A new approach to innovation for logistics service providers based on inventive analogies

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Abstract

Logistics service providers (LSPs), especially small and medium sized companies, need to increase their innovative output to improve their competitive position. A promising approach to foster their innovativeness seems to be the application of inventive analogies – transferring solutions from other industries or from nature. The benefits of this method have already been proven for the development of physical products: increased creativity as well as efficiency effects. The aim of this paper is to transfer this innovation method to the needs of LSPs. Therefore, interviews are conducted to identify current problem fields of LSPs and a framework for the application of inventive analogies in the context of LSPs is derived.

Keywords

Service innovation, logistics, inventive analogy, bionics

1 Introduction

Innovations are drivers of economic growth and company success [Schumpeter 1934]. Today's fast changing environments force companies to continually innovate in order to remain competitive. This coherence is also applicable to logistics service providers (LSPs). The launch of new services offers additional revenue streams and can constitute a unique selling point to the customer. Innovations leading to improved processes are valuable contributions to cost savings as well as increased quality. However, the innovative output of the logistics service industry is rather low. If money is spent on innovation projects, these usually aim at improving technological infrastructure and equipment, as for example investments in logistics parks or new fleets [Wagner 2008].

Logistics service innovations are often developed as a reaction to new and unique customer requirements. Thereby LSPs usually develop innovations under high time pressure. Furthermore, they rarely apply supporting methods of innovation management [Busse and Wallenburg 2011; Wagner and Franklin 2008]. This results in a narrow perspective in the idea generation and concept development stage. However, idea and concept generation are crucial for the success of any innovation project. General requirements for implementation and market launch are set in this front end stage of innovation. Well thought-out ideas and concepts increase the possibility of a successful market introduction and contribute to the reduction of development costs [Khurana and Rosenthal 1998; Kim and Wilemon 2002].

A promising method for successful idea and concept development is the application of inventive analogies. The use of an inventive analogy consists of a knowledge transfer between different domains (e.g. between industries or from nature) in order to creatively solve problems [Hargadon 2003; Kalogerakis et al. 2010]. The application of inventive analogies can increase the creativity of newly developed product concepts [Bonnardel and Marmèche 2004; Dahl and Moreau 2002] and has a high potential for market success. As solutions are used that have already been effectively applied in other areas the risk of an economic failure is significantly reduced [Kalogerakis et al. 2010; Enkel and Gassmann 2010].

This paper aims at adapting the use of inventive analogies to the needs of LSPs. By transferring this promising methodological approach from the front end of new product development to service innovation in logistics, this paper presents a new way for LSPs to overcome their innovation deficit. As LSPs usually suffer from small innovation budgets as well as a lack of established innovation routines, quick and easy applicability of inventive analogies is a particular focus of the methodological concept. Furthermore, in order to ensure the relevance for LSPs, interviews were held to identify problem fields that especially small and medium sized LSPs face.

In section two of this paper, characteristics of innovation management in logistics are outlined and the method of inventive analogies is further explained. Section three shows the research approach. It is described how qualitative data from interviews is collected and further processed. In section four typical sectors of logistical problems are identified and analogue areas for these problems are discussed. A new framework for the front end of innovation processes at LSPs is introduced. The paper concludes with a discussion of the results and an outline for future research.

2 Relation to Existing Theories and Work

2.1 Innovation management at logistics service providers

LSPs manage a wide range of logistical services, including transportation and warehousing, but also shipment consolidation, customs and other services. Due to an increasing trend towards outsourcing and globalized supply chains the logistics industry is rapidly growing [Anderson et al. 2011; Ellinger et al. 2008]. Innovations provide LSPs an opportunity to strengthen their competitive position. Furthermore, empirical results indicate that an important customer segment includes the innovativeness of LSPs in their logistics outsourcing decisions [Anderson et al. 2011].

Innovations are not limited to technological improvements and physical products, but also include the development of services and processes. Most concepts of innovation management stem from general product innovation. Services, however, have special characteristics which hamper a direct transfer of the innovation management approaches for physical products [De Brentani 1989; Heskett 1986]. Services are intangible and cannot be held in stock. Their production usually requires the participation of the client and the actual performance of a logistics service occurs during the process of its consumption [Gallouj 2002; Gallouj and Weinstein 1997; Cowell 1988]. As success drivers of innovation management in services are similar to those of physical products [Cooper and de Brentani 1991], in some aspects, a product-oriented view to services can be considered conducive. However, the innovation process of service providers has specific features concerning content and activities within the specific stages as well as concerning processing time that differ from classical innovation management [Hipp and Herstatt 2006].

New service developments of LSPs are mainly reactions to single customer requests [Kersten et al. 2010; Oke 2008]. Such reactive innovations are more difficult to manage than proactive innovations, because they occur under an enormous time pressure [Oke 2008]. Moreover, using this approach, the development of standardized solutions is difficult. Usually, a great additional development effort is required to offer such individualized innovations to other customers. Altogether this reactive innovation behaviour is not cost-effective and often only minor improvements are generated which are strongly based on industry trends [Wagner and Franklin 2008]. Furthermore, to ensure their competitiveness and to fulfil customer demands with limited resources of time and money, LSPs often pursue an imitation strategy. However, these imitating companies are less successful than companies that are launching innovations as pioneers [Langerak and Hultink 2008; Naranjo-Valencia et al. 2011; Zheng Zhou 2006].

Approaches of traditional innovation management can be useful in the idea and concept development stage of service innovations, but due to a lack of knowledge barely any are used by LSPs [Klement 2007]. In general, improvements in the innovation management of LSPs would be advantageous. A well structured and systematic approach that is supported by appropriate methods is needed [Klement 2007; Wagner and Busse 2008]. A focus on the idea and concept development stage of LSPs is very promising, because the front end of innovation is crucial for the whole innovation process [Kim and Wilemon 2002; Khurana and Rosenthal 1998]. A general and easily applicable method that meets the special needs of LSPs at the front end of innovation has a great potential for improving the innovative output of LSPs.

2.2 Application of Analogies

Based on a resource perspective that reaches back to the ideas of Schumpeter [1934], even radical innovations are to a large extent a recombination of existing knowledge. Accessing knowledge from different domains and combining already established solutions in new ways is a powerful way to innovation [Koestler 1964; Weisberg 1993; Hargadon 2002].

The transfer of knowledge from one context to another can be fostered by the use of far inventive analogies. In the process of an inventive analogical transfer existing solution elements from a familiar conceptual domain (the base) are used to solve a given problem or engineering challenge at hand (the target). Innovation occurs as, by analogical transfer, disparate pieces of knowledge are blended in a novel way [Gick and Holyoak 1980; Holyoak and Morrison 2005; Ward 1998; Kalogerakis et al. 2010]. Based on analogical thinking knowledge can be transferred flexibly between different contexts.

The use of inventive analogies is not a new phenomenon. For example, the innovation of mass production in the automobile industry by Ford is based on several inventive analogies. By combining technologies that were already well-known in other industries, he developed a system that revolutionized automobile manufacturing. To create his new production system Ford transferred knowledge from granaries, breweries, foundries, bicycles, canning, and meatpacking [Hargadon 2002; Hargadon 2003].

In cognitive psychology the process of analogical thinking as well as its results have been studied intensively [Gentner 1989; Holyoak et al. 2001; Holyoak and Morrison 2005]. Concerning the process of analogical reasoning usually three activities are distinguished:

1. Retrieval - knowledge from an analogous source area has to be accessed.
2. Mapping - elements of the source are mapped onto elements of the target.
3. Transfer - knowledge is transferred from the source to the target of the analogy.

After this process of analogical thinking, learning can occur if general solution schemata are developed.

Analyzing the results of inventive analogies, different types of analogies are distinguished concerning the conceptual distance between its source and target. Near analogies are differentiated from far analogies. An analogy is defined as near, if source and target of the analogy belong to the same domain. By contrast, the source and target of a far analogy belong to different domains [Gick and Holyoak 1980; Perkins 1997; Reeves and Weisberg 1994; Ward 1998]. To transfer, for example, the process of freeze-drying peas to some kind of fruits would be an example of a near inventive analogy while the transfer of this process to a method of blood preservation would constitute a far inventive analogy.

In product development, far inventive analogies can be either based on knowledge from other product categories or from nature. An example of a “cross-industry innovation” is the development of an innovative sewing machine that regulates its speed depending on the used

fabric. To achieve this innovation, technologies of an optical computer mouse were transferred [Enkel and Gassmann 2010]. An example of a bionic innovation (a solution transfer from nature) is the ant colony optimization algorithm that can be used to solve the travelling salesman problem. While searching for food sources, ants mark their way by pheromones. Following strongly scented paths leads to a heuristic approach in finding shortest ways to new food sources [Dorigo et al. 1996].

Psychological research results as well as experimental and explorative studies in the context of new product design indicate that far analogies have a higher creative potential than near analogies. Near analogies tend to preserve the status quo whereas far analogies have a greater potential of transforming existing paradigms and are therefore better suitable for exceptional creativity [Perkins 1997; Ward 1998; Dahl and Moreau 2002; Kalogerakis et al. 2010].

As an inventive analogical transfer involves the reuse of already existing knowledge, it is likely to reduce the overall development effort. Transferring solution elements between domains can increase project efficiency resulting in lower development costs or shorter development time [Majchrzak et al. 2004; Kalogerakis et al. 2010]. Furthermore it can be expected that the transfer of solution elements based on inventive analogies also contributes to a reduction of innovation risks, because it encompasses the application of already well known and tested solutions.

Based on empirical evidence, it can be assumed that industrial design and engineering companies that offer innovation services to clients from diverse industries often use far inventive analogies [Hargadon 2002; Hargadon 2003; Kalogerakis et al. 2010; Lüthje et al. 2010]. In these companies inventive analogies are usually applied spontaneously and unsystematically. Due to efficiency effects they are often based on knowledge that is already available within the development team [Kalogerakis et al. 2010]. However, companies that do not routinely work in different industries and contexts are likely to miss valuable far inventive analogies if they do not use a systematic approach.

3 Research Approach

In order to provide a new approach to innovation for LSPs the research is conducted in two stages: first a qualitative empirical investigation to identify problem fields; second a conceptual design of an innovation method for LSPs based on inventive analogies.

A qualitative investigation was chosen to identify innovation needs, because there were no previous research results available that analyze problem fields of LSPs. The interviews were addressed to the higher management of small and medium-sized LSPs and to managers of innovation projects in large logistics companies. The semi-structured interviews were held either personally or via telephone and lasted between 30 minutes and 60 minutes.

After a short introductory part, questions about practices of innovation management in the company and future innovation needs were asked. The introductory questions dealt with logistics services which are offered by the company. Following, to assess the current status of innovation management in the company, questions were asked about the implementation of continuous improvement processes as well as about innovations in the core business of the LSPs. The following main part of the interview about future innovation needs was divided into five topics: The need to improve (1) the quality of services, (2) the transportation process, (3) the handling of goods, (4) warehousing and (5) customer relationship management. The interview ended with questions about the main challenges for LSPs in the next three years and in a long-term period (10 – 20 years).

After seven interviews about possible future innovation needs for LSPs theoretical saturation was reached [Corbin and Strauss 2008; Charmaz 2006; Goulding 2002; Patton 2001]. Based on the collected answers, additional interviews seemed unlikely to provide further information to the

object of research. These seven interviews are close to the number of needed samples which is recommended by McCracken [1988]. The obtained results are only qualitative and do not claim any statistical significance.

The results of the interviews are the basis for the conceptual design of an innovation method for LSPs. In order to use the results to detect inventive analogies, their content needs further processing. First, the interviews are analysed to identify logistical problems. In a second step, these problems are clustered and abstracted to improve the ability to find inventive analogies. Figure 1 shows a structured approach to apply inventive analogies that can solve current problems of LSPs.

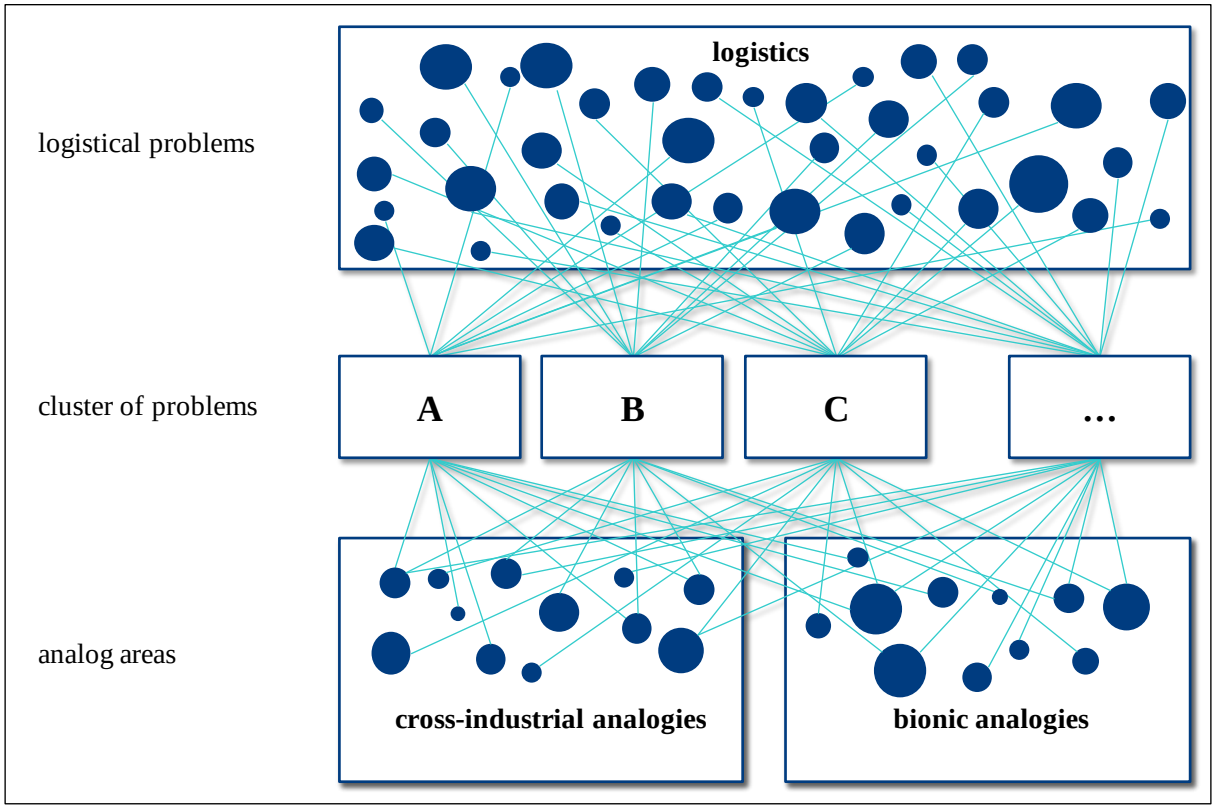

Figure 1: Network of analogies for logistics problems

4 Findings

The results of the interviews support the expected deficit of innovation management at LSPs. Although several companies have well established routines for continuous improvement processes a formal innovation management, so far, has not been implemented at any one of the interviewed companies. Real innovations, if they occur, are usually a reaction to current customer requests. However, one of the interviewed managers stated, that her company is right now in the process of establishing formal innovation processes.

An interesting finding of the interviews is that analogies are already used at LSPs to create innovations for their customers. Yet the application of inventive analogies at these companies is not structured and rather spontaneous. One interviewee for example responded to the question about the sources of innovations at his company: “I must confess that I am a thief. When I walk around, I steal with my eyes and ears. […] Thus I already use analogies!”[1] An interviewee of another company could provide one example of a near and one of a far analogy that led to

[1] Interviews were conducted in the native language of the interviewee and are translated into English by the authors

innovative services for their customers. As they globally sell small standard parts for assembly of all kinds of products, many customers expect just in time delivery. In order to provide these customers with a more exact delivery time, they implemented a track and trace system which they knew from one of the world's largest online retailers. This example can be categorized as a near analogy. The far inventive analogy was based on a knowledge transfer from medical surgery. In order to ensure efficient surgery processes surgical instruments are prepared as special sets in advance. An analogy was detected to the problems some of their customers face at offside assembly. Therefore they introduced a new product of assembly sets that are individually composed for the special requirements of offside assembly at objects with difficult access.

More than sixty logistics problems could be identified during the interviews. To summarize these abundant data the problems were aggregated and clustered. All problems could be assigned to the following ten superordinate terms:

- Process monitoring
- Resource scheduling/disposition
- Transportation process
- Transport unit
- Packaging and picking
- Interface problems
- Ecological improvements
- Customer Relationship Management
- New Service Concepts
- Finances

For example "interface problems" were often described by the interviewees in different contexts. The term summarizes problems that occur by manual transfer of a current delivery status from one system to another, but also inconsistencies in delivery notes and freight documents.

In the area of resource scheduling and disposition two interviewees criticized the regulative restrictions of drivers' working hours which are in a conflict to flexible delivery options. Other interviewees reported in this context about problems occurring at the last mile especially in inner city logistics, optimizing the degree of capability utilization of trucks or avoiding empty tours.

To find inventive analogies based on the identified problems of LSPs a framework is needed. As the core competence of most of the interviewed companies is road transportation, the base domain of analogy search is defined to services of truck transports – including all the superordinate concepts listed above. The first decision in the process of finding analogies is between a search for near and far analogies. As displayed in Figure 2, near analogies can be found in other transportation domains or other areas of logistics. For example, if a logistics services problem exists in the road transport of chemical products a near analogy might be found in solutions for railroad or air transportation. Another search field for near analogies could be, for example, road transportation for consumer or electronic goods. A technical example of the application of a near analogy is the well-known anti-lock breaking system (ABS) for trucks. Originally it was invented for aircrafts by Gabriel Voisin in 1920 [Aviation History 1953]. Sixty years later Mercedes-Benz transferred this principle to the pneumatic brakes of trucks.

If the aim of innovation is to find solutions with a high degree of newness, far inventive analogies should be considered. As mentioned before, far analogies can be classified into analogies from other product categories or analogies from nature. For this framework other product categories are defined as other business sections which can be either service based (e.g. tourism and banking) or industry based (e.g. mechanical engineering and consumer goods). Analogies from nature can be further categorized as either organizational bionics or technical bionics. An example of an analogy stemming from organizational bionics is the already

mentioned ant colony optimization algorithm which can be used for scheduling and vehicle routing problems in logistics.

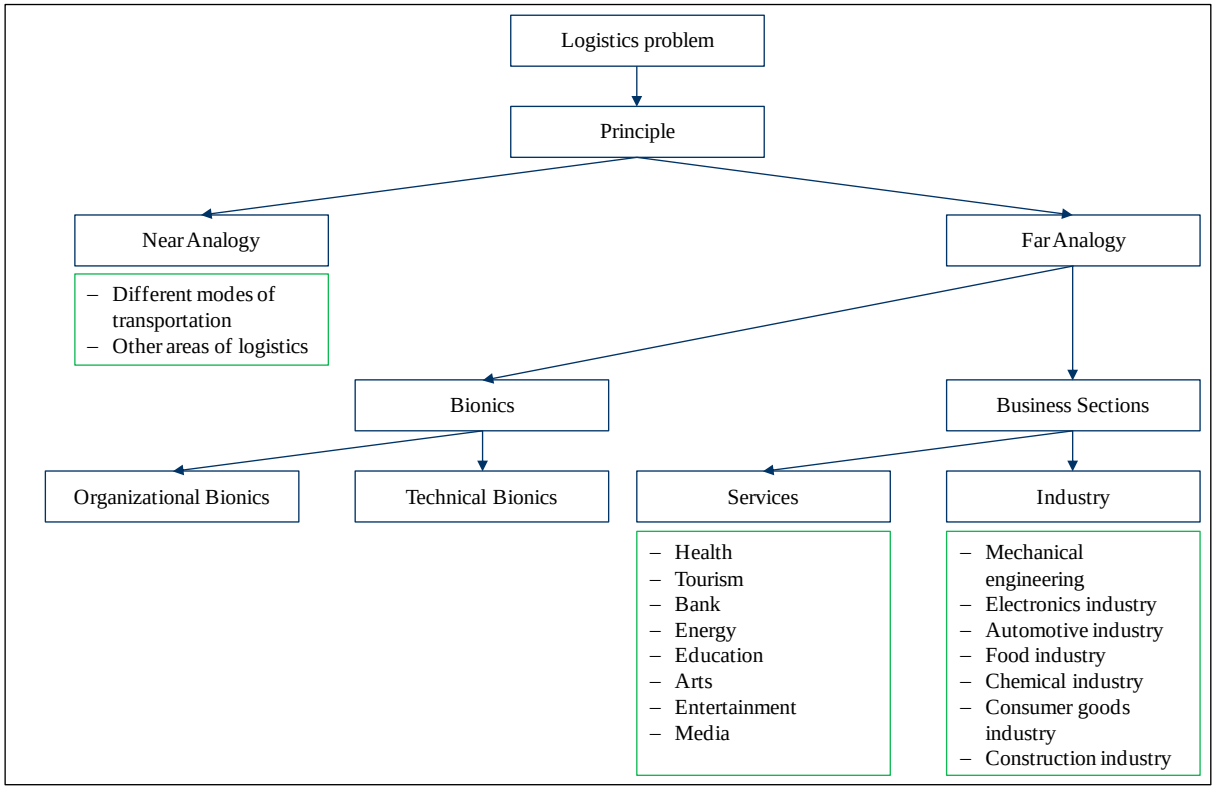

Figure 2: Analogy tree

In order to find inventive analogies an abstraction of the logistics problems is needed. Therefore, in the next step, both the superordinate concept and the linked problems are abstracted. To stay with the beginning example of "interface problems" more abstracted terms can be: multiple entries, information exchange, lack of knowledge, documentation and identification. Those terms are based on the initially identified problems out of the interviews. A good example which illustrates the abstracted terms in the category interface problems is the inconsistency of delivery notes and freight documents. Due to inconsistent delivery notes and freight documents multiple entries are often needed. Delivery notes are made for information exchange, but drivers often make mistakes, because of lacking knowledge. Thus an identification of the delivery fails.

This step needs to be repeated with the other superordinate concepts and logistical problems. Afterwards, inventive analogies can be found by following the different junctions of the analogy tree (Figure 2) and searching with the identified abstracted terms in suitable domains. The last step of this new approach for LSPs to get to more radical innovations is the transfer of the identified analogue solutions from the source to the target area of innovation. LSPs can use this simple but effective draft of a framework as a guide to find inventive analogies. It thereby supports them to leave traditional paths of thinking and to reach more innovative solutions for their problems.

5 Conclusion

Logistics service providers seem to need methodological support in order to increase their innovative output. The use of inventive analogies is a powerful way to reach very innovative solutions with limited internal resources and moderate risks. Findings of the interviews indicate that LSPs already apply inventive analogies occasionally. However, they are lacking a structured way to find them.

The framework outlined in this paper tries to adapt the general method of inventive analogies to the special needs of LSPs. It should help them not only to find near analogies, but furthermore to develop radical innovations by using far analogies.

By collecting general logistical problems, finding superordinate concepts for them, abstracting these and linking them to analogue problem fields, a network of analogies for LSPs is established. This conceptual framework should enable LSPs to apply inventive analogies more systematically, faster and with fewer resources than before. So far, this is only a conceptual approach even though its generation was grounded in empirical data analysis. However, the aim of the research project is to provide LSPs with a tool that empowers them in using inventive analogies routinely. A further developed network of logistics analogies should aid LSPs with their current problems by guiding them to inventive analogies and facilitate their innovation processes.

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