framework and/or model produced in this study could be useful for a broad array of individuals and organizations that fund, manage or otherwise participate in technology innovation projects and activities. These will direct them to focus on operations management areas where they turn out critical, thus helping realize advantages of effective management of operations, and avoid certain costs, efforts, time and operational arrangements, where those are unnecessary or even hindering.

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