Transitioning Ideation to Commercialization: A Comprehensive Product Development Strategy with an Application in the Wood Products Industry

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Abstract

This article introduces a comprehensive product development strategy to transform ideas into commercial products. Although there is abundant literature on product development tools and innovation theory, the inconsistency of results in previous studies in innovation theory has not produced compatible theories that can be put into practice. To help overcome this problem, grounded theory was used to build a novel and holistic strategy that connects and relates current product development tools with marketing research, value chain, business process management, and innovation theory. The resulting strategy combines a series of product development tools that can help practitioners to easily identify customer requirements, to develop ideal solutions, and to deploy solutions. The proposed strategy was applied in the wood products industry with successful results. It is expected that this product development strategy will help researchers and practitioners better integrate theory and practice in innovation research.

According to the US Census Bureau (USCB 2009), the value of the total 2006 wood product manufacturing shipments under North American Industry Classification System codes 31 to 33 was $5.0 trillion, employing over 13 million people. Although this represents a significant national economic impact, the sector has been in decline over the past decade; thousands of US manufacturing sites have ceased operations, causing millions of people to lose their jobs (US Bureau of Labor Statistics 2009). Primary reasons for these closures and loss of employment are the economic downturn in the United States and an overall inability to compete against lower foreign wages. The effects on the US wood products industry have been exacerbated by a significant and sustained downturn in housing starts, the primary market for wood products (Quesada and Gazo 2006, Zi and Bullard 2008). Hovgaard and Hansen (2004) and Bullard (2002) suggest that only those firms in this sector that have learned to innovate by means of introducing new products, implementing process improvements, developing new defensible niche markets, or improving human resource productivity will survive over this period. Also, recent research conducted by Madrigal and Quesada-Pineda (2010), concluded that the wood products industry is one of the lowest adopters of innovation when compared with other industry sectors in manufacturing.

The complexity of translating theoretical concepts into practical applications in innovation theory has been challenging in all industries, especially in the wood products industry. Researchers continue to look for ways to connect practitioners with research outcomes. According to Tidd (2001), inconsistency in studies of innovation in organizations has failed to produce compatible theories that can be

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put into practice. Damanpour and Wischnevsky (2006) indicated that in order to address the inconsistent results of the studies of innovation in organizations, researchers have developed contingency theories of innovation types. This type of theory distinguishes between product and process (Brown and Eisenhardt 1995, Damanpour 2010), technical and administrative (Madanmohan 2005), and incremental and radical innovations (Dewar and Dutton 1986). However, the impossibility of developing consistent arguments across the different innovation theories that support practical applications continues to be a challenge (Wolfe 1994, Fiol 1996, Damanpour and Gopalakrishnan 1999).

In order to look for new theories to eliminate these inconsistencies, research on innovation topics has shifted focus to process, service, and strategy innovation issues rather than merely product or technological innovation (Damanpour and Gopalakrishnan 1999). Given this new research focus, this article introduces a strategy based on existing product development tools to help translate ideas into commercial products using a comprehensive approach. The final strategy is applied to a wood products company to solve a product development challenge. It is expected that the proposed strategy will help not just wood products industries but any firm to increase their familiarity (absorption) of the innovation process in order to improve or develop new products or processes.

Theoretical Background

Evolution of innovation research

As defined by Schumpeter (1934), innovation is the foundation of economic development. Schumpeter developed the notion that economic change revolves around innovation, entrepreneurship, and market power. In the 1980s, Stevenson and Gumpert (1985) continued to define innovation as the heart of entrepreneurship. The definition of innovation has not evolved much since Schumpeter (1934). Hage (1999) indicated that across a large number of articles, the definition of innovation continues to be quite consistent: ''it can be defined as the adoption of an idea or behavior that is new to the organization'' (p. 599). However, Hage stated that the focus of research has changed from the study of incremental change in public organizations between the 1960s and 1970s to the study of radical change in private organizations during the 1980s and the 1990s. Despite this change of focus and the large interest in research on the innovation process, Damanpour and Gopalakrishnan (1999) stated that the fundamental questions ''Why are some organizations more innovative than others?'' and ''What are the drivers or inhibitors of the innovation process?'' continue to be unanswered. More recently, Fagerberg (2004) indicated that innovation continues to be a broad phenomenon and that there are several types of innovation such as technological, product, process, and organizational innovations, but consistent results and the lack of compatible theories continue to undermine transition from theory to practice in innovation research (Damanpour and Wischnevsky 2006).

Innovation and competitiveness

Innovation and competitiveness have often been linked in the literature. For example, Metcalfe and Ramlogan (2008) suggest that innovation is an economic act that relies on new perceptions of market opportunities, while D'Cruz and Rugman (1992) believe that competitiveness can be defined as the ability of a firm to design, produce, and/or market products superior to those offered by competitors, considering price and nonprice qualities. Innovation is any significant improvement at the product, process, organizational structure, or marketing level. Morris (2006) promotes a definition where innovation can be classified in four different ways according to the degree of development within the organization: incremental innovations, product and technology breakthroughs, business model innovations, and new ventures. The Organisation for Economic Co-operation and Development's (OECD) definition captures the spirit of innovation in a business context as ''the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organizations, or external relations'' (OECD 2005, p. 46). Business model innovation is particularly interesting because this is the stage of innovation where a business organization is not just capable of creating new products and developing new or better processes, but also the organization is capable of delivering and supporting their products or services so that their customers are extremely satisfied. Another way to define innovation is from a capability point of view. Christensen (2001) points out that those managers who are interested in initiating an innovation process might be limited by the capabilities of their resources, processes, and values. Other important considerations are the relationship between innovation and other core business processes on the performance of the organization. The importance of innovation has evolved to the point where today's economy is framed as innovation-based evolving from a high-tech economy, which was preceded by a manufacturing-based economy (Situngkir 2009).

Today, businesses are performing on a vastly different stage, where knowledge has become the most important driver and innovation is the mechanism to create that knowledge. According to Srivardhana and Pawlowski (2007) and Jaruzelski and Dehoff (2008), business organizations invest millions of dollars to support innovation activities, but their innovation processes per se and outcomes are still not well understood (Science of Science & Innovation Policy 2008). Business organizations make these investments because they know there is value in improving their products and processes; however, little is known about the underlying relationships of the innovation process, business processes, organizational structure, process performance, customer satisfaction, and associated information technologies that facilitate the innovation process (Hertog and Gjalt 2007, Vega-Jurado et al. 2008).

Methods

Based on the findings from the literature, we intend to answer the following question: What product development tools can be used to connect customer requirements, idea development, and solution deployment into a holistic approach? As indicated by several authors, innovation should be a process that is clearly integrated with other processes, such as strategic, business performance, organizational, and customer service processes (Christensen 2001, Hertog and Gjalt 2007, Vega-Jurado et al. 2008).

To answer the posted research question, the research plan in Figure 1 is followed. To reach the outputs, rigorous and systematic qualitative research methods were used in every

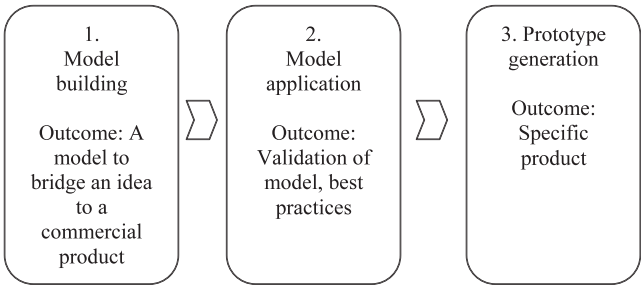

Figure 1.—Research plan.

stage. The first part consisted of a review of a large number of documents to answer the research question. After the sample of documents was systematically and rigorously analyzed using grounded theory, a strategy was created and then applied to a product idea in the wood products industry sector. In the third step, the newly created product was built to test for product functionality.

Document sample

To set up the sample of documents in order to revise existing product development tools, the authors searched for peer-reviewed articles in the database Ebsco Host using the Boolean expression ''(product and development) and (tool or method or procedure or strategy or model or methodology)'' in the title subject. The initial sample contained 56 peer-reviewed articles from 1995 to 2010. This technique of filtering and selecting documents by typing key words is an accepted research technique, and it has been used in qualitative research projects to identify attributes, core categories, and themes on the topics of interest. Some examples of innovation studies where this sampling setting method was used are Van de Ven and Poole (1995) and Schroeder et al. (1986).

Document analysis

To help answer the research question from the documents that were found, grounded theory was used. This qualitative research approach relies heavily on observation, interviews, and other empirical data collected (Bowen 2006). This research method is very appropriate when answering research questions from existing data or where no specific model or theory exists. The method prescribes rigorous methods for developing, testing, and extending new models or theory if necessary. Also, the method is inductive and deductive, and it allows the researcher to develop theory or models from an initial set of data, such as documents, then the results can be revised, proved, or disregarded. For this particular research, it was very important to analyze existing product development strategies to understand their level of integration with strategy, business performance, and innovation theory. To test for this integration, the document titles and abstracts were copied and pasted into a spreadsheet. With the help of searching and matching algorithms, open and axial coding based on causal relationships was performed as suggested by grounded theory.

Results and Analysis

Grounded theory was used to understand the degree of integration of the reviewed articles with value chain, marketing, business process management, and innovation theory. Also, it was possible to identify causal relationships that affect the occurrence or development of the phenomenon studied. After analyzing 56 peer-reviewed documents related to product development tools, 251 fundamental concepts were uniquely identified in the open coding step. The axial coding was performed using inductive and deductive thinking as recommended by Strauss and Corbin (1990), and it included the identification of relationships between the categories and subcategories in terms of properties and dimensions. Specifically, causal relationships were used to fit the open coding terms into a basic frame of generic relationships. This basic frame included five categories of causal relationships: phenomenon, conditions, context, strategies, and consequences, as suggested by Strauss and Corbin (1990). Table 1 shows the final axial coding of terms by causal relationship.

Six terms were related to the phenomenon in study (holistic product development tools) by using the definition of innovation by Damanpour and Gopalakrishnan (1999), which states that innovation can be classified as an output or as a process. This first piece of information was critical in the search for an answer to the research question.

To classify the open code terms by condition or causes, the factors that drive or inhibit innovation by Hage (1999) were used. Hage stated that three organizational factors limit or drive the innovation process: lack of high-risk strategies, division of labor, and structure of the organization. In this case, 18 terms were related to this causal relationship. As shown in Table 1, the most important cause or condition for the phenomenon in study is the organic structure of the organization, and the second is the lack of investment in higher risk strategies to increase the degree of innovativeness. This result might indicate that current research on product development tools is limited by organization structural issues and does not relate well with other conditions or determinants of innovation, such as labor and higher risk strategies.

The context axial coding was made using the critical issues that should be considered when studying organizational change and development as recommended by Pettigrew et al. (2001). Therefore, the axial coding of this causal relationship included internal structure; competitors; suppliers; customers; regulation; and social, cultural, and longitudinal relationships. A total of 45 terms were classified under this causal relationship, as shown in Table 1. The most important context relationship was internal structure, meaning that internal structural factors are the dominant issues that impact the revised product development tools. This result is consistent with the coding performed in the previous causal relationship condition. The second important context causal relationship was the customer. This suggests that the identification of customer needs through the marketing research theory would come into a secondary order if the product development tools were analyzed.

To classify the open code terms as strategies, the value chain approach by Porter (1985) was used. In this case, 50 terms were classified as cost strategies, 37 as differentiation strategies, and 11 as niche market strategies. The results imply that the product development tools that were revised mostly focus on impacting manufacturing costs rather than supporting the creation of products with impact on higher value chain strategies such as differentiation or niche market strategies.

Table 1.—Axial coding by causal relationships.

Underlying theory	Axial coding	Causal relationships (Strauss and Corbin 1990)				
		Phenomenon	Condition	Context	Strategy	Consequence
Innovation theory (Damanpour and Gopalakrishnan 1999)	Process	5				
	Outcome	1				
Organizational factors impacting the innovation process (Hage 1999)	Organic structure		8			
	Risk		7			
	Labor		3			
Issues to considered when studying organizational change (Pettigrew et al. 2001)	Internal structure			17		
	Customers			11		
	Regulation			6		
	Longitudinal			4		
	Social			3		
	Competitors			2		
	Product shape and features			1		
	Suppliers			1		
Value chain (Porter 1985)	Cost				50	
	Differentiation				37	
	Niche market				11	
Business performance (Kaplan and Norton 1992)	Internal performance					16
	Customer satisfaction					7
	Business growth					5
	Financial strength					4

Finally, the balanced scorecard framework by Kaplan and Norton (1992) was used to classify terms under the causal relationship consequences and the results are as follows: 16 terms classified as internal performance, 7 terms as customer satisfaction, 6 terms as business growth, and 4 terms as financial performance. This particular result indicated that the majority of the studied product development tools target internal operations' performance dimensions over customer, growth, or financial dimensions. Potentially, this might imply that the product development tools in analysis do not adequately consider their impact on customer satisfaction and business growth. Interestingly, these results are consistent with the previous causal relationship analysis.

The analysis (Table 1) using grounded theory revealed that the product development tools that were studied are limited to internal causal relationships (main condition, organic structure; main context, internal structure; main strategy, cost; and main consequence, internal performance) with the phenomenon being studied. Also, these product development tools have little focus on more important causal relationships such as higher risk strategies, customer relationships, product differentiation, and customer satisfaction performance. Specifically, it was found that none of the revised product development tools integrate support tools or methods for the following.

- Determining customer requirements and needs: Most of the revised product development tools focused on cost reduction strategies and less on developing more customer-oriented products (differentiation and niche market strategies).
- Relating customer requirements with ideal solutions: Since the majority of the revised product development tools are influenced mostly by internal issues (production system, technology, human factors, and organizational structure), they do not explicitly address external factors that could be limiting the generation of the ideal solutions.
- Transforming the ideal solutions into technical specifications: The revised product development tools do not relate to other business processes such as manufacturing, procurement, business performance, and quality control.

Product Development Strategy: Connecting Theory with Practice

To help overcome these disconnections between theory and practice in innovation research, the strategy shown in Table 2 is proposed. This strategy connects fundamental theory in marketing research, value chain strategy, innovation process, and business process management through the sequential application of known innovative practical tools.

Results of the application of grounded theory show that the most important context of causal relationships that affects the innovation process is the internal organizational structure (see Table 1) with less attention directed to external context relationships, such as customer requirements and regulations in that order. One way to shift the focus to the most important contextual relationships is the use of marketing research tools such as site interviews and direct observation methods as recommended by Yin (1994) and Camp (1995). To document, classify, and analyze the collected data from interviews and direct observation, the Voice of Customer (VOC) tool (Bhote 1997, Edney and Slocum 2009b) is recommended. The use of VOC would help users to understand what is really important for their customers and to relate customer needs with value chain strategies that can positively affect their business as well as their customer satisfaction levels.

After the problem and potential customer requirements have been identified, the next step is to relate customer requirements with potential solutions. In this step, it is important to understand the organizational factors (division of labor, organizational structure, and high-risk strategies) affecting the innovation process as explained by Hage (1999). For instance, the higher the knowledge and

Table 2.—Recommended product development strategy.

Tool	Goal	Theory integration
Interviews and direct observation in industry sites (Yin 1994, Camp 1995)	Collect data	Marketing research
Voice of customer (Bhote 1997, Edney and Slocum 2009b)	Determining problem and requirements	Value chain
Transformation of ideal solution elements through associations, TILMAG (Edney and Slocum 2009a)	Identify ideal solution elements for the requirements	Organizational factors affecting the innovation process
Quality function deployment (Hauser and Clausing 1988).	Translate ideal solution elements into technical specifications (parts, process, and control mechanisms)	Business process management
Product prototyping	Test for functionality of features	

experience of the team working on developing the solutions for the specific problem, the higher the chances that they find an acceptable solution. The solution process also is affected by the organizational structure, because flexible and horizontal organizational structures tend to be more innovative than rigid and vertical structures. Finally, the development of solutions might require the implementation of high-risk strategies, and innovative organizations tend to support these types of strategies. One available tool that could support these three conditions is the Transformation of Ideal Solution Elements through Associations (TILMAG, acronym in German) tool. This tool recognizes the need for a flexible organization, work teams with extensive knowledge, and likelihood to invest in high-risk strategies for problem solving. The application of the TILMAG tool results in defining ideal solution elements (ISE) that simultaneously meet customer requirements, overcome problems, and eliminate relationship contradictions (Edney and Slocum 2009a).

The fourth step requires translating all underlying principles of every ISE into technical specifications for the final product conception. As indicated in the literature by Hertog and Gjalt (2007), Christensen (2001), and Vega-Jurado et al. (2008), little is known about the relationships of the innovation process with other business processes such as procurement, manufacturing, and distribution. One available product development tool that can provide a common ground for establishing these process relationships is the quality function deployment (QFD) or house of quality defined by Hauser and Clausing (1988). This systematic product development tool involves the following actions:

- Translation of ISE into technical specifications
- Translation of technical specifications into the required product parts
- Translation of the required product parts into the manufacturing processes
- Translation of the manufacturing process into the appropriate quality control procedures

From the above systematic procedure note that QFD could provide the grounds to connect the innovation process with other business processes. Finally, the last step in the strategy shown in Table 2 is product prototyping to determine whether the proposed solution is aligned with the customer expectations.

Discussion and Conclusions

It was found from the literature review that one of the main problems in innovation research has been the inconsistency of results that has limited the production of compatible theories that can be put into practice (Tidd 2001). In an effort to create compatible theories of innovation that can be put into practice (Damanpour and Wischnevsky 2006), the recent research in innovation theory tends to focus on the development of contingency innovation theories (product vs. process, incremental vs. radical, and technological vs. administrative), but still the impossibility of developing consistent arguments across these contingency theories that support practical applications continues to be a challenge (Wolfe 1994, Fiol 1996, Damanpour and Gopalakrishnan 1999). This proposed product development strategy aims to address the main problems in innovation research theory by connecting theory with practice as shown in Table 2. Most of the product development tools that were analyzed using grounded theory were limited to internal organizational aspects and had little connection with marketing research, value chain, business process management, and innovation theory. Although the revised product development tools have proved effective as isolated tools, there was no evidence of an integrated approach that could help practitioners to transform ideas into commercial products in a comprehensive way.

Also, it is important to discuss the methods and sample size used in this paper. Grounded theory has been recognized as an excellent approach to build theory or models using existing data. However, because of its deductive and inductive methods of establishing categories and causal relationships between the coded terms, results might vary depending on the researcher's experience and knowledge of the phenomenon. Another fact that could be used to argue the validity of this research is the small sample size (56 documents) and searching criteria used. For future research, the sample size could be expanded by using a more flexible document search and using alternative databases. However, the authors feel confident that the sampling setting procedures were clearly adjusted to the particular research question of this research.

Finally, the presented product development strategy was successfully applied to a specific idea in the wood products industry leading to significant design modifications of an existing wine barrel configuration. It is important to mention that the research team had to study the process of wine making and the interactions between wine and wood very carefully in order to successfully apply the proposed strategy. This new wine barrel design has already been patented, and the patent's owner is currently producing and marketing the new design. The product development strategy introduced in this article can be used for any firm

that needs to focus on the design or redesign and production of value-added products that are better aligned to marketing research, value chain, business process management, and innovation theory. Although there is a plethora of literature on innovation theory, and specifically in product development tools, there is little information on how to integrate these theories with known innovation tools.

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