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INNOVATION NETWORK MANAGEMENT: TOWARDS A VALUE BASED FRAMEWORK

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Innovation Network Management: Towards a Value Based Framework

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ABSTRACT

This paper presents the concept of innovation network management through the use of a matrix that illustrates the processes, steps and required passages and implicated actors. Moreover, the paper uses the concept of value to demonstrate the motivations and advantages of each of the actors throughout the innovation process. It is hoped that this reflection on value as it is perceived by other actors will lead to new insight for all actors to better mange their innovation network by facilitating the development, transfer and implementation of knowledge and technologies created by academic centres of expertise in industry.

INTRODUCTION

The new global economy poses numerous and seemingly unending challenges for many industries. In particular, primary sector firms find themselves playing catch-up to new environmental regulations, new technologies, changing customer expectations and increased competition. Additional hurdles exist for traditional, commodity based industries such as forestry, where change is often seen as a negative, no matter what the context. However, change is required to ensure the sustainability and even "survivability" of many firms. The radical nature of some of these changes often forces companies to look to outside agencies such as universities or centers of expertise to find solutions to these new challenges with innovative products, processes and business systems.

In this context, developing and transferring all forms of knowledge and eventual innovation is done in a network setting involving actors from diverse communities. Actors can be researchers, graduate students, people working in development centres, practitioners from the industry or even policy makers. The authors believe that the different perceptions of value, on the part of all actors in the process and at all stages, are important to the successful development of the knowledge into implanted innovations. In fact, the perception of value acts as a trigger or source of "energy" for the continued progress of the innovation network. Furthermore, value perception can be seen as a determining factor behind the motivation of actors to work towards the success of the innovation network.

The purpose of this paper is to develop a framework of the innovation process from academic centre of expertise to industry that is based on the tangible and intangible values perceived by each actor of the network in each stage of the process. This framework has been developed building on previous work by Van Horne *et al*. (2005b). It is hoped that this framework will assist researchers and firms reflect on the management of their innovation network. In turn, this reflection on value as it is perceived by other actors will lead to new insight for all actors to better manage their innovation network by facilitating the development, transfer and implementation of knowledge and technologies created by academic centres of expertise in industry.

The forest products industry

The global forest products industry is undergoing enormous changes and challenges. Juslin and Hansen (2002) have identified four major trends facing the industry. First is a restructuring of the industry, consolidation and search for profitability. Second is an emphasis on technological innovation and reducing costs through production optimization. Third is a shift towards a customer orientated business model, centered on differentiation and adding value. Finally, the fourth trend is confronting new environmental regulations and increasing consumer sensitivity to these issues. In parallel to these trends, the industry has adopted a triple bottom line that includes economic, environmental and social considerations (De la Roche and Dangerfield, 2002) in a search for sustainability of the environment and "survivability" of firms.

In a knowledge and innovation based global economy forest products industry firms have been forced to look outside the boundaries of their firms for innovative knowledge and ideas, perhaps due to the extremely low rates of spending on R&D in the industry, where even the largest global firms spend less than 1% of their revenue (Hansen, 2006). Universities and academic centres of expertise are an important source for this outside knowledge, especially in Canada (Nakamura *et al.*, 2003).

Academic centre of expertise

A centre of expertise has been defined by Van Horne *et al*. (2005a) as a center, whether virtual or physical, that gathers experts from multiple disciplines to study complex and multidimensional contextual problems in a team environment, in order to create and transfer new knowledge and insights to concerned stakeholders. The mission of a centre of expertise may serve various purposes and "customers/audiences" according to the sources of its funding, but a common goal can be extrapolated: that is to create value using research and innovation. A centre works in collaborative networks with researchers from other centres and universities, government agencies and practitioners from the industry to advance science and stimulate continuous knowledge development and innovation in the industry. However, the tools and methods used to develop and implement this new knowledge and innovation have changed over the years as companies have changed their focus from innovations in products (i.e. plywood, I-joists), to processes (Just in Time, Total Quality Management) and most recently to innovations in business systems (enterprise resource planning, advanced planning and scheduling).

There is much debate and questioning by researchers and transfer professionals as to what are the best tools and methods to use to transfer abstract concepts such as supply chain management from centre of expertise to industry practitioners. Van Horne *et al*. (2005a) describe the Quebec Wood Supply Game that was developed by the FOR@C Research Consortium based at the Université Laval in Canada as a technology transfer tool built on previous work (Fjeld, 2001; Goodwin and Franklin, 1994). This tool has been used in online and workshop settings to teach the importance of communication and collaboration in supply chains to reduce inventories and costs. However, even if these kinds of tools do succeed in transferring complex concepts, their "value" for the industry is rather difficult to demonstrate to practitioners and researchers. Moreover, the potential and even final values are often intangible and not easily quantifiable making it difficult for all actors to choose which research projects to embark on.

The first section of this paper will present a literature review of knowledge and decision support systems for R&D, as well as a look into the concept of value. Then, the framework of the innovation value network will be presented and discussed. Lastly, the conclusion will include future research directions.

LITERATURE REVIEW

Knowledge and decision support systems for R&D

An excellent review of the many well-established decision support systems for R&D projects involving products is outlined in Maine *et al*. (2005). However, as the author mentioned these systems are often complex in nature and require many financial, human and software resources that are not available in all firms. Some examples such as, project selection techniques, new product development processes, and in particular stage gate systems (Cooper, 1999), have given structure for companies dealing with complex systems. However, these structured processes do not always "fit" in all contexts, such as in small and medium sized enterprises (Maine *et al*. 2005) and in the forest products industry (Hansen, 2006). Furthermore, the values used in these systems are often economic in nature, which does not apply to projects based on improved processes and business systems that affect the triple bottom lines of firms mentioned earlier.

As companies can innovate in three main categories, products, processes and business systems (Boer and During, 2001) other frameworks need to be developed to assess the intangible value of new projects.

Value

Contingent valuation has been used to given an economic value to intangible value by several economists since it was developed by Ciriacy-Wantrup in 1947 (Hanemann, 1994). This system uses questionnaires and surveys to ask consumers the dollar value that they place on abstract concepts such as the environment. However, this concept has come under much criticism from within the economic community (Diamond and Hausman, 1994) for creating rather than measuring value. In addition, empirical studies on consumers "willingness to pay" for certified wood products (Anderson and Hansen, 2004) seem to discredit the good intentions of consumers to pay more for an intangible added-value.

As the knowledge economy makes its impact on all (and not just high-tech) industries, attention has increasingly turned to the valuation of intangible assets such as R&D and knowledge. Tipping *et al*. (1995) list ten metrics used by high-tech companies to determine the value of their R&D projects: financial return, strategic alignment, projected value of R&D pipeline, sales or gross profits from new projects, accomplishment of project milestones, portfolio distribution of R&D projects, customer satisfaction surveys, market share, development cycle time, product quality and reliability and gross profit margin. Many of these measure the effective value of an implemented innovation rather than the intangible value of knowledge of the inventions.

Using a much studied firm in the innovation literature, Krogh *et al*. (1988) describes how 3M predicts the probability of success for new R&D projects, and therefore chooses the projects in which to invest. An outside team evaluates projects based on several factors. The predicting items are: the competitive position of the business unit spearheading the project, 3M's performance compared to competing firms, the degree to which the technology relates to existing technical base and the degree to which the new (or proposed) market relates to their existing customer base. More recent work by Dillon *et al*. (2005) indicates that the most successful companies search for "key value commodities" to create products that meet "unspoken need." A value commodity could be "coolness", a commodity that Steve Jobs and Apple have been able to mass market (i.e. iPod) to great success.

In the academic world the classic work by Stahl and Steger (1977) used scales of innovation and productivity to rate researchers, and then, had scientists rate their peers; in fact, they found a great degree of correlation between the two results.

Valuing knowledge and inventions is still not a fixed science. In comparison, valuing commercialised or implemented innovations using financial analysis is a less frustrating pursuit. A recent study by Greenhalgh and Rogers (2006) of market valuations of British firms indicates that although innovation is rewarded through share price, there are higher returns in less competitive markets. However, not all benefits or value is derived from increased profits or decreased costs. In knowledge-based companies Sveiby (1997) has developed several valuation metrics based on "intangible" knowledge and human assets, although they do not seem to have been adopted by many North American companies. Moreover, the triple bottom line important in so many natural resource industries, where environmental concerns are paramount, are often considered more "valuable" than a higher Return on Capital Employed. Intangible values thus need to be taken into account in any decision to innovate.

Finally, Thomke (2006) writes that many of the procedures and tools used for innovation are often mistaken for innovation in itself. The author explains that new business systems, in particular, often have new "values" created which can not be measured with existing systems. He also writes that the intangible values so prevalent in the knowledge economy are difficult to capture and measure. Researchers and firms are told to go innovate… however the tools and methods to get from the idea to the implanted innovation are often not available and researchers are left to their own experience, creativity and intuition to bring innovation to life. The innovation value matrix was developed in the hopes that researchers and practitioners will gain insight into the concept of value in the innovation process and thereafter develop more appropriate means to ensure success in the quest for "value" from innovation.

INNOVATION VALUE MATRIX

The innovation value matrix (Figure 1), introduced in Van Horne *et al.* (2005b), analyses how value is perceived by the various actors of the innovation process and the aim of this matrix is to aid researchers and firms to develop formal means to evaluate the tangible and intangible value of innovative knowledge, invention and innovation as it is perceived by the diverse actors of the innovation network. The forest products industry provided the setting for the development of the framework, as the great majority of R&D work and innovations are transferred from external sources. The authors believe this framework can be generalized to all industries and firms where R&D is "outsourced" or done in a network setting.

	Centre of expertise	**Development centre**	**Private firm**
Innovative knowledge (new knowledge)	**Scientific value** - peer recognition - number of references	**Opportunity value** - relevance to real world problems - possible solution to a client's problem	**Potential development value** - relevance to actual problems - potential contribution to strategic goals
New-use of knowledge and invention (embodiment into an invention)	**Implementation value** - patents - credibility/good will	**Potential business value** - in-depth market analysis - customers prospects	**Potential service value** - potential to improve competitive advantage or fulfill environmental regulations
Innovation (exploitation of the new-use and invention)	**Application value** - licensing agreements - licensed patents	**Effective business value** - number of users - sales	**Effective service value** - improved market position - increased sales - increased efficiency

Figure 1: The innovation value matrix

Phases of the innovation process

Innovative knowledge is built from an initial idea or problem and for the most part is based in existing base of knowledge. The four phases of knowledge transformation, socialization, externalization, internalization and combination, as outlined by Nonaka (1991), are all used to create new explicit knowledge that is written and easily transformed and new tacit knowledge of the researchers. Actors in the network must combine practical (tacit) knowledge with scientific knowledge (explicit) to create the new knowledge necessary to find solutions. This knowledge is created both in explicit ways, through reports and papers and tacitly, as the individuals in the process learns from one another. New-use of knowledge and invention represents applied research and application of the knowledge created in the first phase of the process. Once research is applied, or existing knowledge has been used in a new way, there is invention. This invention often takes the form of beta-systems, prototypes or trial projects, for example implementing a new form of customer relationship management in one sawmill, before making wide-spread changes.

Innovation occurs when the invention is implemented or commercialized by the consumer of the innovation. The Organization for Economic Co-operation and Development (OECD, 1997) defines a technical product or process innovation as the implementation/commercialization of a product or process with improved performance, production or delivery methods that deliver marked new or improved services to the consumer. To this we must add new business-systems and business models, as these are a growing source of innovation in many industries. If the invention is never exploited there is no innovation. Therefore, the authors do not consider a patent an innovation, unless that patent has been made operational or produced by a company.

Roles and values

There are three main roles identified by the model: the centre of expertise, the development centre and the private firm. Intuitively we understand that each actor views the value of each stage of the process in a unique and particular manner and in this way each stage of the process is valued in many different ways at the same time. The authors believe that by understanding the value attributed by each role, the other actors in the network will be able to better "sell" their knowledge, invention or innovation to the respective decision makers in each organization. However, the literature and experience of the authors demonstrates there need to be at least one individual in an organization that has the ability to recognize and "translate" value that is perceived by all actors in the chain. He or she acts as the "spokesperson" for the innovation and her ability to translate value into the terms of other actors plays a vital role in the innovation process.

The producer of the innovative knowledge in this study is a centre of expertise. However, innovative knowledge can be developed by an internal research department or any other group that specializes in the creation of new knowledge. From the point-of-view of the innovative knowledge producer, innovative knowledge has scientific value that can be evaluated in terms of peer recognition. This translates into the number of published papers and the number of times these papers are actually cited. Implementation value can be judged by the number of patents issued and the credibility or goodwill that the scientist or centre of expertise has accrued. Finally, application value can be assessed in terms of the number of licensing agreements reached and the development of collaborative relationships with the consumer of the innovation. In addition, applying "science" to real-world problems is also a valuable intangible benefit for many researchers working with industry. In fact, real-world application can help advance science as theories can be tested and rejected or even validated.

The consumer of the innovative knowledge in this study is a development centre, however it can be an internal unit of an organization that takes the innovative knowledge and uses the new knowledge to develop a new product or a new use of that knowledge. From the point-of-view of the consumer of innovative knowledge, innovative knowledge has an opportunity value which means that the innovative knowledge is relevant to real world problems. In other words, developing the innovative knowledge could lead to a solutions (or be a part of one) to a problem of one of their clients. Preliminary market studies and the number of potential users are also evaluated. The potential business value of an invention is judged through customer prospects and an in-depth market analysis. Effective business value would be calculated by the number of users, sales and the number of commercialization agreements reached.

The consumer of the innovation is the organization or individual who purchases, uses or directly benefits from a new product or service, and in our study it is a private firm. From the point-of-view of the consumer of the innovation, innovative knowledge has potential development value which again refers to the relevance of the innovative knowledge to actual problems. Developing this knowledge must also contribute to, or be in line with, the strategic goals of the corporation. Potential service value is evaluated by an invention's potential to improve the competitive advantage of a company and its usefulness and ease of use. Furthermore, it can be judged by its contribution to the fulfillment of environmental or certification regulations. Effective service value can be assessed with several variables: increased sales and efficiency, improved market position, decreased costs, etc. Overall an innovation will be judged by its contribution to the sustainable growth and development of a corporation. Of course these intangible values are used in conjunction with the tangible measures mentioned earlier.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This paper presents the concept of innovation network management through the use of a matrix that illustrates the processes, steps and required passages and implicated actors. The paper uses the concept of perceived value to demonstrate the motivations and advantages of each of the actors throughout the innovation process. The purpose of this paper was to develop a framework of the innovation process from academic centre of expertise to industry that is based on the tangible and intangible values perceived by each actor of the network in each stage of the process.

Further research will be required to further investigate the nature of the perceived values that are drivers of the innovation network process. As firms increasingly turn to outside academic centres of expertise for new knowledge this is an important avenue of future research. This research will lead to the creation of tools and methods to manage the network and facilitate the development of transfer activities between actors and means of measuring the intangible values of the innovation process.

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PRESENTER

Constance Van Horne will present the paper at the conference.

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