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Supply chain innovation-driven business models – exploratory analysis and implications for management

Abstract

Purpose: This research explores case studies of business models (BMs) driven by supply chain innovations in order to investigate how supply chain innovations (SCIs) can lead companies to discover new BMs.

Design/Methodology/Approach: This research is based on an in-depth literature analysis. Literature supports that SCIs drive new BMs. An exploratory interview-based study with practitioners from German and Italian companies shed more light on the ways SCIs can contribute to the discovery of new BMs.

Findings: So-called operators can establish close links between SCIs and business model innovation. Because in general supply chains are designed to improve operational performance, most business model improvements are incremental. Large companies, however, can leverage SCIs to generate new BMs that are complementary to their current BMs.

Research Limitations/Implications: This research is exploratory in nature. Further (quantitative) research studies can link SCIs types to specific business model patterns and examine contingency factors such as size and industry sector that influence the relationship between SCIs and BMs.

Practical Implications: This research draws the attention of practitioners to SCIs as a valuable opportunity to discover new BMs. The operators enable companies to estimate the effects of specific SCIs on their BMs and to identify the SCIs required for achieving a targeted business model.

Originality/Value: This paper elaborates propositions about the relationships between SCIs and BMs. It identifies supply chain and process management as important streams of literature that can support the advancement of business model research.

Keywords: supply chain innovations, business models, core business processes, operators, exploratory study

Paper Type: Conceptual paper

1. Introduction

Competitive pressures and turbulent business environments push companies toward innovation. Very often, innovation is not a choice but a must if companies are to survive. Innovation is however not restricted to products and services, as it also embraces new ways of business organization and marketing. In this regard, management literature has witnessed the emergence of a new stream of research called business model innovation (e.g. Osterwalder and Pigneur, 2010). In simple terms, business model innovation denotes the design of new ways of making money and, as such, focuses on the essence of entrepreneurial activity—the generation of revenues (e.g. Johnson, 2010).

While the concept of business models is appealing to academics and practitioners, researchers are still looking for solid theoretical underpinnings. Authors have related business models to several theories, including resource-based theory, transaction cost theory, and the dynamic capabilities concept (e.g., Gassmann et al., 2016; Trkman et al., 2015). In this paper, we contribute to this literature by advancing our understanding of business models by connecting it to the concept of supply chain innovation.

In contrast to business models, supply chain design management is already well-established in academia and practice (Petersen and Autry, 2014). Interestingly, very often companies considered as best case examples of innovative supply chain management are also used to illustrate innovative business models. For example, Dell has been known for its virtual supply chain, which eliminates retailers between the company and its customers (Simchi-Levi et al., 2003) but also for its direct business model (Magretta, 1998). Amazon is known for its advanced logistics execution but is also referred to as a company with a revolutionary business model that transformed the book-selling business (Johnson, 2010).

Very few attempts have been made to connect the business model and supply chain management streams of research. Munksgaard et al. (2014) is the first study that attempts to explore how supply chain innovation contributes to value creation, value delivery and value capture. The mentioned case examples (Dell and Amazon) suggest, however, that new ways of designing and managing the supply chain can give rise to new business models. Therefore, we explore three major research questions:

- What are so-called supply chain innovation-driven business models?
- How are supply chain innovation and business model innovation linked?
- How can companies leverage supply chain innovations to systematically generate business model innovations?

The first question posits that supply chain innovation is a source for the generation of new business models. The second is more theoretical in that it aims at exploring the relationships between supply chain innovation and business models to stimulate future research on the links between the two literature streams. The third, however, aims to derive practical recommendations on how supply chain innovation supports the creation of new business models.

This research is conceptual in nature. It draws on extant literature and exploratory interviews with experts (largely practitioners). The initial motivation is to develop recommendations for practitioners on how to generate business model innovations by leveraging supply chain innovations and to document a new perspective for academics researching business models.

This paper is structured as follows. Section 2 is dedicated to a literature review that deals with the types of supply chain innovations and the specifics of business model innovation. Section 3 introduces, by means of case studies from secondary literature, four prominent business models that are driven by supply chain innovations. Section 4 creates a bridge between supply

chains and business models by introducing the concept of operators. Section 5 describes our research design, which is based on exploratory interviews with German and Italian academics and practitioners. Section 6 summarizes the main interview results, whereas section 7 elaborates the implications of for research and management. Finally, section 8 concludes and provides directions for future research.

2. The Literature Review and the Types of Supply Chain and Business Model Innovations

2.1 Supply chains and supply chain innovation

A supply chain represents a network of companies that interact to turn raw materials into finished goods and services and to deliver them to end customers (Supply Chain Council). Supply chain management (SCM) is the integration of the business processes used to manage the supply chain. These processes can be strategic (e.g., localization of plants), tactical (e.g., purchasing), or operational (e.g., scheduling) (Simchi Levi et al., 2003).

Evidence for innovation in supply chains can be found in any logistics-related process or service, from the basic to the complex. Innovation is seen as new and advantageous to a particular focal audience (Flint et al., 2005) and it may also be fundamental for some companies, e.g., in the transportation industry (Wagner, 2008). As proposed by Bello et al. (2004), supply chain innovations are new logistic, production, or marketing processes—or the combination of innovations in information and communication technologies with new logistic, production, and marketing procedures—to improve operational efficiency and enhance service effectiveness.

In line with Bello et al. (2004), Franks (2000), and Arlbjørn et al. (2011), we distinguish two types of innovation: supply chain concept innovation and technological innovation. The first consists of three categories: structural/configurational, operational, and revolutionary. The introduction of new technology in the supply chain counts as a technological innovation if it is new to the company, even though it may not be new to the industry or to the world.

Structural innovations lead to changes in the supply chain configuration. For instance, disintermediation minimizes the number of intermediaries between the producer and the customer. It reduces the number of supply chain layers and triggers structural changes (Tay and Chelliah, 2011). In contrast to disintermediation, cross-docking adds a new layer that pools inventories, since in this configuration suppliers ship their deliveries to a central warehouse where they are unloaded and then reloaded onto trucks according to the orders placed by the stores (Van Belle et al., 2012). Another concept leading to structural changes in the supply chain is modularity. Modularity introduces pyramidal structures with a large base of component and raw material suppliers at the bottom of the supply chain and a few module and system suppliers near the original equipment manufacturer (OEM) at the top (e.g., Doran et al., 2007).

Operational supply chain innovations aim to improve the flow of materials. For instance, late customization reduces the level of variety offered to the customer without impairing efficiency, since the products are differentiated as late as possible in the supply chain (Fogliatto et al., 2012). Vendor-managed inventory (VMI) is an operational innovation (Lee and Ren, 2011) that reallocates the inventory management activity from the producer to the suppliers, who gain access to the customer's stock data and replenish inventory when the stock goes under a specified threshold.

Revolutionary innovations in the supply chain lead to deep changes in the supply chain structure and operations. For instance, just-in-time (JIT) can be regarded as a revolutionary logistics innovation. The philosophy underlying JIT is the continuous search for ways to produce goods or services without engendering any waste (Kaneko and Nojiri, 2008). To achieve this goal, every actor in the supply chain should be committed to JIT. Furthermore, revolutionary innovations may attract attention to important aspects of the supply chain that received insufficient attention in the past. For example, environmental concerns have not traditionally been included in manufacturing and supply chain-related strategy (Johansson and Mats, 2010), but the increasing importance of sustainability has resulted in innovative supply chain concepts such as reverse and green logistics. Other issues such as security and risk management have led to concepts that introduced a completely new way of thinking, e.g., the resilient supply chain (Sheffi, 2005).

Technological innovations and innovations in the supply chain are actually independent, but a company can profit more when it combines them. For instance, JIT has been supported by the electronic sharing of data (EDI), as companies can exchange Kanbans electronically. VMI is enabled by fast data exchange systems, computer platforms, communication technologies, product identification, and tracking systems. In this regard, Waller et al. et al. (1999) note that EDI is an enabler, but not a requirement for VMI. Tan et al. et al. (2015) contend that large data analytics can foster innovative ideas and improvements in supply chain processes.

Technological innovations improve the efficiency of information and material exchange in the supply chain. Tracking and tracing systems enable manufacturing and logistics companies to follow objects—such as components, semi-finished, and final products—during production and along transportation routes. For instance, RFID and barcodes capture data in real time and support operations in reducing inventory levels and costs (Li et al., 2010). Global positioning systems (GPS) and transportation management systems (TMS) can track and trace the movement of transportation systems on roads such as trucks to optimize their utilization levels. For information sharing and exchange, companies can use electronic data interchange (EDI) systems to achieve an instantaneous and error-free transfer of data or documents via electronic systems between trading partners. Sophisticated material management and production planning and control (PPC) systems facilitate the planning of production not only inside the company but also between suppliers and producers. Advanced planning systems (APS) integrate the planning systems of different actors in the supply chain to support a continuous production, purchasing and distribution planning (Stadler and Kilger, 2002). In the future, these systems will be supported further by the internet of things (IoT), based essentially on sensor technology and computing power. IoT will have profound implications for the manufacturing industry (Caputo et al., 2016). Other examples of technological innovations are found in transportation and packaging systems. For instance, the introduction of trailer-truck-sized containers has transformed freight transportation worldwide. Containers have reduced the cost and time required to pack and move cargoes, enabled the growth of new players of global production and distribution, and allowed intermodal transport (Donovan et al., 2004). In the field of packaging the introduction of the aseptic packaging technology in the 1960s and 1970s, e.g., Tetra Pak, enabled the development of the “cold” chain supply by facilitating refrigerated distribution and storage. E-commerce and electronic/mobile communications can be used to open new market channels and can be leveraged to connect all supply chain members with real time information (Cagliano et al., 2015). Table 1 shows a non-exhaustive list of supply chain innovations.

<Insert Table 1 approx. here>

2.2 Business models and business model innovations

A business model shows the rationale of how a company operates. It is neither strategy nor operations. A strategy defines the company's long-term objectives and how these can be attained. It serves as guidance for selecting an adequate business model from a number of possible options. Thus, a business model describes how, under certain conditions, a strategy is to be achieved. The operational tasks and activities describe how the business model is executed. Put differently, the business model abstracts the complexity in operations while capturing the essential mechanisms according to which business is done while avoiding the details of its day-to-day execution. Whereas not all companies have strategies, all companies have business models (Casadesus-Masanell and Ricart, 2010).

There are many business model frameworks (Osterwalder and Pigneur, 2010; Johnson, 2010; Lecocq et al., 2006; Abdelkafi et al., 2013), and two main views according to which business models are understood: the activity-based view and the value-based view (e.g., Abdelkafi and Täuscher, 2016). Both views are complementary. The activity-based view considers a business model as a system of interrelated activities (Zott and Amit, 2010), whereas the value-based view distinguishes many value elements such as value proposition, value capture, value creation, value delivery, and value communication (Abdelkafi et al., 2013). Value proposition is the company's offering to the marketplace. Value capture refers to the extent to which a company retains value for itself; it depends on the revenue streams and cost structure. Value creation denotes the processes, resources, and partners that the company relies on to offer the value proposition. Value delivery consists of the customer segments that are served by the company and the distribution channels used to bring the value proposition to the customers. Finally, value communication represents the way the company explains its value proposition to its customers (e.g. Abdelkafi et al., 2013).

Business model innovation is a central issue in management practice (e.g., Schneider and Spieth, 2013) and so have a high priority in the future agendas of managers (Amit and Zott, 2012). Business model innovation is defined as a new way for a company to do business and earn money (Osterwalder, 2004). Researchers often define business model innovation by giving examples of radically new ways of doing business from successful companies such as Apple, Hilti, and Southwest Airlines (Johnson, 2010). However, researchers often focus on one element of the business model when describing business model innovations. For instance, Hacker (2010, p. 42) mentions that experts may confuse the pricing model with the business model. Linder and Cantrell (2000) note that what is called a business model generally represents only a part of it. Spencer (2013) emphasizes that a business model is the entire system of resources and processes that companies use to create and capture value. Abdelkafi et al. (2013) found that so-called business model patterns generally refer to one dimension of a business model framework. They are either related to the value proposition, value communication, value creation, value delivery, or value capture. A business model innovation occurs when at least one of the business model dimensions changes (Abdelkafi et al., 2013). Mitchell and Coles (2003) distinguish business model innovations from business model improvements, which are more limited in scope. More than offering new products and services, Mitchell and Coles (2003) define business model innovation as a change in at least four out of seven dimensions (who, what, when, why, where, how, and how much) of the business model (p. 16). Some authors emphasize the fact that the search for business model innovations is a very practical issue, which requires constant testing and validation. For instance, Blank and Dorf (2012) relate startup business models to the customer development

process, which consists of four steps: customer discovery, customer validation, customer creation, and company building.

3. Examples of Business Models Driven by Supply Chain Innovations

Innovations in supply chains can lead to performance improvements by increasing the service level and reducing costs (Franks, 2000). Service level improves product availability and creates value to the customer. Thus, service level and efficiency directly impact the company's value proposition and value capture. In the field of logistics, innovations such as containerization and temperature control technology had a strong impact on the way companies do business, as these innovations influenced the size of the value network (Teece, 2010). With global sourcing, potential suppliers in a company's network can be located around the world. Supply chain innovations can, therefore, directly impact the company's value creation and delivery. In the following, we discuss four examples from extant literature of companies that were capable of engineering new business models by capitalizing on supply chain innovations.

Dell revolutionized the computer industry in the 1990s by introducing a new way of selling computers. Instead of using traditional third-party distribution channels, Dell sells customized products directly to the customer (Thomke et al., 1998). The company leveraged the Internet as a communication channel to enable customers to place their orders online through the company's webpage. Once the order is received by Dell, the production details of the selected computer configuration are sent to the appropriate assembly line. A logistics service provider, UPS, picks up the computer at Dell's production plant and delivers it to the customer (Magretta, 1998). This business model is called disintermediation (Johnson, 2010) as it takes an activity (retailer storage) out of the producer's system of activities and relocates an activity (computer configuration) from the producer to customers.

The *IKEA* Group is a worldwide leading home furnishing retailer that has leveraged supply chain innovation to create a new business model. The company's corporate slogan is "Low price with meaning". Customers choose *IKEA* for its unique combination of form, function, and affordability (Baraldi, 2008; Moon, 2004). *IKEA*'s main supply chain innovation results from the involvement of its customers in value creation. In *IKEA* stores, furniture is exhibited with information allowing customers to find the furniture they want to purchase easily in the warehouse. *IKEA* expects its customers to collect their purchases, transport them home, and assemble their furniture on their own. Flat packaging facilitates transportation and reduces inventory costs (Baraldi, 2008). *IKEA*'s value proposition is to provide customers with low cost furniture characterized by a minimalist style. The profit formula is supported by transferring the responsibility of certain supply chain activities (order picking, transportation and assembly) to the customers. Customers are active actors and constitute a key resource that *IKEA* uses to deliver its value proposition.

Fourth-party logistics (4PL) are service providers who are responsible for the management of their clients' supply chains. In the automotive industry, General Motors (GM) formed a 4PL joint venture with Menlo Logistics. Each company invested \$6 billion in the joint venture, and General Motors relocated its logistics staff to the new firm, called Vector SCM. Its goal is to reduce SCM costs by streamlining the flow of products from suppliers and manufacturing to end customers. It also maintains single-point communication by using EDI to integrate the technology systems of GM's twelve third-party logistics providers (Hingley et al., 2011). A 4PL is thus a supply chain intermediary whose so-called orchestrator business model consists in coordinating the activities of multiple actors (Andrew and Sirkin, 2006). From the supply chain viewpoint, a 4PL denotes a new node with planning and coordination activities in the

supply chain. Because the new node acts as an online information hub connected to other nodes, the flow of information is significantly smoother and faster.

Click-and-collect is a relatively new business model in the retailing industry (Beck and Rygl, 2015). Traditional and on-line retailers are increasingly offering their customers the possibility to order online and pick up their purchases at shops, supermarkets, post offices, lockers etc. This business model is executed by designing and operating new supply chain processes: gathering customer orders online, picking and packing the goods in a warehouse, and transporting them to the point of delivery. This represents a new way of delivering value to the customer by relying on new supply chain processes and technology.

These four cases all share features that indicate the emergence of a new type of business model. As there is no definition of so-called supply chain innovation-driven business models in the literature, we use expert interviews to develop one in section 6.2.

4. Creating the Bridge Between Supply Chain Innovations and Business Model Innovation

Business model innovation and supply chain innovation do not have the same level of abstraction, as the former has a higher level of abstraction than the latter. The business model, according to Zott and Amit (2010, p. 219), can be understood as “an activity system” but one that only includes so-called core activities. For instance, in an Internet company selling customized products or services to customers, the online capture of customer requirements is a core process with high importance for value creation. Supply chain management, on the other hand, covers even routine activities, such as “order picking and packing” in warehouse logistics.

To solve the problem due to different abstraction levels, we need an approach that brings supply chain innovations to a higher level of abstraction or makes business models more specific. Since the details of a business are context-dependent and can be overwhelming, it is more practical to represent supply chain innovations more abstractly. The abstract representation of supply chain innovation is achieved by so-called operators, which we identify by using case studies from secondary sources (e.g. Simchi-Levi et al., 2003; Dapiran, 1992).

The concept of operators is a priori supported by the literature of business process reengineering (e.g. e.g., Wildemann, 2000; Hammer, 1990; Hammer and Champy, 2006; Al-Hudhaif, 2009; Limam et al., 2007) and supply chain process control (Liker, 2004; Towill and Childerhouse, 2006). Additionally, the concept of operator is similar to an element called “production” in graph theory. In graph theory, a production is applied to an existing graph (a system of nodes connected by edges) to generate a new graph. A node represents an actor who carries out a system of activities by using its own resources and gaining access to the resources of other actors through interaction (Hakansson et al., 2009). Similarly, supply chain operators are applied to the activities performed by actors in the supply chain. And the successive application of one or more operators results in a supply chain innovation.

The concept of operators allows us to know what a supply chain innovation changes and how it makes the supply chain better, without having to know the technical details of how this improvement is attained. Since business models are defined as the system of core activities executed by the company, the identification of the set of operators that apply to the activities of the company’s supply chain enables us to understand how a supply chain innovation can modify the business model. The concept of operators thus links both concepts to each other. We identify seven basic operators that apply to the activities of a supply chain:

- *Eliminate an activity*: Dell eliminated retailer activities from the supply chain to design what is known as the direct business model (Magretta, 1998).
- *Add a new activity*: Wal-Mart added a new activity (cross-docking) to its supply chain to decrease its logistics costs and improve time efficiency (Wal-Mart Supply Chain Management Practices). A cross dock is essentially a transshipment facility to which trucks arrive with goods from different suppliers. These goods are sorted, consolidated with other products, loaded onto outbound trucks and sent to the retail stores (Collins, 2005).
- *Divide an activity*: An example is process standardization, which divides a supply chain in standardized and non-standardized parts. Standardized activities are characterized by a steady and continuous flow of parts and subassemblies according to mass production principles. Non-standardized activities are triggered by the specific orders of the customers (e.g., Swaminathan, 2001).
- *Relocate an activity*: Late customization is an example of the relocation of activities. It describes the rearrangement of a whole process so that the differentiation activity is allocated to another node in the supply chain. HP is a case in point. HP ships generic printers from its central warehouse to a local warehouse, where they are customized by adding the product instructions in the required language and the power supply specific to the customer's country (Lee and Sasser, 1995).
- *Accelerate an activity*: Activities are accelerated through the use of sophisticated technologies that makes the exchange of materials and products faster. Acceleration can also be driven by modern information and communication technologies such as EDI.
- *Invert two activities*: Activities can be inverted to improve, for instance, forecast accuracy. Benetton reversed the main activities of the garment production process by changing the traditional sequence of first dyeing the yarn and then knitting the garment. Since the dyeing process is short and the knitting process is long, this sequence requires that apparel producers decide which colors are in demand by the customers many months before the garments are brought to the market. The reversal of the activities enables the producer to make better forecasts, as the dyeing process is postponed in time until reliable information about customer demand is available (Lee and Tang, 1998).
- *Parallelize activities*: Parallelizing activities calls for the modularity of products and components. In this way, certain activities can be conducted simultaneously, considerably reducing the duration of the whole process (e.g., Abdelkafi, 2008; Ericsson and Erixon, 1999).

5. Research Design

Our field study investigates how companies leverage supply chain innovation to generate new business models. To capture the different aspects of supply chain innovation and to understand the links between supply chain innovation and business model innovation, we conducted interview-based research. Interviews are suitable because both areas of research constitute relatively new research fields (Stern, 1980).

Interviews were conducted by using open-ended questions related to the topic of supply chain innovation and their impact on business models. An interview guide allowed us to ask structured questions that enabled comparable responses across participants while providing the interviewer flexibility in probing areas of particular relevance to each participant (Rosenthal and Rosnow, 2008).

As the objective of our study is not to formulate or test a theory but to provide initial insights into the business models driven by supply chain innovations and to demonstrate the usefulness of operators as a theoretical concept to create a bridge between supply chains and business models, convenience sampling was a suitable strategy. Experts were recruited from universities and from practice. Expert academics were selected in areas relevant for this research. Expert practitioners were selected, using secondary sources, from a list of companies that had changed their supply chains or were well known for being innovative (e.g., Secchi, 2012). The supply chain manager, the production manager, the logistics manager, the sales manager, or the CEO was then contacted.

In the period 2013–2014, we interviewed 24 experts (twelve in Germany and twelve in Italy). The small sample size enables the researcher to develop a close association with participants in the study and so increases the validity of fine-grained and in-depth inquiry (Crouch and McKenzie, 2006). The first round of interviews consisted of six Italian experts from academia and consultancy: four were supply chain management professors, one was an innovation management researcher, and one was working as a supply chain consultant. The objective of this interview round was to test the interview guide and to capture preliminary insights to be considered in the main interview round with practitioners. The second (main) round of interviews consisted of eighteen practitioners from six different Italian companies and nine companies from Germany. For three out of the nine Germany-based companies, we conducted two expert interview sessions because we felt that the second interview would enable us to learn more about the company's endeavors in the area of supply chain innovation and its impact on the business model. The companies the experts were employed by are large organizations that had in the past undertaken many initiatives to improve and change their business models. The companies belonged to different industries: food, furniture, jewels and leather goods, logistics, e-commerce, construction, aerospace, and medical.

The participants in the study are either interviewed in the participants' offices (Italy) or by phone (Germany). One author conducted 12 interviews with the German companies, and the other author conducted the interviews with the Italian experts. Nevertheless, at least two researchers (e.g. author and a graduate assistant) were involved in each interview, which lasted between about thirty minutes and two hours. All interviews were tape-recorded. In only one interview (with a Germany-based company) did the interview partner not allow the researchers to tape record the telephone interview. In this case, one researcher conducted the interview while the second took notes. After completing the interviews, the audio recordings were fully transcribed. Both authors coded the transcriptions and notes of the interviews they were involved in and then discussed the results of the coding process to reach a consensus and to ensure reliability (Miles & Huberman, 1994).

Open, axial and selective coding were done (Strauss and Corbin, 1990) to identify the concepts (e.g., supply chain innovation, business model innovation, and operators), the conditions, and the relationships between concepts. The coding is based on the concepts presented in the previous sections of this paper. The two categories of supply chain innovation are supply chain concept innovation and technological innovation. The seven categories related to operators are eliminate, add, divide, relocate, accelerate, invert, and parallelize activities. The five categories related to business model elements are value proposition, value communication, value creation, value delivery, or value capture (Abdelkafi et al., 2013). Finally, in line with Garcia and Calantone (2002), business model innovations are defined as incremental and radical as well as new-to-the-firm (NTF), new-to-the-market (NTM), and new-to-the-world (NTW). A codebook was defined in English. Then, since the interviews were carried on in Italian and German for the cases in Italy and Germany respectively, the interviews were first coded in each language. Then, based on discussions

between the main researchers involved in the work—the authors of this article—the final coding was defined.

Table 2 presents the sample. Companies are classified according to their size: Small with revenues less than €50 million, medium with revenues between €50–500 million, and large with revenues greater than €500 million.

<Insert Table 2 approx. here>

6. Results

This section presents the results of the exploratory empirical analysis involving interviews with academic experts and practitioners working for companies that had engaged in changes to their supply chain.

6.1 Insights into supply chain innovation

Supply chain innovation is strongly related to supply chain design and information flow. Still, there is no single definition of supply chain innovation. The practitioners describe supply chain innovation by explaining the starting situation (before the change), and the end situation (after the change). The experts find supply chain innovations highly relevant:

“I think they [supply chain innovations] are highly important, and I believe that they will even be more important in the future.”

The experts generally interpret supply chain innovation as changes in the structural design of the supply chain, in operational processes, and in supply chain technology. Revolutionary supply chain innovations were not mentioned. Frequently, companies solve logistical problems by combining many different supply chain innovations. For instance, one German company in the sample added a number of activities for the inspection of goods and supported this operational innovation by using appropriate technologies such as barcodes.

Two types of innovation emerge from the interview study. Some companies have integrated NTF innovations that are new to the company itself, and others added NTM innovations that have not been implemented so far in their industry. There were no examples of NTW innovations. It is worth mentioning, however, that in our sample manufacturing companies tended to add NTF innovations, whereas logistics companies and logistics service providers added NTM innovations.

The introduction of supply chain innovations is described as proactive when the company promotes the innovation independently from external forces and reactive when the company implements the innovation in response to external conditions. The impetus of supply chain innovations can come from different management levels (middle and upper management). All the surveyed companies, however, tended to be reactive rather than proactive.

As expected, most of the operators are confirmed by the interview study. As the hypothesized operators were not explicitly mentioned in the expert discussions, the statements of the interview partners were analyzed to detect whether there were specific terms that imply these operators. Table 2 provides evidence that, with the exception of “parallelize activities” and “invert activities”, all of the operators were implicitly referred to by the interviewees. The analysis of the interviews did not lead to the identification of operators that had not already been identified in the literature.

<Insert here Table 3 approximately here>

By comparing how the companies in our sample achieved supply chain innovation, we notice that different paths can be followed to implement the same type of innovation. For instance, an Italian company introduced a VMI system without EDI and without a common platform technology. Only in response to an increase in the number of its clients did the company recently introduce a new IT system to support data sharing and management. Consequently, we conclude that VMI is a supply chain innovation that can be implemented with or without IT support. In addition, the supply chain manager stated that his company prefers the development of interfaces to connect two different systems instead of asking suppliers to change their own systems. Two German companies chose different paths to achieve the same objective of increasing the efficiency in the order picking process: one company improved efficiency through an operational innovation while the other introduced a special technology.

6.2 Insights into the effects of supply chain innovation on the business model

All the interviewed experts agreed that a supply chain innovation can have a great impact on the business model of a company. For instance, two of the Italian experts from academia and consultancy made the following statements:

“A supply chain innovation can lead to a redefinition of the business model.”

“The concept of supply chain innovation is very close to the concept of business model innovation.”

“In this case, logistics and business models are very closely interlinked.”

An interesting insight is provided by an expert who believes that some business models are based on supply chain innovation. He stated that e-business and e-logistics based business models are fundamentally grounded in a supply chain innovation. In addition, new business model types such as product servitization (also product-to-service business model) are strongly dependent on supply chain innovation as the company's ability to manage the new supply chain is essential for the success of this business model.

Supply chain innovation can impact all five business model value elements (value proposition, value communication, value creation, value delivery, and value capture), and so lead to business model innovation. One German company was able to extend its product range by means of a process innovation and simultaneously improve its value proposition to the customer. In addition, supply chain innovations can result in changes in a company's key resources and processes as well as in its key partnerships. Therefore, changing the upstream supply chain means a modification in the value creation dimension, whereas a change in the downstream supply chain leads to a change in value delivery. A supply chain innovation also has many effects on the cost structure and the revenue streams. It affects how the company captures value. All in all, most experts consider supply chain innovation to be essential for the generation of added value to the customer:

“I think that the crucial point is that—as a logistics service provider—you can provide added value to the customer.”

Although most academic experts acknowledge the importance of value communication, only one practitioner expert (from a German company) reported an impact of supply chain innovation on the value communication of his company's business model:

"You have to understand the [customer's] requirements, and then you should show to your potential customers where you can contribute with value."

The relationships between supply chain innovation and value communication are obvious in some cases. For instance, the supply chain innovations introduced by Wal-Mart enables the company to communicate value by using the slogan of "everyday low prices" (Simchi-levi et al., 2003). Benetton's operations reversal (Lee and Tang, 1998), allowing it to better synchronize its product line production with consumer demand, enables the apparel producer to communicate value as "The United Colors of Benetton" (e.g., Dapiran, 1992).

One company in our sample illustrates how supply chain innovation enables the design of a new business model. Originally, the company's business model was focused on selling dairy products such as milk, yogurt, desserts, and cheese. In 2010 the company decided to redesign its distribution network and started a firm to manage the company's distribution in the Italian market. The new firm owns a fleet of trucks equipped with a new technology that guarantees the safe and high quality transportation of dairy products by monitoring and tracking the temperature of the truck's refrigeration system. The application of this technology to food transportation was innovative since it had only been used in the pharmaceutical industry. The company extended its business by using its fleet of trucks to distribute not only its own products but also the products of other food producers. The company's business model now consists in selling dairy products and providing logistics services.

Based on these results, we thus propose a definition of supply chain innovation-driven business models; they are those business models where a supply chain innovation has a major impact on the core activities of the company and is fundamental in shaping at least one of the five value elements of the business model.

7. Implications for Research and Management

7.1 Implications for research

The role of operators is particularly relevant for researchers investigating both supply chain management and business models since they allow supply chain innovations to be better described and analyzed. They also raise the description of supply chain innovation to the abstraction level of business models. This opens the way to further integration of these two streams of research, thus facilitating the exploration of the relationships between the two concepts.

In line with previous research on the sources of innovation (von Hippel, 1988; Bellingkrod and Wallenburg, 2013), we find business model innovation taking place in the supply chain, thus putting to rest the idea that supply chain innovation is just a way to improve efficiency in the bottom line and so is only of interest to supply chain experts. Because supply chain innovation acts on core activities, it has the potential to change the business model or enable the generation of a new one. For instance, the supply chain innovations of the surveyed companies generally resulted in the development of their current business models. While elements of their business model were affected, these innovations did not lead to revolutionary changes in their business model. Nevertheless, companies that are able to unlock the potential of innovation in the supply chain can make supply chain innovation a part of their business models, and business model innovation can ensure a company's survival. For example, one German company integrated retailing and manufacturing

capabilities to generate a business model innovation that is unique in its industry. Therefore, we advance the following proposition:

Proposition 1: A supply chain innovation influences one or more of the five dimensions of the business model: the value proposition, value creation, value delivery, value capture, and value communication.

Our research, however, reveals that companies did not introduce supply chain innovations with the objective of redesigning their business models or generating new ones. Managers had rather in mind operational problems related to their day-to-day business. Their aim was to improve supply chain functions. Frequently, however, supply chain improvements resulted in a better business model execution, and the company experienced an incremental improvement of the business model—so-called incremental business model innovation. Hence, the second proposition:

Proposition 2: Supply chain innovations are mostly implemented to solve specific operational problems and frequently result in incremental business model innovation.

Practitioners generally do not recognize that supply chain innovations can lead to improvements in the business model. The operational problem is always in their focus, whereas the business model is rarely taken into account. Some practitioners are even reluctant to call their supply chain improvements an innovation because, for them, innovation should be something radical and groundbreaking. In most of the interviews, supply chain innovations were frequently not leveraged to generate radically new business model innovations. Consequently, we propose the third proposition:

Proposition 3: In practice, supply chain innovations are infrequently leveraged to generate radical business model innovations.

A radical business model innovation comes about when a new opportunity is recognized, and the current business model is fully transformed or a new business is added. An incremental business model innovation, however, marginally improves business execution and does not lead to major changes in the business model elements. An example may help illustrate this point. When Dell eliminated retailing activities from the supply chain and built computers after reception of customer orders, it introduced a radical business model innovation that no manufacturer at the time had attempted. It is true that Dell had introduced a series of complementary innovations, but the main operator responsible for this business model innovation was to eliminate an activity. Wal-Mart added the activity of cross-docking to the supply chain, but it did not radically change the business model of the retailing industry. It improved the execution of its efficiency-focused business model. In general, there is not a strong correlation between different types of operators and whether business model innovation is incremental or radical. Nevertheless, we can observe some patterns. The short case studies on Dell, IKEA, 4PL and click-and-collect companies discussed above are examples of radical business model transformations. Dell used the operator “eliminate an activity”; IKEA mainly applied the operator “relocate an activity” to shift transport and assembly to the customers in the mainstream supply chain in the home furnishing industry; and 4PL is a business also created by the operator “relocate an activity”, outsourcing the logistics planning activity to a logistics service provider. These changes led to highly innovative and radically new business models. When activities are inverted (e.g., Benetton), accelerated (e.g., Wal-Mart), divided (e.g., HP), or parallelized, incremental business model innovations are more likely to take place. In these cases, current industry standards regulating supply chain management and the sharing and exchange of information play an important role. For instance, companies in the retail food industry are closely tracking advancements in

technological innovation while continuously adapting their supply chains by leveraging more and more information technologies. For them “accelerating an activity” is an incremental innovation.

Firm size seems to play an important role in the relationship between supply chain innovation and business model innovation. The effect of supply chain innovation on business models in large companies is significantly different than in small and medium-sized enterprises. In large companies when innovations are initially developed to improve the efficiency of the supply chain they may lead to the creation of new businesses. However, in large companies these new businesses tend not to have a revolutionary effect but one that is complementary in that it does not change the core business. Thus, supply chain innovation can lead to extensions in a large company’s business model portfolio. This phenomenon occurs especially when a company takes advantage of logistics innovations created to optimize internal processes and launches a new value proposition in the market. For instance, one large German company began marketing a tracking and tracing tool that was initially developed and used for internal purposes. This allowed the company to expand its core business with an IT-based business model. Another company managed to create a new consulting business on the basis of an IT innovation:

“So the IT development and IT innovation ... have a connection to our consulting topics, because we can provide a better consulting service after having captured and documented the processes of our customers and statistically analyzed them.”

Although many authors assume a company’s supply chain strategy is related to its value proposition (Golicic and Sebastiao, 2011), there is still little research into how a change in the supply chain might lead to a change in the value proposition. Our results suggest this is the case of those companies that introduce supply chain innovations to extend their business model portfolio. Therefore, we advance the following proposition and two corollaries:

Proposition 4: The impact of supply chain innovation on a business model depends on the size of the company:

- *For small and medium enterprises, supply chain innovations support or improve the existing business model.*
- *For large companies supply chain innovations can lead to an extension of the business model portfolio through new business models.*

There may be other relevant contingencies besides size. For instance, the industry a company operates in may be another contingency, but this cannot be confirmed with the available data.

7.2 Implications for management

Based on the classification of supply chain innovation as structural/configurational, operational, and revolutionary, we identify seven ways to change the supply chain. A supply chain innovation can be understood as the application of an operator on supply chain activities. By using these operators, managers modify the supply chain and consequently the business model, which is understood as a system of core activities. Thus, technological and concept innovations in the supply chain, such as the acceleration or addition of an activity, drive business model innovation.

Now, by starting with a new business model as a target that the company wants to achieve, we can also get interesting insights. Companies interested in business model innovation can do so by acting on one or more of the business model’s value elements (value proposition,

communication, creation, delivery and capture). The modifications of the old business model to obtain the new one lead to a new system of activities. Companies can actually identify the operators required to change the system of activities, and then select appropriate supply chain innovations to execute the business model.

Consequently, two procedures are useful in a practical context: supply chain innovations → operators → business models and its reverse: business models → operators → supply chain innovations. The starting point and sequence depends on the objectives of the company. A supply chain innovation, originally introduced to increase operational efficiency, can lead to an update of the business model. The operators enable managers to understand how the supply chain innovation improves the business model. The opposite can also happen. The search for a supply chain innovation can be triggered by the need to develop or update a business model. Managers, in this case, intentionally aim to act on the business model, and to achieve this, they can use the operators to identify which supply chain innovation is appropriate to support the execution of the new business model. Thus, the business model and the supply chain innovation processes are strongly linked, and managers should take this insight into account when they develop their business strategies. For instance, Laine et al. (2010) describe the case of a machinery producer that moved from being a manufacturer to become a comprehensive system supplier. To attain this goal, the company internalized new tasks of their customer and supplier network, thus radically changing its business model. This change in the business model was supported by supply chain and technological innovations.

Companies should be aware of the fact that business models are not long-lived. Dell's description in this paper as a successful business model does not tell the whole story. Since 2006 Dell has lost much of its competitive advantage in the personal computer industry. Competitors such as HP have improved their performance considerably and have outpaced Dell. Dell's business concept, in particular its value proposition, is no longer a winning model. In the meantime, customer requirements have changed considerably, and computer technology is overshooting the needs of most customers. The advantage Dell once provided by offering the customizability option is no longer valued by customers. Now, customers pay more attention to design, a feature that Apple and HP did not neglect in contrast to Dell. Dell reacted to these changes, but late. Now, it sells computers through traditional distribution channels and attaches more importance to computer design, which brings a new set of challenges. Supply chain-driven business models, no matter how successful and robust they seem to be, can become obsolete when market conditions change. Will IKEA keep its leading position in the home furnishing industry in the future? Currently, IKEA is doing a good job, but nothing is sure. Could any researcher or industrial analyst have predicted Dell's difficulties fifteen years ago?

Constant innovation is crucial if a company is to stay successful. A lot of attention has been focused on product innovation but much less to supply chain and business model innovation. Notwithstanding the importance of product innovation, with this study we show that supply chain innovation provides powerful leverage to raise company performance and enable a company to remain successful in the marketplace. This study also contends that supply chain innovation also positively impacts business models. From a managerial perspective, this means that practitioners should embrace the idea that supply chain innovation is a source of competitive advantage. In particular, the operators identified in this study allow managers to better understand the relationships between supply chain innovation and business models.

8. Conclusions and Directions for Future Research

This paper bridges two streams of research and identifies the potential of supply chain innovation as a driving force behind the generation of new business models. We contribute to the existing literature in two fundamental ways. First, we identify the similarities between business models and supply chains. Second, we discover patterns that reflect the main impacts of innovation on the supply chain. These patterns are represented by the so-called operators, which specify how activities in the supply chain are eliminated, added, parallelized, inverted, relocated, divided, or accelerated. The practical implication of this study is that managers can use supply chain innovations to generate new business models. The reverse procedure is also true: managers can combine operators to create new business models without having to think through the details of supply chain innovation. Once the business model has been generated and agreed upon, the exact specification of the supply chain innovations can be defined. Thus, this paper sheds light on the importance of the new category of the business models driven by supply chain innovation.

In this study, however, we did not test the extent to which companies can support their business models by strategically integrating supply chain thinking. In our examples from the case studies and expert interviews, companies seem to primarily focus on their supply chains and not on their business models. In other words, companies are not making the business model a central element of their strategy. If companies are to *consciously* improve and innovate their business models by leveraging supply chain innovation, new methods and tools have to be developed. These new methods and tools should make use of the concept of operators to support companies in integrating supply chain thinking in business model innovation. Another challenge is that business model innovation driven by the supply chain calls for collaborative business model development (Rohrbeck et al., 2013) as the partner companies in the supply chain have to work together in developing new and mutually beneficial business models. Opportunistic behavior represents a serious limitation in the development of collaborative business models.

It is also important to note that the impact of supply chain innovation on the business model is moderated by contingent variables such as company size and industry. The data collected for this study did not permit the identification of the entire set of contingent variables. This is a major research limitation, and other contingent variables should be identified and studied. In a quantitative study the effects of the contingent variables could be estimated and the propositions formulated in this study tested.

As this study is exploratory in nature, it relies on case studies from secondary sources and on data generated from a limited number of expert interviews. While it clearly demonstrates that supply chain innovation drives new business models, it does not provide an exhaustive list of the business model types that can result from innovations and improvements in the supply chain. More research should be conducted in the future to discover new types of business models.

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Tables

Table 1: Basic types of supply chain innovation

Type of supply chain innovation	Concept	Examples
Supply chain concept innovation	Structural/configurational	Disintermediation, modularity, cross-docking etc.
	Operational	Vendor-managed inventory; collaborative planning, forecasting, and replenishment (CPFR); late customization; operations reversal; process standardization
	Revolutionary	Just-in-time (JIT), green supply chain, reverse logistics, resilient supply chains etc.
Technological innovation	Tracking and tracing	Bar codes; radio frequency and identification technology (RFID); global positioning systems (GPS); transportation management systems (TMS) etc.
	Information sharing and exchange/electronic order placement	Electronic data interchange (EDI), configuration systems, e-commerce etc.
	Material management and production planning and control	Warehouse management systems (WMS), material requirements planning (MRP II), advanced planning systems (APS) etc.
	Transportation and packaging systems	Containerization, aseptic packaging technology, refrigerated transports, double-stack car etc.

Table 2: Details of surveyed companies and supply chain innovation

Case	Industry	Size	Selected supply chain innovations
Company 1	Food	Large	<ul style="list-style-type: none"> • Integration forecasting and planning system • Vendor managed inventory (VMI) • Collaborative forecasting • On shelf availability
Company 2	Food	Large	<ul style="list-style-type: none"> • Distribution network redesign • JIT production and sourcing • Continuous replenishment program (CRP)
Company 3	Food	Large	<ul style="list-style-type: none"> • Outbound logistics insourcing
Company 4	Fashion	Medium	<ul style="list-style-type: none"> • Integration of forecasting and planning system • JIT sourcing • Consignment stock
Company 5	Furniture	Medium	<ul style="list-style-type: none"> • New ERP and VMI • Inbound logistics insourcing • Smart labels on packaging
Company 6	Fashion	Medium	<ul style="list-style-type: none"> • Consignment stock • SCM processes integration
Company 7	Aerospace	Large	<ul style="list-style-type: none"> • VMI solutions with customers in the area of spare parts • Lean management approach • IT systems and platforms for customers
Company 8	Online retail	Large	<ul style="list-style-type: none"> • Cross-docking • Connection of web user interface with scanners of articles • Order picking optimization and automation • Process standardization of inbound logistics
Company 9	Logistics	Large	<ul style="list-style-type: none"> • Integrated solutions for their B2B customers (3PL and 4PL logistics) • Value adding activities and delivery just-in-sequence for customers from the automotive industry • Late customization for electronic products
Company 10	Medical industry	Large	<ul style="list-style-type: none"> • Introduction of track and trace tool • Late customization and design for supply chains • Process segmentation and process automation in ship-to-order
Company 11	Groceries	Small	<ul style="list-style-type: none"> • Order picking software and logistics software for inbound logistics, facilitating same day delivery • Optimization of the order picking process
Company 12	Mechanical engineering	Large	<ul style="list-style-type: none"> • Web platforms with suppliers • Rationalization of the supplier basis

	and automation		<ul style="list-style-type: none"> • Diversification of suppliers with focus on Europe
Company 13	Aeronautics	Large	<ul style="list-style-type: none"> • Introduction of RFID technology • Process optimization along the value chain • Introduction of high rack storage areas
Company 14	Glasses	Small	<ul style="list-style-type: none"> • Barcodes in logistics for the identification of end products • Automation process in packaging and order picking • Lean management, process standardization and implementation of six sigma • Implementation of a new ERP system
Company 15	Construction	Medium	<ul style="list-style-type: none"> • Introduction of software in the area of logistics construction for the management of the construction site and for renting machines to customers • IT system for the coordination of transport vehicles to the construction site

Table 3: Statements from the expert interviews confirming the operators

Operator	Statements
Eliminate	<p>“In other cases, a supply chain innovation is associated with disintermediation; that is the elimination of an actor from the supply chain.”</p> <p>“We have a supply chain innovation each time the number of actors in the supply chain changes, the role of an actor changes, or an actor disappears.”</p> <p>“Dell introduced a supply chain innovation, since they redesigned the supply chain by eliminating an echelon.”</p> <p>“... all those cases of supply chain redesign that remove an actor from a supply chain ... or changes the way products reach the clients.”</p>
Add	<p>“Very often a supply chain innovation is associated with outsourcing decisions. Outsourcing results in new actors in the supply chain.”</p> <p>“New activities are introduced: every morning the company receives a report from the distribution centers that contains the level of available inventory for every product, received and fulfilled orders, and stock-outs.”</p> <p>“The company has <i>quick access</i> to more reliable information on product availability on the shelf. This is obtained by sharing a database with points of sales.</p>
Divide	<p>“We had to include in our supply chain a new kind of actor, which is the logistics service provider. Thus, the activities that were originally performed by one company were split between two actors.”</p>
Relocate	<p>“However, other changes are possible such as shifting activities to suppliers.”</p> <p>“...the company decided to redesign its distribution network by insourcing the logistics processes that were previously managed by an external supplier. To achieve this goal, a new company, with new warehouses was created.”</p> <p>“We shifted to our suppliers the responsibility of the management of some activities that were previously managed by us.”</p>
Accelerate	<p>“Supply chain innovation implies for the supply chain actors a new way of coordinating and exchanging information: new flows of information are available for the companies, and normally information reaches the company faster than before.”</p> <p>“Supply chain innovation is often associated with a higher frequency of information exchange.”</p> <p>“A new integrated planning system has been introduced: a new type of information is now available to the plants, and this system allows the fast exchange of information about forecast and plans between the headquarters and the plants, which are distributed all over the world.”</p> <p>“Prompt and more reliable information about sales promotions is now available to the company. This is obtained by means of frequent interaction (face-to-face) and data exchange with distributors.”</p> <p>“We will be able to give the suppliers real time visibility on our stock levels.”</p>
Invert	<p>There are no examples in the interviews, but the Benetton case of operations reversal shows that this operator is an important one.</p>
Parallelize	<p>No evidence</p>

