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THE EVOLUTION OF THE PACKAGING LOGISTICS RESEARCH AREA

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ABSTRACT

Logistics can be regarded as an established research area containing publications in renowned scientific journals and which covers several related fields. One of them, packaging logistics, is a relatively new research area, established at only a few universities and institutes. Consequently, the packaging logistics area is characterised by scattered theoretical frameworks and publications are scarce. Theory in packaging logistics is often delimited to packaging, focusing either on technological aspects e.g. packaging features, or on marketing aspects, e.g. branding. The holistic view of packaging logistics related to overall business systems is however, neither covered by researchers, nor included in related scientific journals.

The aim of this paper is to describe the evolution of the packaging logistics research area based on an evolution model by Reid (1997). Based on that model the paper illustrates reasons for establishing the research area and further inspired the description of the present framework of packaging logistics ten years after its establishment at Lund University. The paper also specifies where current research is heading.

The process used facilitates better understanding of the evolution of the research area, both in the local community and in the discipline. The research area develops from an interaction between the subjects of logistics and packaging, into the present cross-disciplinary research, integrating several theoretical fields. Intensified research and publication, although still inconsistent, indicate the increased awareness and dissemination of the research area. Finally, packaging logistics is proposed as being included as an integrated part in logistics research and practice.

Keywords: packaging logistics, research area evolution, cross-disciplinary, scientific publication, research area integration

1. Introduction

Logistics can be regarded as an established research area containing articles published in renowned scientific journals and which covers several related fields. One of them, packaging logistics, is a relatively new research area, established at only a few universities and institutes. Consequently, publications in packaging logistics research are scarce and the area is characterised by scattered theoretical frameworks. Theory in packaging logistics is often delimited to packaging, focusing either on technological aspects such as packaging features, or on marketing aspects such as branding and design. The holistic view of packaging logistics, related to overall business systems is however, neither covered by researchers, nor included in related scientific journals. A holistic view is underpinned because packaging logistics is becoming increasingly important in the development of sustainable business. Without an understanding of the influence of packaging on the performance of logistics, a valuable component in solving the logistics challenges for sustainable development will be lost. Based on previous experience in the field it is further identified that neglecting product, packaging and production aspects will limit people's understanding of logistic design aspects. There is therefore a need to analyse the disparate research done in this area in order to better understand and structure what has been accomplished in the field and to identify possible future research agendas.

The evolution of a research area is something which can be related to both paradigm shifts in the Kuhnian sense (Kuhn 1996) and to more incremental developments, for example, research "spin-offs" or the combination of research issues driven by both theoretical ideas and identified empirical needs. Kauffman (1995) states that *"self-organization is a prerequisite for evolvability, that it generates the kinds of structures that can benefit from natural selection"*. Hence a research area, in order to evolve, needs a self-organising context, i.e. a situation characterised by a combination of competition and co-operation. Furthermore, similar to what Meyer (2003) observes about academic entrepreneurs, in the process of evolution and self-organisation there have to be entrepreneurs or champions (Beckeman 2006) who not only identify ideas or needs, but put their efforts into the realisation and development of a research area.

The aim of this paper is to describe the evolution of the packaging logistics research area based on an evolution model presented by Reid (1997). The research area develops from an interaction between the subjects of logistics and packaging, evolving into the present cross-disciplinary research area, integrating several theoretical fields. Based on the early phase of the evolution model the paper also illustrates reasons for initiating the research area.

The remainder of the paper is organised as follows: In chapter two our approach and method in conducting this study are presented. This is followed by an identification of early related works and publications, as well as the community members who represented various initial contributors to the research area. The evolution of the packaging logistics research area is then described and analysed in chapter three, starting out with the evolution of definitions, followed, in chapter four, by the theoretical contributions made. Following on from this is a short discussion on the marketing and promotion of the research area, and its influence on decision-making is examined in chapter five. Finally, in chapter six, research areas for further development of packaging logistics will be discussed and the packaging logistics research area is proposed as an integrated part in both logistics research and practice.

2. Approach and method

The evolution of the packaging logistics research area has been purposeful but unpredictable, hence, its current status is the result of a self-organising process based on interactive responses among the researchers involved. In order to assess this evolution, primarily carried out at the Division of Packaging Logistics, Lund University, Sweden, and secondarily in the research field as such, related readings and theories were identified. Reid (1997) describes a similar evolution of the body of knowledge in terrorism research. The article presents a framework for analysis of the evolution based on four different phases: *Phase I, Measure the size of the of science in a speciality*; *Phase II, Measure the dispersion of works and ideas*; *Phase III, Measure influence on decision-making*; and *Phase IV, Measure the impact on growth of knowledge* (ibid. p92). As the authors are influenced by Reid's work a framework for analysis for the evolution of the packaging logistics research area in this paper is presented in table 1.

Table 1: Our framework for analysis of the evolution of the packaging logistics research area (modified from Reid 1997).

<i>Phase I Measure the size of the of science in a speciality</i>	<i>Phase II Measure the dispersion of works and ideas</i>	<i>Phase III Measure influence on decision-making</i>	<i>Phase IV Measure the impact on growth of knowledge</i>
A. Major members of community (chapter 3.1)	A. Dispersion patterns of early work at the Division (chapter 4.1; 4.2; 4.3)	A. Marketing and promotion of the community's ideas (chapter 5.1)	A. Relationships between community's common beliefs and current publications (chapter 6.1)
B. Related work, research and publications (chapter 3.2)	B. Dissemination of work and associated ideas within the discipline (chapter 4.4; 4.5)	B. The indicative influence of the work on the broad assumptions and beliefs underlying programmes and policies (chapter 5.2)	B. Trend analysis and projection of future works/publications (chapter 6.2)
C. Community members casual beliefs and definitions (chapter 3.3)			

Phase I in the framework focuses on related work prior to the establishment of the research area at the primary unit of analysis, i.e. at the Division of Packaging Logistics. This is in order to provide the reader with the ideas and problems which led to the initial establishment of the research area and to present some of the initial beliefs and definitions. The next phase, phase II, looks at the early work at the Division and its evolution, i.e. the patterns which have been formed until now. A short description of related publications during this time is also provided. Phase III deals with how the ideas and results have come into use, i.e. how decision-making has been influenced. The promotion and marketing of ideas are central here, as are the actual influence and impact the research field has on different initiatives and programmes. The final phase, phase IV, deals with the present status of the area and in the projections which can be made for the future. In this paper we put our greatest emphasis on phases I and II.

About 15 doctoral and licentiate theses presented at the Division of Packaging Logistics have been used as basis for the analysis, as well as published conference papers. In addition, 266 journal articles, within the discipline, i.e. both researchers from the Division as well as other researcher's contribution within the packaging logistics research area have been included in the analysis. The journal articles are identified through a literature search (abstract search) based on the keywords *packaging* and *logistics*, in the "ELIN" database at Lund University, of articles from 1900 to 2007.

3. Phase I – initial work

Prior to the initiation of the packaging logistics research area, theory was present, but delimited to focusing on either technological packaging aspects or marketing aspects, such as branding and design. In practice, packaging has been part of human life since the beginning of time, and the need for packaging has evolved with the development of modern society. In the 1950's, for example, packaging started to develop due to the launch of self-service retail (Beckeman 2006; Beckeman & Olsson 2005). In the 1990's packaging development was guided compelled by legislation to take full responsibility for the entire life cycle of the packaging to include all steps from extraction of raw material to landfill when the packaging can no longer be used (called the "closed loop" system). After this initiative the emphasis for packaging has evolved into an understanding that packaging is part of a whole system which includes the product as well as the distribution and use of packaging. The packaging must therefore be developed to ensure distribution, efficiency, provide value to the user, and finally be recovered in the best possible way (Abrahamsson et al. 2000; Jönson 2001).

3.1. Major members of community

Prior to the launch of the freestanding but interdependent research area, certain topics related to the area were on the agenda at certain universities and institutes, due to the specific interest among certain individuals. These individuals can be categorised as the predecessor community members, according to the framework by Reid (1997). As early as 1957, the School of Packaging at Michigan State University in the US was established under the leadership of one community member, Professor James W. Goff. His research in distribution dynamics laid a scientific foundation for other scholars to build on, and led the industry to better understand the protection afforded by packages in distribution. When the theory was proven it was adopted in ASTM (American Society for Testing and Materials) and ISO standards and in today's frequently used tools in product/packaging evaluations.

In the 1960's the importance of packaging became more and more recognised and besides Professor Goff, Professor Frank A. Paine, who headed packaging research at PIRA, in the UK, became an important community member and spokesperson for the importance of packaging, especially in the food packaging area. The Swedish Packaging Research Institute originates from about the same time and received special support from the forest and paper industries. Based on the need to evaluate the performance of transport packaging, packaging research institutes also developed in Denmark, the Netherlands and France. Professor Gunilla Jönson, who later became the founder of the research area at Lund University, was introduced to the community as a PhD student at the Swedish institute of Packaging Research While writing her PhD thesis she also developed packaging performance evaluation methods, based on research studies in co-operation with the above-mentioned institutes and Michigan State University. Further co-operation was offered by Professor Goff and after four years at the School of Packaging, Gunilla Jönson returned to Europe.

The reasons for starting packaging logistics as a separate research area originated in the contacts with Professor Bowersox at the Business School at Michigan State University. This contact established the relationships between packaging performance and logistics. Professor Bowersox continued to identify the relationships between packaging and logistics and he encouraged Dr. Diana Twede, yet another community member, to carry out performance tests with the aim of looking into the consequences of combining packaging and logistics, but now from an economic point of view rather than from a technical point of view.

In this environment the School of Packaging undergraduate programme became successful and a number of graduates and teachers left the School to establish new educational programmes

inspired by the Michigan State curriculum, within the US, but also abroad. The environment also generated know-how about industry needs, available educational programmes, and opportunities for graduates. This know-how inspired the mechanical industry to show early interest in the research, but the food industry followed, when it became clear that distribution performance know-how could be also transferred to the food industry. At the same time, Lund University in Sweden had identified the growth of the packaging industry in its neighbourhood. Through a donation from Bo Rydin Research Foundation, a full professorship in transport packaging at Lund University Faculty of Engineering was established in the 1990's, with an open research agenda for the development of a research area in Lund. At this time packaging focus was on environment, however, it became obvious that traditional research concerning technical performance of transport packaging was an insufficient approach. The need for methodological development as well as new concepts was clear. Packaging logistics as a freestanding, although interdependent research area was established. The open agenda encouraged a self-organised development, inspired by a multidisciplinary environment which facilitated special intellectual strengths in the packaging field, and presented opportunities for new interpretation and achievement. The research area has since been further developed and today, a holistic approach involving consumers/logistics/packaging/product systems inspired by several theoretical fields is being given more and more attention.

3.2. Related work, research and publications

Preceding the establishment of the packaging logistics research area, the pioneer community and other early contributors included research topics which mainly comprised either packaging technology-related topics or marketing-related topics. Early work on packaging and logistics until the mid-1990's was mostly focused on, and driven by the increased discussion of and pressure for environmental considerations in handling and transport. Furthermore, operational aspects focusing on logistics efficiency i.e. the over packaging problem, as exemplified in the related work of that time, represent another major perspective. In conclusion, the field could therefore be described as scattered with only few focused activities trying to deal with the research area systematically. The different perspectives and contributions are described chronologically below and summarized in Table 2.

In the 1980's Paine (1983, 1987) provides two books on packaging where physical distribution is first mentioned. In this particular publication food distribution is in focus. Furthermore, Twede (1988) presents her doctoral dissertation entitled "*The process of distribution packaging innovation and its relationship to distribution channel structure*". In 1990, the International Journal of Physical Distribution & Logistics Management dedicated a whole issue on packaging and its relation to logistics. The guest editor, John L. Gattorna writes in the foreword that "*this long-neglected but fundamental part of our activities has suddenly been brought sharply into public focus*" and he put forward that it is because packaging is a source of profit and the fact that it has impact on the environment that companies must look more closely at their packaging methods. In this issue Wills (1990, reprint from 1975) presents a profit perspective on packaging which suggests that profits are ensured if packaging is taken into consideration in distribution activities. Rod (1990b) puts her focus on packaging as a retail marketing tool and recommends managers to evaluate packaging as a whole and not only make decisions on price. Rod (1990a) in her second contribution in this issue, specifically focuses on the paperboard packaging industry in New Zealand. She concludes that packaging manufacturers are responsible for not over packaging and for ensuring environmental friendliness. Robertson (1990) in his article "Good and bad packaging: who decides?" suggests that "*assessing the environmental friendliness of packaging can be meaningful only if cognizance is taken of the 6 functions of packaging: 1. containment, 2. protection, 3. apportionment, 4. unitization, 5. convenience, and 6. communication.*" The environmental

perspective is also one which Gray and Guthrie (1990) take, focusing on the ethical issues of environmentally friendly packages. Finally, Lancioni and Chandran (1990) discuss the role of packaging in international logistics, arguing that packaging is one of the most important areas in achieving smooth logistics operations in an international context.

Twede (1992) in her article *The Process of Logistical Packaging Innovation* suggests that packaging innovation is a team effort that require input from several company functions. Her study is based on a case study on early adopters of plastic logistics packages. Szymankiewicz (1993) investigates environmental issues affecting business activities and finds from a survey that the most important issues are packaging material and the disposal of waste. Murphy, Poist and Braunschwig (1994) take an environmental perspective on logistics, looking at issues and strategies and identify recycling materials, reducing consumption, and reusing materials as the 3 most commonly used strategies for dealing with and responding to environmental issues in logistics. In this area of regulations and laws regarding packaging Livingstone and Sparks (1994) also contribute with an article entitled: The new German packaging laws: effects on firms exporting to Germany. Lockamy III (1995) provides an article on the strategic perspective on packaging in the organisation, looking at cost, technology and environmental aspects. Prendergast (1995) discusses the relationship between logistics, packaging and the environment, especially in relation to the proposed EC Directive on Packaging and Packaging Waste. Finally, Kroon and Vrijens (1995) discuss reverse logistics and use returnable containers as an example.

Table 2. Publications related to packaging logistics in early phases of the development(- 1995)

<i>Author(s)</i>	<i>Title</i>	<i>Focus</i>	
Paine (1983, 1987)	Handbook of Food Packaging	physical distribution of food	Logistics efficiency focus
Twede (1988)	The process of distribution packaging innovation and its relationship to distribution channel structure		
Twede (1992)	The Process of Logistical Packaging Innovation	team efforts needed in packaging innovation	
Wills (1990)	Packaging as a source of profit	profit perspective on packaging in distribution activities	
Rod (1990b)	Packaging as a retail marketing tool	total cost approach on packaging	
Lancioni and Chandran (1990)	The role of packaging in international logistics	packaging role in getting smooth logistics operations in an international context	
Lockamy III (1995)	A conceptual Framework for assessing strategic packaging decisions	cost, technology and environmental aspects of packaging in organisations	
Rod (1990a)	New Zealand's paperboard packaging industry	over packaging and ensuring environmental friendliness	Environmental issues
Robertson (1990)	Good and bad packaging: who decides?	the multifunctionality of packaging, environmentally friendliness	
Gray and Guthrie (1990)	Ethical issues of environmentally friendly packaging	code of conduct regarding environmentalism	
Szymankiewicz (1993)	Going green: The logistics dilemma	disposal of waste and packaging material on business issues	
Murphy et al. (1994)	Management of environmental issues in logistics: Current status and future potential	recycling materials, reducing consumption, and reusing materials as common environmentally friendly operations in logistics	
Livingstone and Sparks (1994)	The new German packaging laws: effects on firms exporting to Germany	environmental pressure on business, reuse and recycling of packaging	
Kroon and Vrijens (1995)	Returnable containers: an example of reverse logistics	Organisation of returnable containers, economic logistics and ecological aspects	
Prendergast (1995)	The EC directive on packaging and packaging waste: current status and logistical implications	the relationship between logistics, packaging and the environment in an European context	

3.3. Community members' casual beliefs and definitions

Based on the experience from the preceding community of early contributors, the research community in the packaging logistics research area started to define packaging logistics, with the basis in the packaging background. Since the discipline of packaging logistics originates from pure packaging disciplines such as packaging technology, packaging production and packaging development, the evolution of definitions of packaging logistics has started out through the elaboration of existing definitions of packaging (Bramklev et al. 2001). Prior to packaging being defined as an academic concept, packaging was rather classified as primary, secondary or tertiary, reflecting the levels of usage (Jönson 2001).

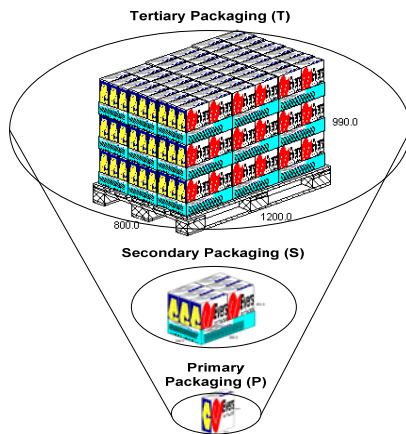


Figure 1: The system classification of packaging

Over time packaging definitions have been provided by researchers at different institutes and organisations such as the UK Institute of Packaging (Paine & Paine 1983; Robertson 1993) and the European Parliament in its Council Directive 94/62/EC (Olsson, Petterson, & Jönson 2004). All definitions provided state that packaging contains, protects and preserves, but they also indicate the link to the processes around packaging, such as transport, distribution, storage, retailing and end-use. All definitions also propose integration of the elements of packaging into the supply chain and involvement the different supply chain users around the packaging system. In other words, the definitions all indicate the need to regard the packaging system as integrated in the supply chain system and not as an isolated unit or system. The exhortation for integration of the packaging system and the logistical system has therefore inspired the development of packaging logistics definitions to evolve into integrated packaging logistics definitions, from the existing packaging definitions combined with existing logistics definitions provided by CSCMP.

The Packforsk institute provided an early definition of packaging logistics, based on the CLM definition at that time (Dominic et al. 2000). Bjärnemo et al. (2000) further elaborated that definition to also include the integration of the handling *after* consumption in the supply chain. These early packaging logistics definitions, as well as existing packaging and logistics definitions, were used and integrated into the latest definition of packaging logistics provided by Saghir (2004a): *“The process of planning, implementing and controlling the coordinated packaging system of preparing goods for safe, secure, efficient and effective handling, transport, distribution, storage, retailing, consumption and recovery, reuse or disposal and related information combined with maximizing consumer value, sales and hence profit.”*

Another related evolution not considered in the packaging logistics definitions, is the one concerning product development processes. Research in the packaging field has proven that packaging development cannot be regarded as a single process, isolated from other activities related to the product or the package. Therefore, in the context of product development,

Björnemo et al. (2000) describe packaging logistics as follows: “*The interaction and relations between the logistical system and the packaging system that “add on” values to the combined, overall, system – the Enterprise*”.

Saghir’s (2004a) aim of taking a packaging focused view in integrating the multidisciplinary aspects of the packaging logistics while co-ordinating the various levels of the packaging system is clear in his definition. However, the definition does not include the integrated product and packaging development processes. The subsequent step would therefore be to combine the definitions and descriptions by Saghir (2004a) and Björnemo et al. (2000), in order to include the entire product life cycle in one definition.

4. Phase II - Theory evolution - the dispersion of ideas

The dispersion of early ideas and contributions in the packaging logistics area started out by classifying packaging as primary, secondary or tertiary, reflecting the levels of usage. These classifications should be used together with the consideration of packaging as a *system*, with hierarchical levels including the product inside (Olsson et al. 2004). This system view of a product and packaging system usually represents the typical technical or engineering system perspective, represented by a delimited “hard system” which consists of physical elements hierarchically connected together to form a whole (Checkland 1993). Nevertheless, the different levels of packaging systems are interdependent and their mutual influence needs to be considered in the development and use of the system. The consideration of the mutual influences at different system levels has inspired the dispersion of ideas toward a holistic approach involving consumers/logistics/packaging/product in the system, within, as well as outside the Division.

4.1. The evolution of the packaging and logistics interaction

The primary function of a package is, according to Jönson (2001), to serve as an interface and a barrier between the product inside the package and the surrounding distribution environment. In the early community work, Henriksson (1998) reports from his research on Swedish retail supply chains that it is important to analyse packaging requirements in all parts of the supply chain. He identifies five essential categories for this; “machinability”, communication, protection, distribution simplification and materials utilisation. The first community doctoral dissertation by Johnsson (1998) concludes that packaging is an element which can influence the cost and effectiveness of all logistics activities. However, he also concludes that integration is complex. In addition, based on early literature studies in the field, it can be concluded that packaging has a significant impact on efficiency in the logistics system. Therefore, a development of the integration of packaging into the logistical system, as visualised in Figure 2, was suggested in the early phase of evolution (Saghir & Jönson 2001).

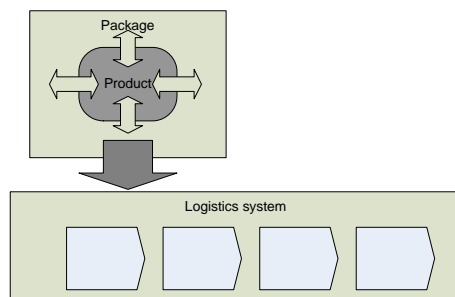


Figure 3: Integration of product and package into the logistics system.

In retrospect, Beckeman (2006) justifies that the technology leaps of frozen food and self-service retail, for example, required a parallel development of packaging and logistics,

including totally new distribution chains which included new packaging concepts. The suggested integration is symbolised in that packaging should not be seen as a subsystem of logistics since it may prevent the development of making both packaging and logistics more efficient and effective. The authors Saghir and Jönson (2001) also ask for investigation and evaluation methods for packaging in the supply chain system, including both “hard” and “soft” factors. This has later been introduced in a packaging scorecard model suggested by Dominic et al. (2003) as well as in the work by Saghir (2002; 2004b) and Hellström (2007).

In his doctoral dissertation, Saghir (2004) uses a systems approach on packaging logistics and the results indicate the important role of marketing in the packaging logistics context. He concludes (ibid. 125); *“packaging logistics, [...] , is an integrated concept that recognizes the interrelated relations between packaging, logistics and marketing”* and this especially in retail supply chains. He also points to the multidisciplinary nature of packaging logistics making it important in several contexts, however, at the same time meaning that it suffers from fragmentation, i.e. not belonging to any established research area.

In alignment with early dispersion, the most recent dissertation at the Division (Hellström, 2007) focuses on the interactions between packaging and logistics, particularly in relation to technological developments and innovations. The dissertation presents the extensive interactions between packaging and logistics and explores this particularly in the implementation of RFID and a new innovative unit load carrier.

4.2. The evolution of interacting product and packaging development processes

In the aspects of technological development and innovation, packaging development, packaging design and development traditionally start when the core product is ready for production in the commercial launch phase in the innovation process (Jönson 1993). Little or no consideration is therefore taken of packaging in the product development process of the core product. The retrospective research by Beckeman (2006) on the other hand suggests that the packaging system may drive product development to a certain extent, since the packaging system, once installed, might be used for adaptation of new products.

The procedure to introduce packaging design late in the product development process was almost sufficient as long as the technical performance of the core product constituted the single most important competitiveness factor on the market. At that time the design of the product-to-be on its own represented the most effective and efficient means of increasing competitiveness (Jönson 2001). However, the transformation toward demand-driven product development, total production efficiency and supply chain management efficiency required new methodologies for focusing on an overall, holistic product development process. This resulted in an investigation on the potential of integration of the product development process with the packaging development process in an integrated manner of concurrent engineering (Bramklev et al. 2001). A schematic integration is provided in Figure 4.

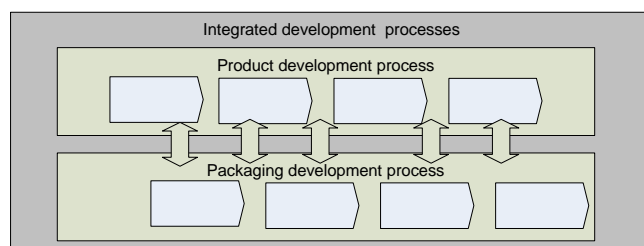


Figure 4: A schematic integrated product and package development process

Further studies by Bramklev et al. (2005) suggest this integration has become not only vertical but also horizontal. They state that besides vertically integrating different functions such as marketing, technology and production, one has to integrate the sub-activities forming each of the phases of a given function in the product and packaging development process. The latter is more an integration along the time axis of the development, and it connects people, processes and technologies.

4.3. The integration of processes and systems

As already discussed, there is a close relationship between product and package and an exhortation for integration of the product, the packaging and the logistics activities of a firm. The integrated product and package are also proven to have great impact on the efficiency of the supply chain. Through the use of IKEA as a best practice, Klevås (2005a; 2005b) shows that with the package function organised both in the product development team and in the logistics function, the integration of packaging and product development will be more successful thanks to the input provided by the supply chain overview. The development processes as well as the supply chain processes represent different activities distributed over time, and the integration of the product and packaging development processes, the supply chain process and the product and package as a system can be visualised in the perspective of the product/package life cycle as in Figure 5.

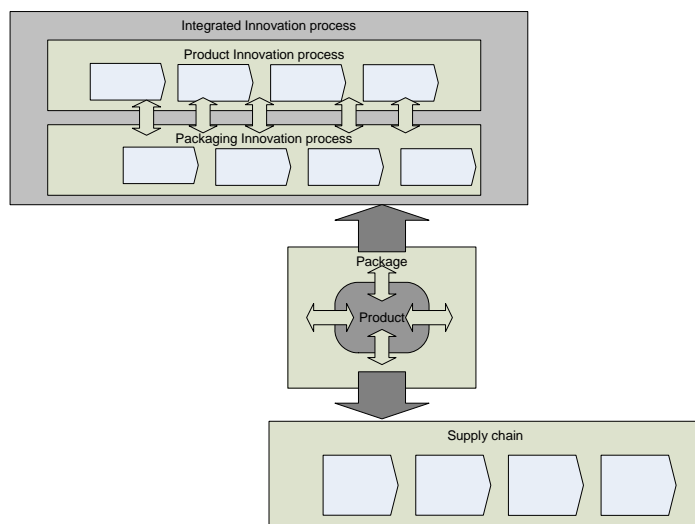


Figure 5: The integration of the development and innovation process, the supply chain and the package/product system.

4.4. The evolution of soft systems human interaction in packaging logistics

In the evolution of the packaging logistics research area it became clear that soft factors, i.e. factors related to human behaviours and decisions had an impact on packaging logistics systems (Beckeman 2006; Nilsson 2005; Olsson 2006). Hence, the multidisciplinary nature of the research area revealed that in order to fully comprehend and deal with the effects and implications of a packaging logistics approach, a greater systems view on the phenomena in industry and society was needed. This led to an evolution by some of the researchers within the community to set out to explore how demand-driven developments and customer orientations influenced the treatment and development of novel approaches in packaging development (Olsson 2006). This research suggests the context for a package or a packaging system to be built up by a core product with additional consequence and value levels for the 1st and 2nd customers as in Figure 6.

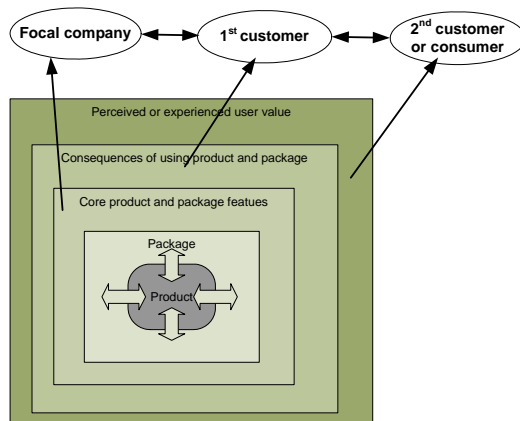


Figure 6: The system with added value, modified from Olsson (2006).

The evolved approach represents a systems view of packaging, which contrary to the hard system described in the early phases, involves subjectivity and relationships between the physical product and the perceived values of actors in the supply chain who use the product (Olsson 2006). Thus, the package with the surrounded value for different actors can be regarded as a soft system (Checkland 1993). This notation on the context of the packaging system proclaims the need for a lifecycle perspective since the purpose and function of the packaging change through the downstream flow and its use and after-use (recycling, return ability etc.).

Furthermore, as the field became more complex as interactions and interdependencies among system components grew in the research conducted, novel perspectives on how to deal with this complexity was also to be explored (Nilsson 2005). The network effects of small changes in one part of the supply chain could lead to changes of behaviours and great effects (often non-linear) in other parts of the supply chain.

4.5. Dissemination of work within the discipline

While the number of packaging logistics-related publications has increased from 51 publications between 1900-1996, to 215 between 1996-2007, the discipline as a whole has been of a scattered and fragmented nature. Most of the researchers who have published packaging logistics-related articles limit themselves to only one contribution. However, Twede and Prendergast are examples of researchers who keep on publishing of packaging logistics-related publications. Furthermore, Jönson has contributed to several journal publications which originate at the Division and lately she has also published a book on retailing logistics focusing on packaging logistics in the management of fresh food supply chains. Professor Jönson continuously develops the field through co-operation with PhD students and research colleagues, with different perspectives on the packaging logistics field. She encourages new initiatives, as Professor Goff did at Michigan State University. As the packaging logistics field is a new discipline it is important to be open-minded and in that way identify aspects which need to be further investigated to find the core perspectives of packaging logistics.

5. Phase III - Influence on decision-making

While this phase is given less emphasis in this paper, a brief reflection on the influence the packaging logistics area has had so far on decision-making in different contexts is made.

5.1. Marketing and promotion of the community's ideas

The community's ideas and results of the packaging logistics research have been promoted by the community in different ways. Yearly seminars are held, where research results and future ideas are presented and elaborated on together with related industry. The research conducted at the Division is applied research and research is put into practice with the related industry as a research partner. Master's thesis works carried out on the subject of packaging logistics are always applied and conducted in partnership with the same industry. The current descriptions of the research area on the Division homepage confirm the broad and applied direction for the area;

“Packaging logistics covers the design of a product, its package and packing, as well as the adaptation and control of the distribution system and the administrative and information systems associated with the processes throughout the whole chain from raw product, via various processing stages, to the distribution to the end user, and on to recycling and recovery. As both packaging and logistics form important parts of packaging logistics thinking, safe delivery can be offered to customers and users at a low cost. Packaging logistics can also contribute to modern product development and design, by ensuring that products are designed such that they can be distributed with a minimum use of resources from production to consumption”(www.plog.lth.se, 070324)

5.2. Influence on programmes and policies

With the package as the least common denominator in the supply chain, from producer to consumer, the influence of packaging logistics on the programme about food traceability is evident. The Division of Packaging Logistics has become the basis for research in the area of food traceability and value creation for the supply chain actors. EU policies such as HACCP and other policies regarding food traceability influence the research, but the research aim is also to influence policies especially as regards the critical contexts between supply chain actors identified in our research programme (Eken & Karlsson 2006).

Furthermore, the packaging logistics research area is part of a research excellence centre in logistics called “Next Generation Innovative Logistics” (NGIL). The vision of the NGIL program is to provide knowledge, methods, techniques and tools for companies and organisations to increase supply chain visibility and to manage deviation in logistics systems.

6. Phase IV - Future development

Future development of the packaging logistics research area can be guided through the knowledge about recent publications in the area and in related areas. In this chapter, current publications are described and analysed followed by a projection of future research. The pattern to observe is that there is still a rather scattered picture of the research carried out, indicating that the research area is still in a rather explorative phase at the same time as examples and results are growing and show the importance of the work in this area.

6.1. Community's common beliefs and current publications

This part suggests further research based on a description of some of the current publications related to packaging logistics, which indicates where research efforts may be heading. These publications, described below, represent the majority of academic articles between 2005-2007 related to packaging logistics, as well as two dissertations in the field.

Cochran and Ramanujam (2006) present an optimisation model for carrier-mode selection where packaging is regarded as a central aspect. While the model assumes several things, the authors suggest further research by more testing with other assumptions since major cost reductions are to be found, especially in JIT supply chains. Chan et al. (2006), presents a

systematic approach to the manufacturing of packaging logistics, and calls for future research on E-shopping and the important role of packaging in that context, in order to reach maximum logistics efficiency. Clark et al. (2006) report on RFID performance trials and suggest a four-step model for managers thinking of implementing RFID technology in their material-handling activities. The authors point out a need for more theoretical research on the physics of radio waves and for standard test methods of the readability of RFID. Gonzalez-Torre and Adenso-Diaz (2006), in the context of reverse logistics, call for future research on comparative studies of different nations' handling of returnable packaging (glass, plastics etc.) concerning what barriers and opportunities exist. The issue of reusable packaging is also something Mollenkopf et al. (2005) address. They call for dynamic simulations in order to assess the costs of returnable containers and transport items, and based on their research results on other industries than the automotive industry. The multi-faceted dimension of packaging is elaborated on by Rundh (2005) where the author called for research on the various aspects of packaging in the supply chain and for research on customer and consumer value from a packaging perspective. Jahre and Hatteland (2004) suggest that *“more in-depth studies on the similarities and possible differences between the concepts of leanness, integration and adaptation and agility, flexibility and adaptability on the other”* in order to get more understanding of possible tradeoffs between leanness and agility. Finally, Dominic (2005) concludes that VMI is useful for the packaging industry and represents a step towards becoming network integrators. More research on the concept of network integrators is called for by the author.

In addition, two Nordic dissertations in the field have been presented in the last year outside the focal community (Engelseth 2007; Löfgren 2006). Engelseth (2007) underpins the importance of the packaging, as the package represents the interplay between the flow of goods and the flow of information. Consequently, it is regarded as a facilitator which enables information between the different actors and different information systems of a supply chain. In a packaging logistics perspective, Löfgren (2006) can also be regarded as a contributor to field, in the sense that he argues that packaging is a product-related attribute which *does* affect the customer's experience of products, i.e. the upstream actor of the supply chain.

Table 3. Current publications related to packaging logistics (2004 - 2007).

<i>Author(s)</i>	<i>Title</i>	<i>Focus</i>	
Cochran and Ramanujam (2006)	Carrier-mode logistics optimisation of inbound supply chains for electronics manufacturing	optimisation model for carrier-mode selection	Logistics efficiency focus
Chan et al. (2006)	A systematic approach to manufacturing packaging logistics	systematic approach to manufacturing of packaging logistics	
Gonzalez-Torre and Adenso-Diaz (2006)	Reverse logistics practices in the glass sector in Spain and Belgium	reverse logistics	
Clark et al. (2006)	Radio frequency identification (RFID) performance: the effect of tag orientation and package contents	RFID technology in material-handling activities	
Jahre and Hatteland (2004)	Packages and physical distribution: Implications for integration and standardisation	leanness and agility in packaging contexts, standardisation	
Engelseth 2007)	The role of the package as an information resource in the supply chain	packages can be regarded as an information source and carrier	Effectiveness and value
Dominic (2005)	Integrating Packaging Suppliers into the Supply/Demand Chain	VMI solutions involving packaging	
Rundh (2005)	The multi-faceted dimension of packaging - Marketing logistic or marketing tool?	packaging in the supply chain, customer value	
Löfgren (2006)	The leader of the pack – A service perspective on packaging and customer satisfaction	packaging as product-related attribute affecting the customer's experience of products	
Mollenkopf et al. (2005)	Assessing the viability of reusable packaging: a relative cost approach	reusable packaging	Environmental

6.2. Projection of future works and publications

The evolution of definitions will probably be extended to include more dimensions than packaging and logistics, with a first step including the product/packaging development process, as suggested in section 3.3. The theory evolution follows the same pattern and suggests an integration of the product and packaging development processes combined with the logistical system. In traditional product development literature, a life cycle perspective is commonly used in theory, while the subsequent evolution in the packaging logistics research area would be to take the entire integration of product/packaging development and supply chain management into a life cycle perspective.

Furthermore, as the focus in the beginning of the 1990's was on environmental issues, it may be time, from a packaging logistics perspective, to reconsider these issues and develop concepts and methods which not only decrease the impact of packaging on the environment but rather improve it. The multidisciplinary nature of the research area may be enhanced, by integrating several theoretical fields which correspond to the suggestions for the future research areas in recently published journal articles, as described in section 6.1.

Other areas for development are in education where the concept of packaging logistics could be further developed and integrated into logistics programmes, marketing programmes and product development programmes. As the packaging is the interface between the product and its environment during all steps in the supply chain and back again, it is natural to consider it a unit of analysis and development.

7. Concluding discussion

In this paper a description of the evolution of the packaging logistics research area is provided with reflections of the developments and further research directions, both on the local community level, i.e. the Division of Packaging Logistics, as well as on the global level, i.e. related research in the field. While there are studies on the development of disciplines, e.g. logistics (Kent Jr & Flint 1997), there are few studies on the evolution of specific research areas, which this paper is a contribution to. Furthermore, this paper shows the potential this type of research has for the self-awareness of the people involved, both on the result and on the process. In addition, the process and results could facilitate a generation of future patterns through providing a better understanding of the evolution of a particular research area, both in the local community as well as in the discipline as such. The framework used for this analysis creates a value for the discipline as a whole, as it exemplifies the self-organisation which may also take place in the evolution of other research areas.

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