

## INNOVATION DIFFUSION IN THE SUPPLY CHAIN

Aleksandra Laskowska-Rutkowska\*

\* Faculty of Economics and Management, Department, Łazarski University, Świeradowska  
43, Warsaw, 02-662, Poland,  
Email: a.laskowska@lazarski.edu.pl

---

**Abstract** Professional literature has not devoted too much attention to innovation diffusion in the supply chain. Specificity of innovation in supply chains also lacks relevant classification. The aim of this paper is to fill this gap by suggesting classification of innovation adjusted to specificity of supply chains and to describe the model of innovation diffusion in the supply chain. In order to verify the model of innovation diffusion in the supply chain, the following research methods were used: literature research, case description and instrumental case study. These are qualitative methods, often applied in theories of management. There were presented two instrumental descriptions of cases, being an effect of literature research and four descriptions of cases, being based on descriptions of innovative solutions in the logistics, submitted to the Polish contest titled "Innovative Solutions for the Logistics" in 2011. The research hypothesis, which is the model of innovation diffusion in the supply chain, has only been partly validated. As a result, the model of innovation diffusion in the supply chain requires further research, with the aim of the confirmation or the falsification.

**Paper type: Research Paper**

**Published online:** 30 June 2015

Vol. 5, No. 3, pp. 287-297

ISSN 2083-4942 (Print)

ISSN 2083-4950 (Online)

© 2015 Poznan University of Technology. All rights reserved.

**Keywords:** *Innovation diffusion, model, supply chain*

---

## 1. INTRODUCTION

Numerous authors have long been noticing the significance of innovation in building the competitive advantage of the enterprise as well as the entire supply chain. Beside costs, quality and flexibility, innovations constitute the top priority of competitiveness of the supply chain (Roh, Hong & Park, 2008, p. 367). General improvement, in terms of competitive advantage, of the entire supply chain is mainly determined by innovation diffusion (Teece, 1980, pp. 464-470). However, leading logistic periodicals have not devoted too much attention to the wider comprehension of innovation (Grawe, 2009, p. 361). Even a view that in logistic studies innovations were largely ignored has been formulated (Flint, Larsson, Gammelgaard & Mentzer, 2005, pp. 114-147).

As a result, the scope of literature concerning the innovation diffusion in the supply chain is limited. The literature focusing on the innovation diffusion in the field of logistics focuses mainly on the diffusion of specific technologies (Gan, Clemens, Hui Kao & Xin, 2007, p. 78).

The authors examining the phenomenon of innovations in the supply chain concentrate mainly on the cooperative dimension of innovations and their contribution to the networks or supply chains. It is obviously a substantial matter, but also a mechanism of the diffusion of previously developed innovations in the supply chain of a given company is worthy of notice.

Advancing the hypothesis presenting the way of innovation diffusion in the supply chain accompanied by the model of the innovation diffusion in the supply chain as well as its partial verification based on the case description method is a purpose of this paper.

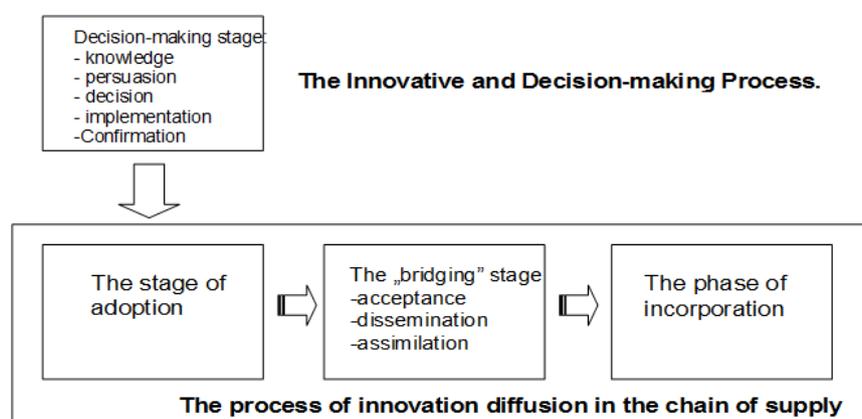
## 2. PROCESS OF INNOVATION DIFFUSION IN THE SUPPLY CHAIN

The notion "innovation diffusion" appears in the realm of literature approaching supply chains, however, there is a lack of the definition of "innovation diffusion in the supply chain" (Laskowska-Rutkowska, 2013, p. 148).

On the basis of the literature review, it is suggested that the innovation diffusion in the supply chain should be understood as the process of spreading innovation within the supply chain of one company leading in the field of the supply chain. There exists a distinction into an intrinsic innovation diffusion in the supply chain and a top-down managed innovation diffusion. The top-down managed innovation diffusion is intentional in its character, and it is the process controlled by the highest management level in the supply chain. The term "innovation diffusion in the supply chain top-down managed" integrates itself into the wider notion of "innovation diffusion in the supply chain" (Laskowska-Rutkowska, 2013, p. 148).

Transferring the views of such authors as E. Rogers, B. Hazen and others (Hazen, Overstreet, Cegielski, 2012, p. 122) onto the ground of the supply chain, it can be assumed that the entire process of innovation diffusion in the supply chain, including the innovation and decision-making process, consists of the following stages and phases:

- decision-making stage, including the phases of knowledge, persuasion, decision, implementation and confirmation;
- adoption of the innovation stage;
- "bridging" stage (after the adoption but before the incorporation), comprising approval, dissemination and assimilation;
- incorporation of the innovation stage (cf. Fig. 1)



**Fig. 1** The process of innovation diffusion; Source: author's own elaboration

These above mentioned notions are understood as follows:

- approval – the degree of employees' support in new solutions;
- dissemination – implementing solutions supporting the adoption of innovation into the supply chain;
- assimilation – the degree, to which exploiting the innovation diffuses among organizational processes and activities associated with these processes;
- incorporation – the final phase of innovation diffusion, when the innovation is incorporated in the supply chain to an extent allowing to achieve anticipated benefits from the innovation.

### 3. CLASSIFICATION OF INNOVATION IN THE SUPPLY CHAIN

D. Gilmore, the Publisher and editor-in-chief of Supply Chain Digest, was working for about one year to collect ten greatest innovations in the history of the

supply chain. Gilmore understands the notion: "leading innovations in the supply chain" as "a certain innovation, as to which we have certainty, who or which company was responsible for the breakthrough, and such an innovation, which had a deep and long-lasting influence on the supply chain practice". This list includes the following innovations: Toyota Production System (TPS), Continuous Replenishment System, IBM software ordered by P&G, standardized steel container for transporting goods by the sea route, Economic Order Quantity, the assembly line of Ford, Universal Product Code (UPC), FedEx system of tracking shipments, Distribution Requirements Planning, Load Control Centre of 3M (LCC), and Taylorism (Gilmore, 2010, pp. 8-11). Innovations enlisted by Gilmore underwent the diffusion in supply chains of many companies. The diffusion of the concept of Toyota Production System - constituting the innovation of the business model – meant also the innovation of processes, operations and resources. The innovation diffusion of the resource, which was the standardized container, also indicated the innovation of operations and processes for supply chains adapting it.

One should conclude from the aforementioned that the traditional "sharp" division of object innovations, in line with which the innovation can concern the product, service or process, does not support capturing the dynamics of innovation diffusion, hence not reflecting the phenomenon of innovation diffusion in supply chains. The innovation diffusion in the supply chain can thus include the level of resources, operations and processes, and the business model. It is dependent on the degree of innovation's assimilation, thus if it is "deep innovation diffusion", the introduction of innovative resources, operations and processes will translate into an innovative business model of the entire supply chain.

#### **4. MODEL OF INNOVATION DIFFUSION IN THE SUPPLY CHAIN**

The model of innovation diffusion in the supply chain is an attempt made by the author of a dynamic approach towards illustrating the innovation and its manner of diffusion in the supply chain (Laskowska-Rutkowska., 2013, pp. 219-273).

Based on the conducted review of literature, the author made an assumption that innovations in the supply chain can manifest themselves on the following levels:

- mental (e.g. turning from perceiving separate logistic functions into the comprehensive perception – the supply chain, the concept of Toyota Production System);
- business model (e.g. Dell direct supply model);
- processes (e.g. completion of an order, adding value for the customer);
- operations (e.g. cross-docking centre);
- resources (human resources, information technology).

A significant role is attributed to the psychological dimension of innovation diffusion. A decision to undertake actions aiming at implementing the innovation is

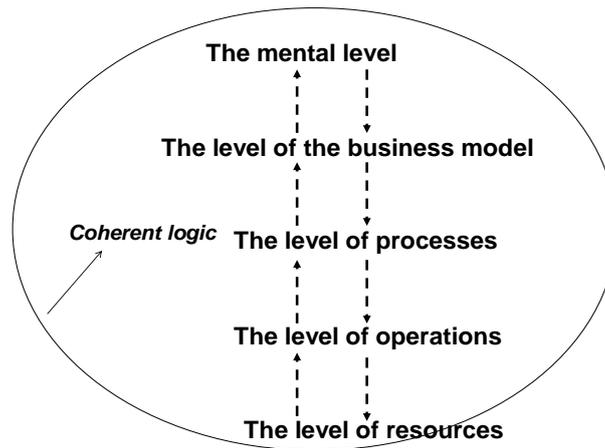
preceded by many considerations. According to E. Rogers the phase of knowledge, persuasion and decision precedes the phase of the implementation of innovation (Rogers, 2003). It is the "invisible" dimension of innovation diffusion. Therefore, important processes take place on the mental level: in the awareness of people responsible for making a decision on innovation diffusion. In this way certain concepts of effects an innovation is supposed to bring for the supply chain of a company arise. These are the mental models constituting the way of perceiving the reality. They describe relations between individual parts, the structures joining individual elements and the way of their mutual interaction (Dubberly, 2009, p.1). They themselves do not take the material form. A change on the mental model level takes results – as a rule ( which exceptions) – in coming into existence of the new business model. "The new business model constitutes the manner of the company's operation. The value for the customer and the logic the enterprise's operation are the core of the business model" (Gołębiowski, Dudzik & Witek-Hajduk, 2008, p. 17). The new business model requires working out new processes. As a result of new solutions within logistic processes, also innovations on the level of operations appear. The level of operations indicates everyday operations of the company in the area of the logistics, transforming resources "on the entry" into resources "on the exit". It consequently requires innovative resources (Bozarth & Handfield, 2008, p.5).

Certain concepts from the area of the strategic management consider the enterprise to be the bundle of resources (Janasz,2009, p.34). The resources are, for example, information technologies or employees. The described path of innovation diffusion descends from the highest to the lowest category of innovation in the supply chain, and from the highest to the lowest management level in the supply chain, and it takes place when innovation diffusion in the supply chain is a top-down managed process. Then the innovation diffusion in the supply chain has a proactive character, serving the spreading or acquiring knowledge, experience and objects. This operation is intentional and directed at the accomplishment of the aim. It is the process which could be managed in a planned way. Participants in the process of innovation diffusion should be involved in the process from very beginning until the very end.

Figure 2 illustrates the proposal of the model of innovation diffusion in the supply chain. The model takes into account management levels of supply chain affected by the innovations. Dotted lines of arrows indicate the direction of the innovation diffusion.

The innovation does not have to go through all the stages mentioned in the model (on that account the arrows in the figure are dotted lines). An example of such a situation is the appearance of Economic Order Quantity formula, when the innovative mental model finds its material reflection in the process (of placing orders). Innovations can also diffuse in the opposite direction, namely from the lowest to the highest level of management ("from bottom to top"). Then innovative resources, e.g. innovative solutions in the area of the information technologies, will lead to the innovation on the level of operations. These in turn will influence the alteration of processes. New processes enable to create innovative business

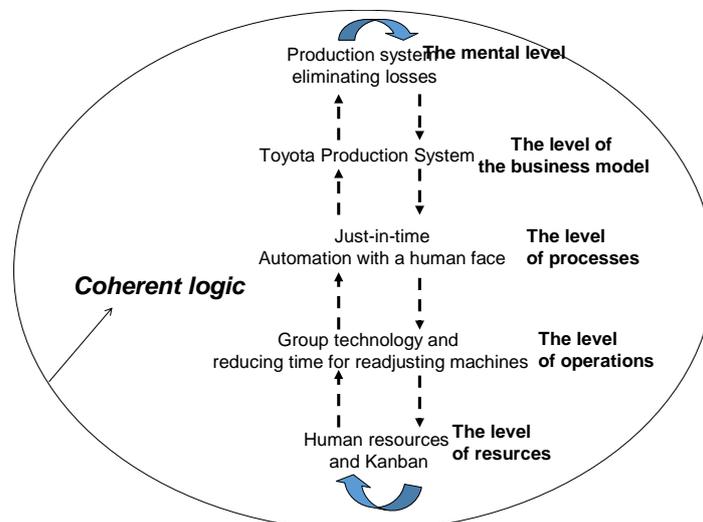
models. A result of all above mentioned can be a change in the way of perceiving the surrounding reality, thus a new mental model. Both directions "from top to bottom", as well as "from bottom to top" are feasible. Under favourable conditions, i.e. cohesive business logic, an innovative resource can eventually lead to the emergence of an innovative business model and the change of the mental model.



**Fig. 2** The model of innovation diffusion in the supply chain demonstrating the flow of innovation "from top to bottom" and "from bottom to top", Source: Laskowska-Rutkowska, 2013, p. 226

When the binder, in the form of cohesive logic, does not appear, then the process of the innovation diffusion will stop at one of stages or at the starting point.

Figure 3 demonstrates the application of the model of innovation diffusion in the supply chain in Toyota Production System (TPS). TPS came into existence as the effect of the top-down managed innovation diffusion. Simultaneously TPS is a kind of "perpetual motion machine" because "innovative human resources" (i.e. Toyota employees) still propose new ideas, what leads to constant streamlining and an increase in the innovativeness of the entire system as well as minor diffusions bettering the system of innovation. This phenomenon is illustrated in Figure 3. In the picture, two block arrows were added at the top and at the bottom of the model. The arrow at the bottom of the model illustrates the innovative impulse, deriving its source from streamlining conclusions suggested by employees. (The innovative impulse and the innovation diffusion do not have to go through the operations level, the system level or the business model level- therefore dotted arrows were used). When the innovative impulse reaches the awareness of managers, their way of perceiving the reality changes. It causes changes on the mental level and the flow of innovation from top to bottom. Since it is possible only when cohesive logic exists in the company, this factor was taken into consideration in the figure.



**Fig. 3** The model of innovation diffusion – the example of Toyota Production System, Source: author's own elaboration

## 5. METHODOLOGY USED FOR THE VERIFICATION OF THE MODEL OF INNOVATION DIFFUSION IN THE SUPPLY CHAIN

The method of case description was used for the verification. The aim of this descriptive research method is the arrangement of collected information and a transparent presentation of materials and effects of previous research (Błachnia, 2007, p.122). Based on the research of individual cases, a general conclusion referring to the correctness of the verified model was formulated.

The verification of the model was divided into two parts. In first part, ex post analysis based on the detailed description of two cases of companies was conducted. These two cases were widely discussed in the literature on the subject. These were production units of the Toyota company and a network of the Iditex Zara textile corporation. Both companies are well-known in literature as leaders in managing the supply chain.

In the first part an instrumental description of the case was applied as the research method. The case is treated instrumentally so that it is possible to understand other problems (Konecki, 2000, p.127). It is of secondary importance as its aim is to help understand something superior and going far beyond the case itself. In the situation of using the instrumental case study - one profound analysis is applicable. Since the description of the case does not constitute such an in-depth analysis as the case study, two descriptions similar to one another were used. Alt-

though these are descriptions of companies operating in different industries, both cases concern the innovation diffusion in the supply chain featured as running "from top to bottom", top-down managed and being an effect of the transfer of innovation. Moreover, in case of Zara, it is exactly Toyota being one of the sources of the transfer of innovation. Therefore, it is possible to regard the problem appearing in both descriptions to be similar. In this way the opportunity of observation of the same phenomenon (innovation diffusion) from two different perspectives (the supply chain of Toyota and the supply chain of Zara) was provided. The description of these cases provided the possibility of profound access into the way of the innovation diffusion inside supply chains of the described companies. It is an example of *ex post* analysis as primary waves of innovation had already rolled through supply chains of the described companies and led to substantial changes.

In the second part, *ex-ante* analysis was conducted. A case description, much less detailed than the instrumental description of the case was applied as a research method. Its subject is current innovative solutions used in the logistic business, drawn up and put forward by four different companies to the annual Polish competition "Innovative Product for the Logistics" in 2011. They were assessed as most innovative of 46 applications. At present it is not known whether and how these innovations will be applied in supply chains of companies adopting these solutions. These solutions were not described in the literature on the subject. They were chosen due to their innovative potential.

In this case the innovation model of supply chain serves as the predictive tool.

Out of 46 survey applications, the author chose those which met the following criteria of choice:

- they obtained the highest total evaluation;
- they gained the high evaluation in the following areas: technological innovativeness, market innovativeness, benefits for implementer, positive environmental interaction;
- as a result of the above mentioned, they provided solutions of huge diffusion potential.

The subjects of descriptions were the following:

- AX4 Open Logistic Platform of the AXIT company (distinction in the "Innovative Product for Logistics 2011" competition). The platform enables clients to independently create and manage logistic processes entailing different companies;
- C3SB collapsible transport box and the double car rack of the DHL Global Forwarding company – a solution for the automotive industry;
- Mobileye System of the Mobileye Vision Technologies company – the only in the world one-camera system that warns the driver against the majority of dangers on the way;
- Automatic Truck Loading System (ATLS) of Ancra Systems company.

## **6. FINAL CONCLUSIONS OF THE VERIFICATION OF THE MODEL OF INNOVATION DIFFUSION IN THE SUPPLY CHAIN**

Verification of the model of innovation diffusion in the supply chain with the use of case description method led the author to specific conclusions, relating to functions the model can fulfil and restrictions resulting from the character and the range of conducted research.

- The model of the innovation diffusion in the supply chain allows to capture certain regularities concerning the way innovation waves diffuse in supply chains;
- Owing to a conceptual apparatus, it is possible to conduct the recurrent procedure in ex post and ex ante situations concerning the analysis of innovation diffusion (after determining the criteria of choice of the research attempt, defining problem and research questions, the analysis of accessible materials, one should determine the level, on which the innovation "targets" the supply chain. The analysis of the way the innovation is diffusing in the supply chain had or will have to cover, in the ex post or ex ante situations, should be the next step).
- The mental model existing in a given company or an industry (in the model of innovation diffusion in the supply chain it is the mental level) is of great significance. In case of the systemic top-down managed innovation, it constitutes a starting point for the innovation diffusion. In case of not the top-down managed and not the systemic innovation, mental models have a decisive part in the diffusion of innovation or ceasing the diffusion. If the innovation becomes part of a functioning mental model, and if it is supported by the company management, the plausibility of the innovation diffusion in the supply chain is much greater.
- The conducted research can lead to the conclusion that the innovation diffusion can in some supply chains have a permanent character. Solutions resulting in a constant implementation of new ideas are possible. If these improvements have operating character, they do not require consultation with the higher level of management – they occur automatically. When improvements concern changes of tactical or even strategic character, the higher level of management's approval is required. In this way they have an influence on a mental model; they can lead to its changes and to innovation diffusion of the systemic character.
- The model does not refer to the transfer of innovation between different supply chains. In order to understand the entire process of the diffusion of innovation waves in the supply chain (especially in case of the systemic top-down managed innovation), one should consider the processes forming mental models in the company leading in the supply chain, thus the mental models causing the appearance of innovation on the business model level. Hence, seeking similar solutions in other sectors and their supply chains is required.

- The conducted research indicates the need of modification of preliminary model assumptions, taking into account primary and secondary waves of innovation or permanent innovation diffusion. It allows to think that in the course of further research a need of implementing other alterations will appear. However, general logic applied in the model works well.
- The verification of the model was conducted based on the method of case description. The research hypothesis, which is the model of innovation diffusion in the supply chain, has only been partly validated. As a result, the model of innovation diffusion in the supply chain requires further research, with the aim of the confirmation or the falsification. In order to be certain about the usefulness and rightness of the proposed solution, it is advisable to conduct research verifying the model of innovation diffusion in the supply chain.

## REFERENCES

- Błachnia K., 2007, Strategie badań empirycznych, Kuciński K. (Ed.), Doktoranci o metodologii nauk ekonomicznych, SGH w Warszawie.
- Bozarth C.C. & Handfield R.B., 2008, Introduction to operations and supply chain management, Pearson International Edition.
- Dubberly H., 2009, Models of models, Interactions Magazine, March 1.
- Flint D.J., Larsson E., Gammelgaard B. & Mentzer J.T., 2005, Logistics Innovation: a customer value-oriented social process, Journal of Business Logistics, Vol. 26, No 1, pp. 114-47.
- Gan Ch., Clemens M., Hui Kao T., Xin Vivian, 2007, Innovation diffusion with the supply chain: the Chinese apparel firms in Shenzhen, Innovative Marketing, Vol. 3, Issue 3.
- Gilmore D., 2010, The top 10 supply chain innovations of all-time, Supply Chain Digest, Dec. 3, pp. 8-11.
- Gołębiowski T. & Dudzik T.M., Witek-Hajduk M., Lewandowska M. (ed.), 2008, Modele biznesu polskich przedsiębiorstw, SGH w Warszawie.
- Grawe S.J., 2009, Logistics innovation: a literature-based conceptual framework, The International Journal of Logistics Management, Vol. 20 No 3.
- Hazen B., Overstreet R.E. & Cegielski C.G., 2012, Supply chain innovation diffusion: going beyond adoption, The International Journal of Logistics Management, Vol. 23, No 1.
- Janasz W. (ed.) ,2009, Innowacje w strategii rozwoju organizacji w Unii Europejskiej, Difin, Warszawa.
- Konecki K., 2000, Studia z metodologii badań jakościowych. Teoria ugruntowana, PWN, Warszawa, p. 127
- Laskowska-Rutkowska A., 2013, Falowa koncepcja rozwoju logistyki. Dyfuzja innowacji w łańcuchu dostaw, PTE, Oddział w Szczecinie.
- Roh J.J., Hong P., Park Y., 2008, Organizational culture and supply chain strategy: a framework for effective information flows, Journal of Enterprise Information Management, Vol. 21, No 4
- Rogers E., 2003, Difusion of innovations, Free Press, New York.
- Teece D.J., 1980, The diffusion of administrative innovation, Management Science, 26(5), pp. 464-470.

**BIOGRAPHICAL NOTES**

**Aleksandra Laskowska-Rutkowska** is professor at Lazarski University. She teaches logistics. Her main scientific interests are: supply chain management, innovation in supply chain, and operations management. She is the author of around 50 publications on logistics, and innovation in logistics and supply chain. She is director of Logistics and Innovation Centre at Lazarski University.

