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Sustainable Packaging of Organic Food

Myth or Reality?

Helena Lindh



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DOCTORAL DISSERTATION

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*“Standing still is falling behind –
sustainability is a competitive issue.”
(ECR, 2009, p. 27)*

Acknowledgements

With the words of a brilliant colleague in my mind that “The acknowledgements are the part I always read first in a doctoral thesis,” I am finally writing my own...

Reflecting over the entire research journey from my first clueless day at the Division of Packaging Logistics up to now, about eight years later, I must admit that it has been very interesting and rewarding, although time wise troublesome and longer than expected. I will never regret taking this path and never, never ever regret putting my research on hold for a time to become the mother of two lovely children.

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somewhere special with you see a real steam train. Love – your cheering laughter and your enthusiasm when we are baking, cleaning or playing together fills me with love and energy. I look forward to devoting more time to play and to discovering all the little mysteries in the world of a three-year old with you, now that this thesis is finished. I am also very grateful to my parents for loving and supporting me along the way. Dearest Mum, thank you for sharing your knowledge, insights and a whole bunch of books; you will always be way ahead of me in methodology and research philosophy. Thanks to my beloved Dad for your support and for inventing and constructing with your grandkids while I have been devoted to this.

Helena Lindh

Lund, January 2016

Abstract

Previous research has argued that packaging has a great potential to contribute to sustainable development, but how to put this potential into practice is not yet fully explored. The theoretical foundation of the research presented is at the intersection of packaging logistics and sustainable development. This foundation was chosen because it offers established models that are well linked to the holistic view of sustainable packaging of this thesis.

The thesis has two purposes. The first is to explore and elaborate on the potential contribution of packaging to sustainable development from a packaging logistics perspective. This is done in two theoretical studies. They are based on data collected via literature reviews and analyzed according to a content analysis procedure. The first theoretical study examines how this contribution of packaging is supported in formalized approaches provided by academia and trade associations. The analysis shows that in general, the approaches fall short in their consideration of packaging functions and the indirect effects packaging functions have on sustainable development. The second theoretical study explores in greater depth how the consideration of packaging functions can contribute to sustainable development. This resulted in extensive lists of how the 19 packaging features of three packaging functions can contribute to sustainable development in 14 different ways. Several practical examples are given.

The second purpose of the thesis is to explore and elaborate on the potential contributions that organic standardization organizations, consumers and brand owners can make to the use and development of sustainable packaging in practice in an organic food context. The data were primarily collected in four studies through interviews and a survey. Content and statistical analyses were applied to the data. The studies show that organic standardization organizations, consumers and brand owners face challenges that limit their ability to contribute to the use and development of sustainable packaging. However, the research also points out additional abilities for these stakeholders that are particularly linked to increased consideration of the important functions of packaging in regulations, purchases, and in packaging selection and development processes.

Overall, this thesis emphasizes the need to integrate consideration of packaging functions and a holistic approach to sustainable packaging in an effort to enhance the sustainable packaging of organic food.

Populärvetenskaplig sammanfattning: Hållbara förpackningar till ekologiska livsmedel, myt eller verklighet?

Förpackningar finns nästan överallt! Ta en titt nästa gång du äter frukost – redan där på morgonen möter och hanterar du ett flertal olika livsmedelsförpackningar. De finns där även om du kanske inte tänker så mycket på dem, mer än när de är svåröppnade, svåra att hålla ur eller när de rent av läcker. Förpackningar har som jag ser det tre funktioner: de ska kunna skydda, underlätta hantering och kommunicera. Detta tar vi som konsumenter mer eller mindre för givet men fundera på följande:

- Om kartongen inte skyddade äggen tillräckligt skulle det bara vara sörja när vi kom hem från affären.
- Om förpackningen med toalettpapper inte hade något handtag skulle den vara svår att bära hem.
- Om förpackningar inte hade bilder, texter eller färger skulle det vara svårt för oss att hitta den produkt vi söker efter i butikshyllan.

När man tänker efter spelar förpackningar en stor roll i vår vardag. De spelar även en viktig roll ur ett hållbarhetsperspektiv. Med hållbarhet menar jag hur hållbara de är utifrån ett ekologiskt, socialt och ekonomiskt perspektiv. När det gäller hållbara förpackningar visar min forskning att förpackningens funktioner spelar en viktig roll.

Förpackningar har under en längre tid haft en plats i skamvrån i miljö- och hållbarhetssammanhang. De har setts som något ont, något som till varje pris måste minimeras eller rent av elimineras. Jag tillhör dock den, under de senaste åren, växande skara forskare som ser att förpackningar faktiskt kan bidra till en mer hållbar utveckling av vårt samhälle. Ett exempel på förpackningars möjlighet att påverka är att en gurka utan förpackning håller i ungefär tre dagar medan en gurka med plastfilm håller 14 dagar. Förpackningen bidrar till en längre hållbarhet och ökar chansen att gurkan blir både såld och uppäten. För att se denna potential krävs en förståelse för förpackningens tre funktioner. Det krävs också att man ser förpackningen i sin relation till innehållet och i samspelet med de olika människor den möter längs sin resa från tillverkning till att den når konsumenten och sen lämnas för återvinning.

Hållbara förpackningar är speciellt intressanta att studera i förhållande till ekologiska livsmedel eftersom dessa i mångt och mycket delar samma värden. Mitt forskningsintresse väcktes när jag såg ett uttalande att "7 av 10 svenskar utgår från att förpackningen är klimatsmart om produkten är miljöprofilerad" i ett pressmeddelande från ett förpackningsföretag. Detta antyder att det skulle kunna vara en myt bland svenska konsumenter att förpackningar till ekologiska livsmedel är mer hållbara än andra. Förpackningar används för att kommunicera olika budskap till dig som konsument, däribland det ekologiska. Men att produkten är ekologisk innebär inte med någon självklarhet att förpackningen är ekologisk eller mer hållbar än andra. Min forskning visar att det bara är ett fåtal av de varumärkesägare som har både ekologiska och konventionella produkter som vidtar speciella åtgärder när det gäller förpackningar till ekologiska livsmedel. Den visar även att varumärkesägare har möjlighet att påverka förpackningen, men omfattningen beror på den aktuella utvecklingsprocessen, befintlig förpackningslina, deras leverantörsrelation samt kunders och konsumenters inflytande.

EUs ekologiska märkning innehåller inte några särskilda regler för förpackningar till ekologiska livsmedel ur ett hållbarhetsperspektiv. När det gäller den svenska KRAV-märkningen har det skett en utveckling där man sedan 2015 har striktare regler när det gäller förpackningen. Trots detta tyder min forskning på att det finns en potential för vidareutveckling även av KRAVs regler speciellt med hänsyn till förpackningars funktioner. Framtiden får utvisa om KRAVs nya regler får någon märkbar effekt.

Kan du som konsument bidra till mer hållbara förpackningar genom dina val i butiken? Min konsumentstudie visar att speciellt de som gärna köper ekologiska livsmedel tycker att det är viktigt med miljömässigt hållbara förpackningar. De är också villiga att betala mer för sådana förpackningar. Men det finns ett dilemma. Eko-konsumenterna som är villiga att betala mest för miljömässigt hållbara förpackningar är också de som löper störst risk att välja förpackningar med motsatt effekt. Eko-konsumenter väljer nämligen i större utsträckning än andra, förpackningar utifrån förpackningsmaterialet – mängd och sort – medan andra oftare väljer utifrån hur de upplever dess funktion. Materialet visade sig vara det som konsumenterna överlag kopplar starkast till förpackningars miljöpåverkan. Detta trots att det finns tidigare forskning som tydligt visar att en förpacknings förmåga att skydda innehållet ofta är viktigare, eftersom förpackningen generellt står för en liten del av produktens och förpackningens totala miljöpåverkan. Detta pekar på ett behov av information eller vägledning riktad till konsumenter för att de ska kunna göra medvetna val utifrån förpackningars miljömässiga hållbarhet.

Så är det en myt att förpackningar till ekologiska livsmedel är mer hållbara, eller är det verklighet? Jag skulle säga att förpackningar till ekologiska livsmedel i dagsläget inte generellt sett är mer hållbara än andra. Någon generell myt skulle jag inte heller vilja säga att det är eftersom min forskning visar att det bland konsumenter istället råder en stor osäkerhet kring ekologiska livsmedelsförpackningars miljöpåverkan. Jag skulle därför snarare säga att: - Hållbara förpackningar till ekologiska livsmedel, det är en möjlighet!

Papers

Appended papers

This thesis is based on the following four appended papers. The accepted and published papers have all been subjected to a peer review process.

- I. **Lindh, H.**, Williams, H. Olsson, A., and Wikström, F. 2016. Elucidating the Indirect Contributions of Packaging to Sustainable Development: A Terminology of Packaging Functions and Features. *Packaging Technology and Science*. Published online.
- II. **Lindh, H.**, Olsson, A., and Williams, H. 2016. Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development? *Packaging Technology and Science*. 29(1): p. 3-23.
- III. Olsson, A., **Lindh, H.**, and Bertoluci, G. 2011. Packaging Design in Organic Food Supply Chains: A Case Study in Sweden. In the Proceedings of the 20th International Conference on Engineering Design, Copenhagen, Denmark.
- IV. **Lindh, H.** and Olsson, A. Who Decides About Organic Food Packaging? Typologies of Organic Food Brand Owners in Sweden. *Renewable Agriculture and Food Systems*. Submitted for publication.

Author's contributions to the appended papers

The contributions of Helena Lindh to the co-authored papers included in this thesis are as follows:

I. Elucidating the Indirect Contributions of Packaging to Sustainable Development: A Terminology of Packaging Functions and Features.

This conceptual study was initiated and planned by Lindh. Lindh conducted the main part of the review and analysis of literature with assistance from Williams and with advice from Olsson and Wikström. Lindh was the main author of the paper with textual as well as inspirational input from Williams, Olsson and Wikström.

II. Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development?

This consumer study was initiated, planned and the data were collected by Lindh with advice from Olsson. Content analysis and statistical analysis were performed by Lindh with advice from Williams and Olsson. Lindh was the main author of the paper with textual and inspirational input and advice from Williams and Olsson.

III. Packaging Design in Organic Food Supply Chains – A Case Study in Sweden.

The data collection from the national companies was performed by Lindh. The analysis was mainly performed by Lindh and assisted by Olsson. Lindh was the main author of methodology, results, analysis and discussion section. Bertoluci contributed with experience and knowledge through critical reflections in the writing of the paper. Lindh presented the paper at the conference.

IV. Who Decides About Organic Food Packaging? – Typologies of Organic Food Brand Owners in Sweden

The brand owner study was initiated, planned, data were collected and analyzed by Lindh. Lindh wrote the paper with advice from Olsson.

Other publications not included in this thesis

Journals

Lindh, H., and Olsson, A. 2010. Communicating imperceptible product attributes through traceability: A case study in an organic food supply chain. *Renewable agriculture and food systems*, 25(4), 263-271. (Included in licentiate thesis)

Conference papers

Lindh, H., Williams, H., and Annika, O. 2012. Consumer Perceptions of Sustainable Packaging – Limited by Lack of Knowledge? In *The 3rd Nordic Retail and Wholesale Conference*, Lund, Sweden. November 7-8, 2012.

Olander, M., **Lindh, H.** and Silgård Casell, S. 2009. Towards Improved Reporting of Case Study Research – An Evaluation of Articles in Top Tier Logistics and Management Journals. *The 21th annual NOFOMA Conference Proceedings*, Jönköping. (Included in licentiate thesis.)

Ask, A., **Lindh, H.**, Modin, H., Pemsel, S., and Uhr, C. 2009. Studenters uppmärksamhet under föreläsningar. In *Utvecklingskonferens*, p. 112-120. Lund University, Sweden.

Lindh, H., Skjöldebrand, C., and Olsson A. 2008. Traceability in Food Supply Chains: Towards the Synchronized Supply Chain. In *Proceedings of the Logistics Research Network Annual Conference 2008*, p. 309-314. (Included in licentiate thesis)

Lindh, H., Skjöldebrand, C., and Olsson A. 2008. Brownboard: A Tool to Facilitate Improved Supply Chain Traceability, *The 20th annual NOFOMA Conference Proceedings*, V. Autere et al., eds., Helsinki, p. 393-408. (Included in licentiate thesis)

Master theses supervised by the author

Vargas Julián, M. 2010. Comparison Study of the Reducing and Recycling Knowledge and Habits of Conventional and Organic Food Consumers. *Division of Packaging Logistics*. Lund University, Lund, Sweden.

Licentiate thesis

Lindh, H. 2009. Traceability in food supply chains - Beyond food safety, Licentiate thesis, Division of Packaging Logistics, Lund University, Lund, Sweden.

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1. Introduction

Packages surround us almost everywhere: at home, in retail stores, at work. They are there even though we do not pay much attention to them apart from when they fail to fulfill our expectations. What caught my interest was the silent presence of packages combined with their multifaceted nature and large potential.

Upon completion of my licentiate thesis on packaging from a traceability perspective, my research focus turned to packaging from a sustainability perspective. Sustainability and its relation to the organic food context (in which the empirically based research of this thesis is conducted) surfaced when I conducted a study on using traceability to communicate imperceptible product attributes, such as organic, via the package (Lindh and Olsson, 2010). I then realized the importance of packaging for brand owners in communicating ethical and organic values to consumers. At that time I also came across a press release on the results of a survey commissioned by Tetra Pak. It stated that 7 out of 10 Swedish consumers automatically assume that the environmental values of the product also go for the package (TetraPak, 2009). I made a few rounds in the local retail stores studying packages for organic food products and found no striking difference compared to conventional food packaging, apart from the labeling and graphic design. I started to wonder about the package. Are there any standards or regulations for the packages of organic food products? Do these packages measure up to the organic values of the content? Do the organic food brand owners make any difference in their selection or development of packages for organic food products compared to conventional food products? Is sustainable packaging of organic food a myth among Swedish consumers or is it reality?

Background

The general awareness and interest in sustainable development is growing stronger in our society. Despite this trend, there are still discussions on how to interpret and put the concept into practice. Sustainable development is also becoming more integrated into different areas of our society. This thesis adds to the recently growing list of research contributions striving to support the integration of sustainable development in packaging.

Recent research argues that packaging has a great potential to contribute to sustainable development (Grönman et al., 2013; Hellström and Saghir, 2007; Holdway et al., 2002; Nilsson et al., 2011; Nordin and Selke, 2010; Svanes et al., 2010; Vergheze et al., 2012).

The use and development of sustainable packaging is one way to achieve this potential. In the past, though, packaging has been regarded as a part of the problem rather than a part of the solution (Lockamy III, 1995; Simms and Trott, 2010). In line with this, packaging has also in the last two decades been portrayed in the media and in legislation as something that should be minimized or even avoided (EC, 1994/62; Svanes et al., 2010). As a result, environmentally conscious consumers also tend to have a more critical view of packaging than others (Simms and Trott, 2010; Williams et al., 2008).

The ability of packaging to contribute to sustainable development is not only related to the package itself, but in particular to its content and the supply chain through which it is distributed, including the consumer or user (Büsser and Jungbluth, 2009; Emblem, 2012; Fitzpatrick et al., 2012; Hellström and Saghier, 2007; Holdway et al., 2002; Kooijman, 1993; Nilsson et al., 2011; Silvenius et al., 2014; Thurgood). The field of packaging logistics offers established models in which the product and its packaging are integrated into a system, and in which the packaging's interactions along the supply chain are explored and described. This is why a packaging logistics perspective is relevant to apply in the research presented in this thesis.

Interpretations and definitions of sustainable packaging are found in prior research; but how to put the potential of packaging into practice has not yet been fully explored, especially not from a packaging logistics perspective. Prior research also argues that there is a need to broaden the horizons of the packaging debate from the persistent focus on minimization of packaging material, material selection and recycling of the same in favor of a more holistic view (Franco, 2013). This view should also encompass the functions of packaging in order to gain its full potential to contribute to sustainable development (Verghese et al., 2010). This thesis is a response to the call for such research.

Another trend in society is the increasing sale of organic food (EC, 2013; Ryegård and Ryegård, 2014; USDA, 2014). Packaging can be of interest to organic food consumers no matter if their choice is guided by their environmental, ethical or health concerns – the packaging selection has the potential to influence them all. In addition, the organic values are easily related to the values emphasized in sustainable development. Thus, if the values of the product and its packaging are to be aligned, organic food ought to be packaged in sustainable packaging. What remains uncertain, though, is if the values of organic food products that are generally communicated through their packaging, cover just the products or also the packaging.

Previous research was found that defines and explores the concept of sustainable packaging. However, no published research was found that specifically focuses on linking sustainable packaging and organic food. The ways in which to interpret and operationalize the concept of *sustainable packaging in an organic food context* thus remains a challenge for researchers and practitioners alike.

Making informed choices is argued to be decisive for sustainable development:

“Achieving sustainable development will depend on the widespread support and involvement of an informed public and of NGOs, the scientific community, and industry. Their rights, roles and participation in development planning, decision-making, and project implementation should be expanded.” (Brundtland, 1987, p.22)

In parallel, the sustainable packaging of organic food is thus not a responsibility restricted to the packaging industry but is rather dependent on the support and demands posed by consumers, brand owners, standardization organizations, legislative authorities, academia, and trade associations. This thesis is devoted to the exploration of how these stakeholders can contribute to the use and development of sustainable packaging. Such contributions can also trigger a demand that aggregates upstream in the supply chain and reaches the packaging industry. The choice to study the brand owners and consumers, who are closer to the product and the consumption of the product than the packaging industry, is further motivated from a packaging logistics perspective. This is because the sustainability profile of packaging is dependent on the interrelations between the packaging, the product and the supply chain actors in contact with the product packaging system.

Research purposes and research questions

The research presented has **two purposes**:

- To explore and elaborate on the potential contribution of packaging to sustainable development from a packaging logistics perspective.
- In an organic food context, to explore and elaborate on the potential contribution of organic food standardization organizations, consumers and brand owners to the use and development of sustainable packaging.

Since packaging is argued to have a potential to contribute to sustainable development, it is essential to explore and elaborate in what ways and under what conditions these contributions can emerge. The research includes two theoretically and four empirically based studies.

Theoretically based studies

The first purpose is addressed in the two theoretically based studies, Study 1 (Chapter 4) and Study 2 (Chapter 5, Paper I), that respond to the first and second research questions, respectively. These studies are not strictly limited to food packaging although many of the examples in Study 2 (Paper I) refer to food packaging.

The integration of sustainable development into different areas of our society is argued to be challenging in different ways. As a response to these challenges, different formalized approaches have been developed for the systematic management and monitoring of sustainable development on a general level according to Robèrt (2000). The present research takes its point of departure in exploring existing formalized approaches specifically directed at sustainable packaging. Attempts to compare and contrast these formalized approaches have been addressed from different aspects in prior research (Azzi et al., 2012; Grönman et al., 2013; Pålsson et al., 2013; Svanes et al., 2010). However, these studies are delimited to comparing approaches found in academic literature. These studies also include a limited set of parameters in relation to the tokens of sustainable packaging that were identified from a packaging logistics perspective. This resulted in the first research question.

RQ 1: How is a contribution of packaging to sustainable development potentially supported in formalized approaches provided by academia and/or trade associations?

Study 2 was triggered by a gap identified in Study 1 (related to RQ 1). The review in Study 1 revealed that the formalized approaches were limited in their consideration of packaging functions and the inclusion of indirect effects on sustainable development generated by these functions. This led to the second research question.

RQ 2: How can considerations of packaging functions in the packaging selection and/or development process potentially contribute to sustainable development?

Empirically based studies

The four empirical studies focus on how the aspects and perspectives of sustainable packaging identified in theory are addressed in practice. The studies address the second purpose of the thesis. An organic food context was chosen because organic food shares values easily related to the values emphasized in sustainable development.

The four empirically based studies explore and elaborate on the potential contribution organic food standardization organizations, consumers, and brand owners can make to the use and development of sustainable packaging. These stakeholders were selected on the assumption that they can contribute through: informed choices (consumers); the selection and/or development of packaging adapted to its specific content and context (brand owners); but also by creating and/or articulating demands that can aggregate

upstream in the supply chain (consumers and brand owners). Organic standardization organizations can contribute by encouraging use and development of sustainable packaging through encompassing packaging regulations in organic standards. Thus through guidance and regulations, organic standardization organizations have the potential to influence brand owners and consumers in their packaging-related decisions (Figure 1).

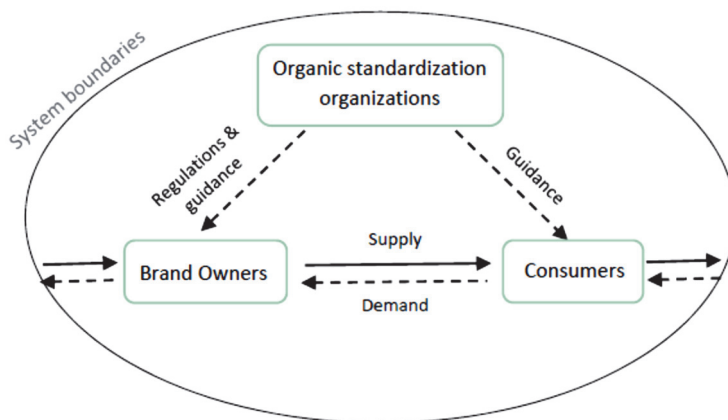


Figure 1: The three stakeholders studied and their interrelations.

The package is regarded as the interface between the product or brand and the consumer (Olsson and Larsson, 2009). As such, packaging promotes its content and through textual and graphic communication it affects consumers' perceptions of the product (Venter et al., 2011). For organic food, the organic message is primarily communicated via the package. However, it is uncertain if the organic values of the product also encompass the packaging. The first empirically based study (Study 3, Chapter 6) thus consisted of a situation assessment in the organic food context to explore and elaborate on the inclusion of packaging regulations in organic food standards in Sweden. An analysis was also carried out of how these packaging regulations can encourage and contribute to the use and development of sustainable packaging, thus addressing the third research question.

RQ 3: How is the use and development of sustainable packaging potentially encouraged by regulations in organic standards?

The empirically based research continued in Study 4 (Chapter 7, Paper II) with an exploration of how consumers can contribute to the use and development of sustainable packaging. This is explored in relation to sustainable packaging because the importance of consumers for sustainable development in general is emphasized by Brundtland (1987). Study 4 explores how well informed consumers are in terms of their perceptions and knowledge when it comes to environmental aspects of food packaging in general and

organic food packaging in particular. The organic values are communicated to consumers through the packaging which makes their perceptions and knowledge of organic food packaging in particular important to study. Study 4 also elaborates on consumers' ability to contribute to the use and development of sustainable packaging through their packaging selections based on their perceptions and knowledge. Study 4 addresses the fourth research question.

RQ 4: How can consumer perceptions and knowledge of environmental aspects of food packaging contribute to the use and development of sustainable packaging?

The results of the review of packaging regulations incorporated in the organic food standards revealed that brand owners need to take actions towards the use and development of sustainable packaging to comply with the organic food standards. The brand owners' ability to affect packaging solutions for their products emerged as an important area to explore. Its importance is further strengthened by indications that packaging plays an essential role as an intermediate between the brand owner and the consumer, and that packaging is used by brand owners to convey important messages and values to consumers. Thus, I found it important to explore whether the organic values of the product and the production of the same are also considered in brand owners' packaging selection and/or development processes. These processes were explored from a brand owner perspective, including the identification of challenges and enabling factors they encounter. Thus Studies 5 and 6 (Chapter 8, Paper III and IV) address the fifth research question to gain insights into the brand owners' ability to contribute to the use and development of sustainable packaging for their organic food products.

RQ 5: How can organic food brand owners contribute to the use and development of sustainable packaging through their ability to affect the packaging for their products?

Research focus

The focus of this thesis is on sustainable packaging. It is explored in two theoretically based studies in a more general packaging context and in four empirically based studies specifically related to organic food packaging.

My engineering background guided me to an initial focus on the environmental dimension of sustainable development, although efforts were made in particular in Study 2 (Paper I) to also encompass the social and the economic dimensions of sustainable development. The entry to sustainable packaging via the environmental dimension was also driven by the findings reported in the literature specifically related to this dimension. For instance, the World Economic Forum (WEF, 2009) claims that packaging has the third largest potential among the alternatives with the highest feasibility when it comes to decarbonizing supply chains. Thus, my initial research interest was directed to environmentally sustainable packaging. However, along the research process I gained

deeper insights into the integrated nature of the three dimensions and I widened the research scope to encompass all three. The incentives for companies to address the economic dimension is already strong, whereas incentives to address the environmental and social dimensions are not as obvious.

Food packaging is particularly relevant to study in relation to sustainable packaging because it stands for the majority of the packaged consumer goods in Sweden (Nilsson et al., 2011; Thorén and Vinberg, 2000). Food packaging thus concerns the daily living of consumers to a large extent. In addition, food and beverages represent a large part of the resource use and environmental impact of European households (Tukker and Jansen, 2006).

I selected the organic food context because of the increasing interest in organic values in society possibly related to an increasing awareness of health concerns and environmental effects of food consumption. The organic food context is of particular interest in studies on sustainable packaging because of the high demands and expectations consumers have that the content and its processing should live up to organic values. Since the package is used to communicate these values to consumers, I wanted to find out if these values, which are easily related to the values of sustainability, are apparent in the selection, use, development and regulations concerning packaging for organic food.

In Sweden there is a well-established organic food standardization organization, KRAV, founded in 1985. It has a high recognition rate among consumers (TNS_Sifo, 2010). KRAV, along with the strong growth of awareness and interest in organic values (Ryegård and Ryegård, 2015) and sustainable development among Swedish consumers is why the Swedish context was selected for the empirical studies.

Disposition of thesis

This thesis consists of ten chapters, three appendices and four appended papers.

Chapter 1: Introduction

This chapter provides an overview of the research area, places the research in a greater context, and describes its relevance. The purposes and the research questions are posed and the focus of the research is presented, along with a disposition of the thesis.

Chapter 2: The search for knowledge

The scientific reasoning of my search for knowledge, my role as a researcher, the process of knowledge generation, the research design, methods for data collection and analysis, as well as research quality and scientific rigor are discussed.

Chapter 3: Theoretical point of departure

Here, I elaborate on and provide the theoretical foundation of the research with a theoretical point of departure at the intersection of the areas of packaging logistics and sustainable development. A holistic view of sustainable packaging that integrates perspectives from packaging logistics and sustainable development is put forward. The organic food context is presented.

Chapter 4: Formalized approaches towards sustainable packaging (Study 1)

The RQ 1 results are presented. Study 1 covers how different formalized approaches such as frameworks, methods, models, guides and guidelines provided by academia and/or trade associations potentially support the contribution of packaging to sustainable development.

Chapter 5: Proposed terminology on packaging functions, features and their related indirect effects (Study 2)

This chapter responds to the gap identified in Study 1 by addressing RQ 2. It does this by exploring how packaging through its functions can indirectly affect sustainable development. A complement to the existing formalized approaches is proposed. The main findings of Paper I are summarized.

Chapter 6: The contribution of organic standards (Study 3)

The RQ 3 results are presented. The results were generated by a situation assessment and deal with how the regulations of organic food packaging in organic standards can contribute to the use and development of sustainable packaging.

Chapter 7: The contribution of consumers (Study 4)

The results from a consumer survey are presented that provide insights into how consumers' perceptions and knowledge of environmental aspects of packaging can contribute to the use and development of sustainable packaging. This responds to RQ 4 by presenting the main findings from Paper II.

Chapter 8: The contribution of brand owners (Studies 5 & 6)

This chapter summarizes the main findings from Paper III and Paper IV, providing insights on how brand owners can contribute to the use and development of sustainable packaging through their ability to affect the packaging of their products. It responds to RQ 5.

Chapter 9: An integrated perspective of sustainable packaging: extended analysis and discussion

This chapter provides a synthesis of the theoretically and empirically based studies and an extended discussion of the findings.

Chapter 10: Concluding remarks

The overall conclusions of the research and its contributions to academia and practice, and ideas for further research are put forward.

2. The search for knowledge

Every journey starts with a single first step, as does a research journey. A research journey towards a doctoral degree aims for knowledge enhancement. A suitable first step is thereby to reflect on the question: How is knowledge generated? This chapter takes its point of departure in this question by presenting the scientific reasoning behind the knowledge that has been generated. My research assumptions lay the ground for positioning the research and the use of a systems approach; they lay the ground for the process of knowledge generation, for the research design, and in the end, for the data collection and analysis methods (see Figure 2). I am convinced, in line with the reasoning of Arbnor and Bjerke (2007), that the generation of knowledge is influenced by my background and perceptions of reality. That is why this chapter concludes with my reflections on research quality and scientific rigor.

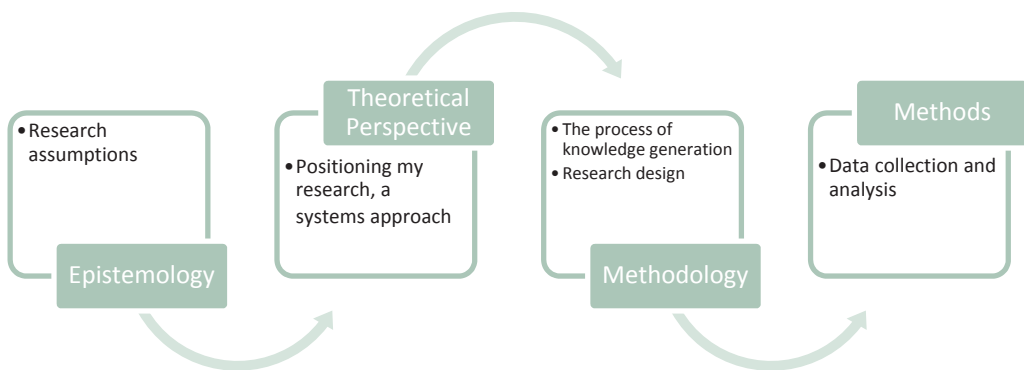


Figure 2: The process from research assumptions to the selection of methods inspired by Crotty (1998).

Research assumptions

In the search for knowledge, epistemological standpoints concern the grounds of knowledge and how one might begin to understand reality and communicate this knowledge to others (Burrell and Morgan, 1979). Epistemology has its roots in the Greek “episteme”, which means “knowledge”, and can be described as the science of knowledge (Åsberg, 2000). Positivism and anti-positivism have been identified as the two extremes

regarding epistemology (Burrell and Morgan, 1979). Positivism is characterized by the search for an objective form of knowledge free from values and independent of time and context (Mentzer and Kahn, 1995). Such knowledge is searched for in the laws of nature, regularities and relationships. For the anti-positivist, knowledge is a subjective creation and can only be understood from the perspective of the people directly involved in the activities studied (Morgan and Smircich, 1980).

In relation to the research presented in this thesis, it is impossible for me to disregard influences from my personal background, preconceptions and experiences. Consequently, I position myself closer to anti-positivism. I also consider knowledge as being created through one's efforts and not "out there" waiting to be discovered. In this research, knowledge springs from my interaction with other people during interviews and a survey, but also from my interpretation of the data and of the literature in an iterative process between the empirical data and theory.

As a researcher, I influence the results of my research. This influence has been present from the very beginning of my research journey in defining the research topic. My genuine interest in organic food and my educational and research background in packaging logistics guided my research interest. Another interest of mine is of a more political nature and a desire to contribute in a larger perspective to the better good of coming generations by enhancing sustainable development. Packaging logistics is an area with great potential to contribute to the greater good of society through its ability to enable safe and secure supply of necessities globally, but also through its potential to contribute to a more sustainable tomorrow. Thus, my background and interests have guided me and influenced my perception of what is an interesting and valuable area in which to conduct research.

I therefore argue that it is important to be aware of the influence a researcher's perceptions have on the research he or she is carrying out. This influence together with the measures I have taken to maintain research quality and scientific rigor are further elaborated in the section with that heading.

Positioning my research

According to Arbnor and Bjerke (2007), the methodological approach a researcher takes to his or her subject is divided into three categories on an objective-subjective scale: the analytical approach, the systems approach, and the actors approach. In an analytical approach, the whole is assumed to equal the sum of its parts (i.e., by studying the parts this can be summarized to explain the whole). Reality is also assumed to be objective and thus the knowledge generated is considered to be free of subjective experiences. At the other end of the objective-subjective scale is the actors approach. It attempts to understand rather than explain, and the knowledge generated is dependent on individuals; reality is assumed to be a social construction. The systems approach can be placed between the two,

although they overlap. In a systems approach, positive or negative synergies are found because the whole is not regarded to be the sum of its parts but instead more or less (Arbnor and Bjerke, 2007). The position of my research is illustrated by the green shaded area in Figure 3 in regard to the kind of knowledge, theoretical perspective and kind of data.

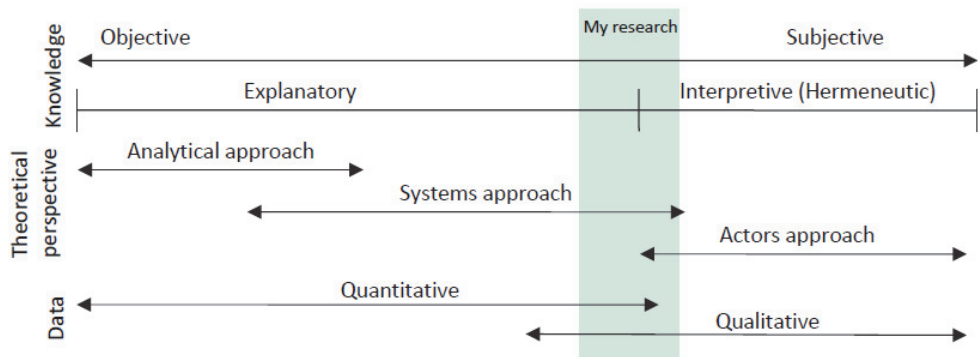


Figure 3: Positioning my research to kind of knowledge, theoretical perspective and kind of data in a modified version inspired by Arbnor and Bjerke (2007).

My research assumptions, described in the previous section, along with the topic of my research interest have led me to choose a systems approach because it enables knowledge development of the interactive nature of the parts in relation to the whole, rather than in relation to the separate parts. This is confirmed by Checkland (1993) who emphasizes the importance of studying the properties of the whole rather than its parts. The systems approach was also motivated because it is beneficial in understanding interrelationships:

“Functions or activities need to be understood in terms of how they affect, and are affected by, other elements and activities with which they interact.” (Ellram et al., 2006, p. 6).

The process of knowledge generation

The researcher’s path to knowledge can be approached from theory (deductive) or from the empirics (inductive). The research presented in this thesis followed an abductive path, that is, a learning loop between theory and practice (Kovács and Spens, 2005), which includes both inductive and deductive approaches to knowledge generation. In the literature, abductive processes are also referred to as “theory matching” or “systematic combining”. The abductive research process is focused on searching for suitable theories for empirical observations. Abduction is a process regarded to be important in the development of new theories (Dubois and Gadde, 2002). In logistics research, suitable

theories are commonly found in other research fields because logistics is a relatively new discipline, according to Kovács and Spens (2005).

In the abductive research process the empirical data are collected simultaneously with theory building, which results in a loop of learning (Dubois and Gadde, 2002; Kovács and Spens, 2004).

“By constantly going “back and forth” from one type of research activity to another and between empirical observations and theory, [the researcher] is able to expand his understanding of both theory and empirical phenomena.” (Dubois and Gadde, 2002, p. 555)

The knowledge generation presented in this thesis has followed an iterative process between empirical data collection and the review of existing literature. This process is schematically illustrated in Figure 4. The abductive approach was found to be suitable, in line with the reasoning of Kovács and Spens (2005) regarding its suitability for logistics research, since sustainable packaging from a packaging logistics perspective is an even newer research area with limited previous publications.

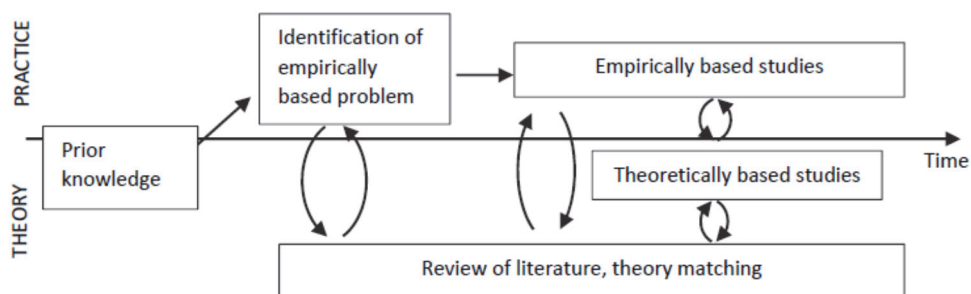


Figure 4: My abductive research process schematically illustrated, inspired by Kovács and Spens (2005, p.461).

The research design

The thesis research has an emergent design which means that new research questions arose based on the preceding studies and thus successively added to the knowledge development. The thesis consists of six interlinked studies as illustrated in Figure 5. These studies and my theoretical foundation gradually evolved together along an abductive research journey that iterated between theory and practice. The empirically based and theoretically based findings led to further inquiries.

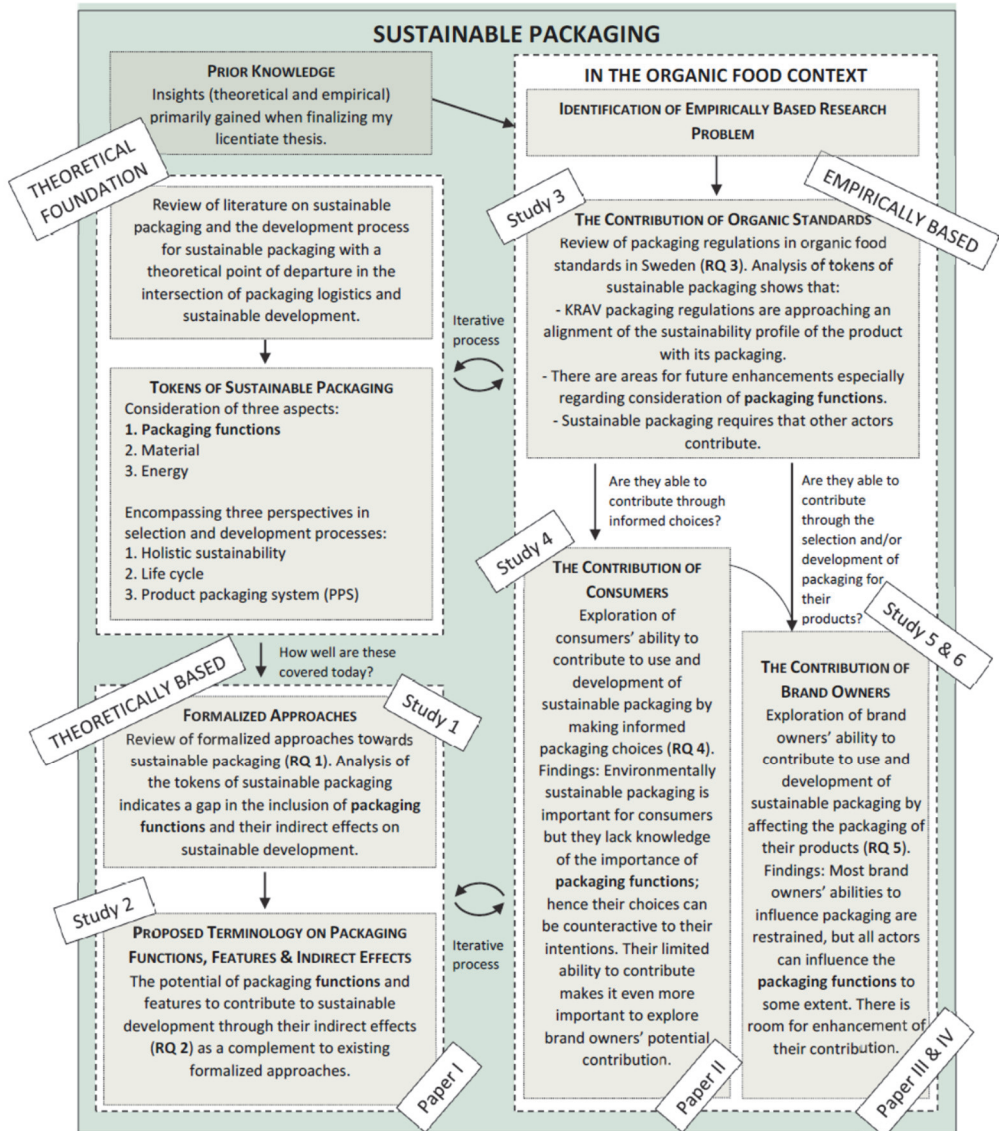


Figure 5: Structure of the research design, its theoretical foundation, the two theoretically based studies (Studies 1-2), the four empirically based studies (Studies 3-6) and where the results are reported schematically illustrated as an extended version of the illustration of the research process in Figure 4.

Influenced by my prior knowledge, a theoretical foundation at the intersection between the fields of packaging logistics and sustainable development was chosen because these areas together offer established models that are regarded as essential in striving for a holistic view of sustainable packaging. Three main packaging aspects were identified:

- functions
- material
- energy

Three perspectives were also identified:

- holistic sustainability
- life cycle
- product packaging system

These three aspects and three perspectives are defined here as “tokens” of sustainable packaging and are used as parameters in the analyses of sustainable packaging. The tokens are regarded as central to being able to successfully approach sustainable packaging in the process of packaging selection and development.

Sustainable packaging is sparsely covered in prior published research, especially from a packaging logistics perspective. Nor was any published research found that explicitly links sustainable packaging to organic food. This is why an exploratory approach was chosen, which is also reflected in the research purposes. As a result, qualitative data were primarily sought in order to achieve an in-depth understanding of the research topic and to gain contextual insights.

Theoretically and empirically based studies were included in order to enrich the research. The two theoretically based studies address the first purpose and respond to RQs 1 and 2. The four empirically based studies address the second purpose and respond to RQs 3-5.

Theoretically based studies

The first theoretically based study, Study 1, examined how the potential contribution of packaging to sustainable development is supported by different formalized approaches provided by academia and/or trade associations. It was not sufficient to only review academic approaches because the results were intended to be of high practical relevance. Including both also made it possible to capture and elaborate on the differences between the two. The research in Study 1 encompassed a literature review and an analysis based on the tokens of sustainable packaging that were identified in theory. The strength of the literature review was in its ability to provide an overview of the state-of-the-art of formalized approaches and to reveal the gaps in the approaches. The gaps were identified through analysis of the extent to which the formalized approaches included the tokens of

sustainable packaging. This indicated suitable areas for further research from a packaging logistics perspective. In this way, the review provided focus and direction for further studies and analysis. The literature review and the analysis are described in more detail in Appendix A.

In the second theoretically based study, Study 2, I chose to contribute to filling a gap identified in Study 1 of the formalized approaches. The gap addressed was the limited inclusion of packaging functions and their indirect contribution to sustainable development. I conducted a literature review encompassing a wide range of relevant literature on packaging functions and features. This was carried out to acquire an overview of the existing terminology on packaging functions and features, and to see how the terms were used in academia. The first step in the analysis was to structure the existing terms related to packaging functions and features. Then a review and analysis were carried out on how packaging could contribute to sustainable development by considering these terms. The data collection and the analysis are described in more detail in Paper I.

Empirically based studies

The empirically based research started out with a situation assessment in Study 3 to acquire insights into the state-of-the-art of packaging regulations in organic food standards in Sweden. The focus was on the organic food standards behind the EU Leaf (EU organic label) and KRAV label, by far the two most frequently appearing labels of their kind found in Sweden. The results of the EU standards review clearly revealed that no packaging regulations from a sustainability perspective were specifically directed to organic food packaging. In the search for a deeper understanding of KRAV's packaging regulations and the reasoning behind them, qualitative data were gathered through interviews and participation in workshops and seminars. Study 3 also offered an opportunity to influence future packaging regulations on the basis of my research findings. The research procedure in Study 3 is described in more detail in Appendix A.

The empirically based research in Study 4 explored consumers' ability to contribute to the use and development of sustainable packaging based on their knowledge and perceptions of environmentally sustainable packaging. Study 4 focused on the environmental dimension of packaging. This was judged to be a dimension that consumers most likely would have reflected upon and have opinions about. It is more frequently addressed in public debates and in the media than the social and the economic dimensions. One dimension was also considered to be sufficient when carrying out an in-depth survey in order to keep it within reasonable length. The survey instrument was chosen to access the perceptions and knowledge of a relatively large sample of consumers. It was constructed to capture primarily qualitative data in order to provide rich information and to enable access to consumers' perceptions and knowledge expressed in their own words. The smaller amount of quantitative data was collected to increase the generalizability of the results (Harwell, 2011) and to facilitate comparisons with results from other studies.

Additional descriptions of the construction of the survey instrument, the questions included, sampling, sample description and data analysis are found in Paper II.

Studies 5 and 6 are empirically based and focused on the brand owners' ability to contribute to the use and development of sustainable packaging by affecting the packaging of their products. Qualitative data were gathered through interviews to gain an in-depth understanding from a limited number of informants. Study 5 of brand owners was conducted based on small- and medium-sized brand owners and one large brand owner as a reference case. This data along with data from three micro-sized local brand owners collected in another project (Olsson et al., 2011) were analyzed and reported in Paper III. The results from Study 5 (Paper III) lead to further explorations in Study 6, an extended study that covered a wider range of different brand owners and their abilities to contribute to the use and development of sustainable packaging. The data collected from the five first brand owners in Study 5 were subjected to a reanalysis in Study 6 together with new data collected from 15 additional brand owners (Appendix B). How the informants were selected, how the interviews were conducted and how the data were analyzed in the extended study, Study 6, are reported in Paper IV. Further details on the brand owners and the informants included are found in Appendix B.

Data collection and analysis

The procedures used for data collection and analysis are described in this chapter. Table 1 provides an overview of the methods used in the six studies presented in this thesis.

Table 1: Data collection and analysis in the six thesis studies and where the results are reported.

		Data collection					Data analysis		
		Interviews	Survey	Observations	Seminars, workshops	Literature reviews	Content analysis	Typologies	Statistical analysis
Study 1 – Formalized approaches	Chapter 4,								
Study 2 – Proposed terminology	Chapter 5, Paper I								
Study 3 – Organic standards	Chapter 6,								
Study 4 – Consumers	Chapter 7, Paper II								
Study 5 – Brand owners	Chapter 8, Paper III								
Study 6 – Brand owners	Chapter 8, Paper IV								

Data collection

The data on which the studies are based were collected through interviews, surveys, observations, seminars, workshops, and literature reviews. The rationale for using these methods and the procedures followed are described below.

Interviews

The empirically based qualitative data input was primarily gathered through interviews. Interviews were chosen for their benefits in collecting in-depth data from a limited sample of informants. The interviews were based on open-ended questions because they allow the researcher “to enter into the other person’s perspective” (Patton, 1990, p. 278). The informants’ views were valuable and useful in these studies, which is regarded by Marshall and Rossman (2006) as an underlying assumption in conducting such interviews. Before the interviews were conducted, all participants gave their informed consent to participate. The interviews followed what Patton (1990, p. 280) calls “a general interview guide approach” where the interviews are focused on a set of issues outlined in advance. These issues were complemented with questions, but the order and the exact wording of the questions were adapted to the situation.

The interview was to be a beneficial data collection method because it enables the researcher to probe further into important topics that surfaced and to seek clarifications directly from the informant when needed (Bell, 1993; Marshall and Rossman, 2006). The interviews lasted 45-90 minutes. Most were carried out face to face; however in some cases by telephone, per the informant’s request. The interviews were generally taped and transcribed afterwards so the interviewer could focus on listening during the interview; exceptions were also made here per the informant’s request.

Because the brand owner study (Study 6) aimed for diversity and an understanding of the variation in the brand owners’ ability to affect the packaging of their products, a relatively large sample of brand owners was sought as recommended by Patton (1990). However, the exact number was not set a priori; new informants were interviewed until a point of saturation was reached. The brand owners were selected according to a purposeful sampling described by Patton (1990). The selection of in total 20 brand owners aimed to cover a broad variety of brand owners regarding their company size, in-house production and/or packaging or not, and food categories.

The informants were selected in consultation with the companies based on their perception of who was most involved in the selection or development of packages for their organic food products. During the interviews, most of the informants showed different examples of their packaging, occasionally contrasting them to past and/or forthcoming ones to provide a deeper understanding of the changes they had made and the rationale behind their packaging decisions.

The interviews in the organic standards study (Study 3) aimed for an in-depth understanding of their packaging regulations. Two informants were interviewed who had been identified as being the most engaged in the process of developing new packaging standards and guiding documents.

Survey

The survey format was chosen in the consumer study (Study 4) to capture data from a larger sample of respondents in line with Ejvegård (2007). The survey captured both qualitative and quantitative data. The qualitative data on consumer perceptions and knowledge were collected by means of open-ended questions, a procedure that van Dam and van Trijp (1994) and Gelici-Zeko et al. (2013) argue to be successful in studies of consumer perceptions. Patton (1990, p. 278) explains that the purpose of open-ended questions is to “not put things in someone’s mind but to access the perspective” of the respondent. The respondents were able to answer freely without being tied to a predefined set of alternatives and thus provide rich information and access to their different views and thoughts expressed in their own words. The quantitative data were collected by means of close-ended questions in the survey to increase the generalizability of the results (Harwell, 2011), and in some instances also increase the ability to compare the results to similar studies. The survey format also allowed the respondents to abstain from answering questions; their participation was voluntary. A more detailed description of the construction of the survey instrument, the questions included, the sampling procedure, and the sample description are found in Paper II.

Observations

Unplanned observations were carried out as a complement to some of the brand owner interviews. They occurred spontaneously when a given brand owner offered to show the interviewer around and let her follow the flow of the product packaging system through the processes at the brand owner site. This kind of observation is recommended by Widerberg (2002) and resembles what Arbnor and Bjerke (2007) call non-participant, direct observations. These observations added to a deeper understanding of the context.

Workshops and seminars

Notes were taken during the workshops and seminars in Study 2 and Study 3 and are considered as a complementing part of the data collection.

A workshop with a “brainstorm” session was held with 12 professionals in packaging logistics in 2012 to gather input on packaging features in Study 2.

My first contact with KRAV was in 2010 at a seminar held by KRAV’s Standards Director. I took notes and gained my first insights into their packaging regulations. I also participated in three workshops and one seminar in 2014-2015 arranged by KRAV and was asked to provide input to their process of developing new standards and guidelines on the packaging of organic food. During these sessions, I gained insights into the standards

development process, the thoughts and concerns behind the standards. This added to my understanding of the research context in Study 3 in particular. I was able to share insights from my research and together with the other participants, we contributed with our knowledge and perspectives to the development process. This participation can be regarded as an attempt to fulfill the third purpose of academia – the outreach of science.

Literature reviews

The two theoretically based studies (Studies 1 and 2) are based on literature reviews. A literature review according to Bryman and Bell (2015, p. 14) is a “critical examination of existing research relating to the phenomena of interest and relevant theoretical ideas”. Data for these reviews were identified through extensive computer based searches of literature. The literature reviews were guided by the procedure proposed by Hart (1998). These reviews were also systematic in terms of planning and structuring with inspiration from Bryman and Bell (2015). The first literature review (Study 1) covered an analysis of aspects included in the 18 formalized approaches to sustainable packaging that were identified. The second literature review (Study 2) presented an overview of packaging functions and features and an analysis of terms used and what they comprise. The search strategies, the sources of data, search terms and criteria for inclusion are described in Appendix A (Study 1) and Paper I (Study 2).

Data analysis

The collected data were analyzed based on their nature and the relevant research question. The rationale for using these methods and the procedures are described below:

Content analysis

Content analysis procedures with guidance from Patton (2002) were used to analyze the qualitative data in all the studies. Content analyses “refer to any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meaning”; content analysis also includes pattern recognition, “the ability to see patterns in seemingly random information” (Patton, 2002, p. 452-453).

I listened to the data material and read the transcripts several times; keywords and reasoning that were relevant to the purpose of the study (i.e., the core content) were identified, interpreted and coded. The coded data were organized thematically into categories that were either theory driven or data driven. Theory driven categories were used in Study 1 and for parts of the analysis of the organic standards in Study 3. These categories were derived from the tokens of sustainability identified in theory. In Study 5 (Paper III), the categories were derived from a framework for holistic packaging design inspired by Svanes et al. (2010). Whereas in the data-driven analysis in Studies 2, 4 and 6 (Papers I, II, IV) the data were organized into data-driven (i.e., inductively-generated)

categories. These data-driven categories were then matched to the categories identified in theory. In both these procedures, a spreadsheet was used as an aid in the process of categorizing.

I then searched for patterns or “descriptive findings” as described by Patton (2002) in the categories. In the analysis process, I searched repeatedly for alternative understandings as proposed by Marshall and Rossman (2006).

In Study 2 (Paper I), the content analysis of packaging functions and features was inspired by what de Groot (2006) refers to as “function analysis”. The inspiration regarded primarily the categorization: the process of structuring the data into packaging functions and features.

I included samples of direct quotes from the respondents and informants in order to illustrate the interpretation of the collected data as suggested by Corden and Sainsbury (2006). These quotes were used in three of the empirically based studies: Study 3, Study 4 (Paper II) and Study 6 (Paper IV). The quotes were selected with consideration to safeguarding the confidentiality of the respondents and informants so that they could not be identified.

Typology construction

The interviews revealed differences in the challenges the brand owners met (Paper III). These differences influenced their ability to affect the packaging for their products (Paper IV). To highlight these differences, what Marshall and Rossman (2006) call “an analyst-constructed typology” was thus selected.

The typology was constructed with guidance from Marshall and Rossman (2006), Patton (2002), Kluge (2000) and McKinney (1969). Typologies are used to describe empirical tendencies as they are “a system used for putting things into groups according to how they are similar” (Merriam-Webster, 2015). These were used to “identify, simplify, and order data so that they may be described in terms which make them comparable”; this is because “perceiving the world and structuring it by means of categorical types, is evidently an essential and intrinsic aspect of the basic orientation of actors to their situation” (McKinney, 1969, p. 1). The brand-owner typology was thus formulated based on factors in their organizational contexts that were identified in the data as having an influence on their ability to affect the packaging for their products. The four types identified were then used to describe and elaborate on their different abilities to contribute to the use and development of sustainable packaging.

Statistical analysis

The quantitative and qualitative data collected in the survey (Study 4) were subjected to statistical analysis (Paper II). These analyses were performed with the *Minitab* software. The values of the qualitative variables were assigned numerical values and then subjected to quantitative, statistical analysis in line with Trost (2012) and Dahmström (2011). The

qualitative data generated by the open-ended questions were first subjected to a qualitative content analysis. The coded responses (i.e., the non-metric data) were subjected to frequency counts and their relative frequency (percent) was calculated. These coded responses were then assigned numerical values. The responses were cross tabulated to the demographic variables and to the organic preference and subjected to a likelihood ratio chi-square test of significance to determine the potential significant differences in the consumer responses dependent on the demographic variables or organic food preferences.

Mean values were calculated for metric data generated by the responses on a scale of 1-5. These were then subjected to an analysis of variance in order to determine the differences in mean values between different groups.

Research quality and scientific rigor

Trustworthiness is important in research but as in all scientific efforts, the research presented in this thesis has strengths and weaknesses. These are discussed in relation to a set of specific criteria. Näslund (2008) argues that relevance and rigor are equally important in all research, irrespective of if it has a qualitative or quantitative approach.

In qualitative research, the criteria “credibility”, “dependability”, “confirmability” and “transferability” are often used (Lincoln and Guba, 1985). Common criteria used in quantitative research are: “internal validity”, “reliability”, “objectivity” and “generalization” (Hamberg et al., 1994). Because this thesis is based on research questions of a qualitative nature, the majority of the data is qualitative, and so the qualitative research criteria were chosen for this discussion.

A general strategy to ensure rigor in both qualitative and quantitative research is a “systematic and self-conscious research design, data collection, interpretation and communication” (Mays and Pope, 1995, p. 110). Näslund (2008) claims in relation to qualitative research that rigor should not only be based on traditional validity and reliability, but rather on the entire research approach and the process from design to analysis and the subsequent reporting thereof. This is in line with Marshall and Rossman (2006), who with reference to the criteria proposed by Lincoln and Guba (1985) explain the need for qualitative researchers to explicate the design and methods in detail so the reader can judge whether they are adequate and make sense. The importance of the actual reporting of the research is further highlighted as it is the main source for judging the quality of the study (Olander et al., 2009). Thus, particular efforts have been made in the reporting of the research to present the research process, methods used and interpretations to the reader. A set of techniques to enhance the trustworthiness of research are suggested by Lincoln and Guba (1985). The extent to which their techniques have been applied is elaborated on in the following four sub-sections.

Credibility

The credibility criteria deals with whether or not the findings and the interpretations are credible and truthful and apply to the collection of data as well as the analysis (Hamberg et al., 1994).

My prolonged engagement in the research process implies that I had the time needed to learn about the culture and the terminology used in the empirical context of the research, in line with Lincoln and Guba (1985). It provided time to build trustful relationships. This was accomplished, for instance, by participating in workshops and seminars with the informants (Study 3). One risk with such engagement highlighted by Lincoln and Guba (1985) is that these relationships can threaten the neutrality of the researcher. Aware of this threat, I reflected over my role as a researcher and strived to always stay true to it also in these relationships.

Triangulation was applied in the research in terms of engaging multiple and different sources, data collection methods and investigators. Regarding different sources, triangulation can refer to “multiple copies of one type of source” such as several respondents or informants; but it can also refer to “different sources of the same information” (Lincoln and Guba, 1985). Both of these were applied in the research but to a varying degree. In all six of the empirically and theoretically based studies, multiple sources in the sense of “multiple copies of one type of source” were included. Triangulation was also applied in the sense of “different sources of the same information” in the consumer survey reported in Paper II, where the empirical based findings were matched to findings generated from the literature. In most of the studies, the data were collected by more than one method. In addition, multiple investigators were used in the analysis of the data in Study 5 (Paper III) and in parts of the analysis in Study 2 (Paper I). In general, triangulation was used in order to be open to different perspectives of the same phenomena and thus enhance the credibility of the interpretations and findings in the research.

A strength related to the credibility of the research is the richness of data unfolding different perspectives. This enables a deeper understanding of processes and interactions in sustainable packaging, and thus further strengthens the applicability of the selected methodology.

The steps taken in the research process, the procedures chosen in data collection and analysis, and the findings were repeatedly discussed with co-authors and supervisors to decrease the influence of my pre-understanding on the findings. This together with the subjection of the research results to the peer review process of academic publishing, conferences and seminars has contributed to the trustworthiness of this research.

There are many challenges to ensure that literature reviews are rigorous and that the findings are credible. Many of these challenges are inherent in qualitative methods in general and have been discussed above. However, some of them are unique to the process

of reviewing literature and worth additional attention. Overall, the reviews in Studies 1 and 2 were conducted systematically and corresponded to clearly defined research tasks in efforts to respond to the research questions. This can be considered as a contribution to credibility in terms of the identification of relevant literature. Despite this, there is a risk that not all the relevant literature is retrieved due to overlooked databases and search words, which in turn affects credibility negatively. Nevertheless, the reviews encompass an extensive array of relevant references retrieved through structured database searches, encompassing several databases judged to be relevant for the topic. The criteria for inclusion were carefully defined, linked to the research questions. The systematic approach adopted in the process of analyzing the literature and the critical stance taken in identifying gaps is also an advantage in achieving credible results.

Dependability

Dependability refers to the stability of data, that is, the degree to which data change over time and due to the alterations that are made by the researcher during the process of analysis (Lincoln and Guba, 1985). Since the collection of data in the empirically based studies extended over time, there was a risk for inconsistency in the data collection. The use of interview guides was a means to achieve dependability. Although the interviewer strived to ask the same questions to all the respondents, the interviewing was an evolving process during which new insights could influence follow up questions, for example. The structured methods of analysis counteracted the risk for inconsistency in the categorization. Dependability was also addressed in terms of a detailed reporting of the research and procedures that was carried out, as suggested by Shenton (2004).

Confirmability

Confirmability is the criteria concerned with establishing that the “findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher” (Shenton, 2004, p. 72). The steps in the research process are described as fully as possible in the research presented to strive for transparency and thereby establish confirmability. The carefully chosen quotes enable readers to act as co-examiners of the interpretation of the data, which further strengthens both the dependability and confirmability of the studies.

Transferability

According to Lincoln and Guba (1985), the researcher is responsible for providing sufficiently thick descriptions of the topic and the time and context of his/her research to

enable others to determine its transferability. However, how thick such descriptions ought to be seems to diverge (Lincoln and Guba, 1985).

Descriptions of the time, context, participants or demographics of a sample, and the data collection methods have been included in all the empirically based studies (Studies 3-6) to enable others to make judgements regarding the transferability of the research. Particular efforts were made to provide the information suggested for inclusion by Shenton (2004) and Hamberg et al. (1994), but without endangering the confidentiality of the informants and respondents. The thickness of the descriptions included in the papers has been shortened to adapt to the format and praxis of such publications.

3. Theoretical point of departure

The research presented in this thesis is of an interdisciplinary nature, which has not made the research journey any easier but interesting and enriching. This has influenced the theoretical foundation of the research that spans over more than one research area, which is common in multifaceted research areas. The research builds upon theory identified at the intersection of packaging logistics and sustainable development (Figure 6). Particular attention is paid to the systems and models that have been used. A description of the organic food context in which the empirically based studies were carried out is also provided.

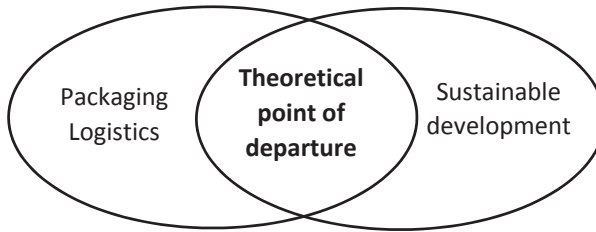


Figure 6: Positioning of the theoretical point of departure in this thesis.

Packaging logistics

Packaging logistics is a theoretical field of knowledge at the intersection of packaging and logistics (Figure 7). The importance of the interaction was realized about twenty years ago and is the point of departure for packaging logistics as a field of its own. The concept of “packaging logistics” was defined by Saghir (2002) in a way that captures the benefit of optimizing packaging in relation to the logistics processes instead of minimizing it. The definition also addresses the environmental aspects of packaging implicitly through its contribution to efficient processes:

“The process of planning, implementing and controlling the coordinated packaging system of preparing goods for safe, 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.” (Saghir, 2002, p. 45)

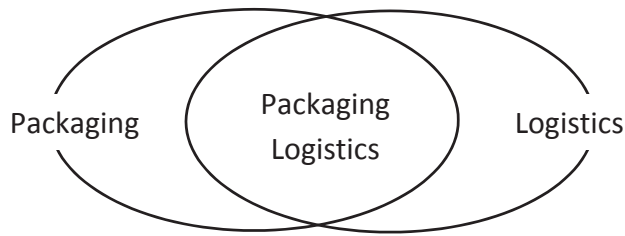


Figure 7: The theoretical positioning of packaging logistics research adapted from the Division of Packaging Logistics' website, Lund University, Sweden (2016).

Packaging logistics research originating in the Division of Packaging Logistics at Lund University has evolved over the years. Early theses from the Division focused on establishing the research area and positioning the concept of packaging logistics (Hellström, 2007; Johnsson, 1998; Saghir, 2004). Then came theses that applied the concept to studies of packaging development (Bramklev, 2007b; Klevås, 2005; Olsson, 2005; Silgård Casell, 2011; Sohrabpour, 2014), technology integration (Hellström, 2004; Viström, 2008), intelligent packaging (Johansson, 2009), tracking and traceability (Lindh, 2009; Pålsson, 2009; Ringsberg, 2013), sustainable supply chains (Abbasi, 2014), and managerial aspects and innovation (Beckeman, 2011; Olander Roesse, 2014). Despite this growth and involvement of the research area, the definition of packaging logistics has to my knowledge remained unchallenged.

Packaging logistics is further described to capture the multifaceted nature of packaging as it:

“...puts emphasis on a wider systems view, where interrelated aspects and trade-offs such as product development, logistics, marketing and environment are addressed and managed with emphasis on the understanding of the role of packaging along the product life cycle and its efficiency and effectiveness in the supply chain.” (Saghir, 2004, p. 41)

This description explicitly states that environmental aspects are addressed in the concept of packaging logistics, although neither environmental nor sustainability aspects are included in Saghir's (2002) definition; these two aspects are there implicitly, though, by the inclusion of the terms “safe, efficient and effective” that describe the journey of goods through the supply chain. The life cycle perspective in Saghir's (2004) description emphasizes packaging functions in terms of the “role of packaging”. Thus Saghir's (2002) definition remains relevant despite the shift in society towards environmental and social issues.

Packaging from a packaging logistics perspective

A package is the actual physical object. Packaging also includes the package's interaction with the logistics processes along the supply chain, such as packing, handling, display and unpacking; in other words, packaging is more than the actual package (Bramklev et al., 2004; Jönson and Johnsson, 2001; Olander-Roese and Nilsson, 2009). Packaging has a fundamental role in ensuring delivery of goods to the user or consumer in the best appropriate condition (Robertson, 2011). The following definition of packaging is often used in packaging logistics:

“Packaging is a coordinated system of preparing goods for safe, efficient and effective handling, transport, distribution, storage, retailing, consumption and recovery, reuse or disposal combined with maximizing consumer value, sales and hence profit.” (Saghir, 2002, p. 41)

In general, packaging is regarded in the packaging logistics field as a packaging system (Figure 8) comprising three different interrelated levels of packaging: primary, secondary and tertiary (Robertson, 1990). Primary packaging, or “consumer packaging”, is the one consumers generally relate to as packaging. They are the packages that come in direct contact with the product (Johansson et al., 1997; Krochta, 2007). The secondary level, or “retail packaging” is often used for grouping primary packages and thereby facilitates the handling of the products in retail (Hellström and Saghir, 2007; Johansson et al., 1997; Krochta, 2007). The tertiary level or “transport packaging” consists of pallets, shrink wrap and roll containers (Hellström, 2007; Hellström and Saghir, 2007). These are important enablers of the efficient transportation of many products at the same time (Johansson et al., 1997; Krochta, 2007).



Figure 8: Examples of the three packaging levels: primary, secondary and tertiary. Illustrations modified from Efficient Consumer Response (ECR, 2008).

The product packaging system (PPS) is commonly referred to in the field of packaging logistics. It is based on a systems approach that emphasizes the interdependence between the three levels of packaging in the packaging system and also with the product (Sohrabpour, 2014). From filling until consumption, the package and the product are to be regarded as a unified unit (Hellström and Saghir, 2007). The systems perspective shows that the performance of a product packaging system is not only dependent on the sum of the performances of each packaging level and the product, but on the interactions between the three (Figure 9) (Hellström and Saghir, 2007).

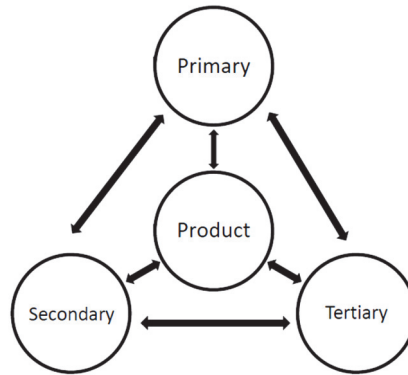


Figure 9: The product packaging system (PPS) and the interactions, adopted from Hellström (2007)

A product packaging system perspective is argued to be important since changes in one of the levels will impact the others (Olsson and Larsson, 2009; Pålsson et al., 2013). Pålsson et al. (2013, p. 290) exemplifies the interrelation:

“... improved protection of secondary packaging may reduce the level of protection needed in the primary packaging.”

The importance of regarding the product and its packaging together as an interlinked system is also emphasized from a sustainability perspective by Fitzpatrick et al. (2012) and Svanes et al. (2010). In this research, the first fundamental sub-systems in sustainable packaging is the product packaging system, where the product and packaging are interdependent, and where the three interrelated packaging levels together meet the demands on the packaging.

Logistics from a packaging logistics perspective

Several slightly different definitions of logistics have evolved over the years. The definition used in this thesis is the Council of Supply Chain Management Professionals’ (CSCMP, 2013):

“The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements.”

It was chosen because it is perceived to be the main definition of logistics used in the field of packaging logistics. The interconnection between logistics and packaging is particularly

well-covered from a packaging logistics perspective by Saghir (2004) and Hellström (2007).

Despite the slightly diverging definitions of logistics, Silgård Casell (2011) concludes that, the schematic illustrations remains similar with a flow of physical goods, money and information along a network or chain of different actors. The real picture of actors in a supply chain is more of a complex network structure according to Nilsson (2004), involving several different actors that are in turn part of other networks in different constellations. In spite of this, it is commonly simplified into a schematic illustration of a chain of actors, a simplification also applied in this thesis (Figure 10).

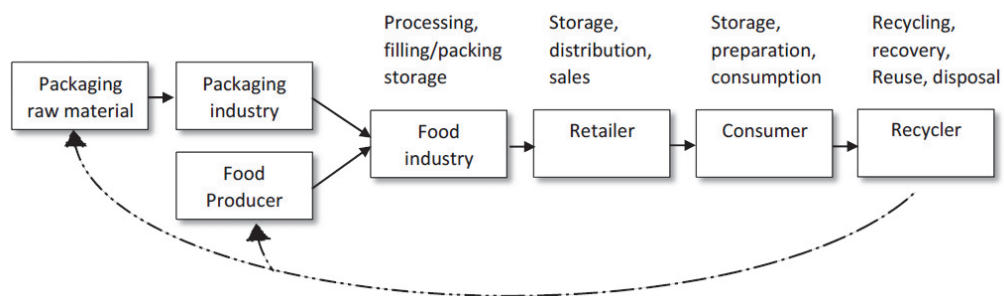


Figure 10: Schematic model of a supply chain for a generic packaged food product distributed through retail, complemented with a cyclic approach illustrated by the dotted arrows of back flow. Arrows represent transports. Illustration inspired by Simms and Trott (2010) and Williams et al. (2008).

Network or supply chain models are frequently used in packaging logistics research to depict a product packaging system's journey from raw material production to use. Some of these models include recycling, some not. A circular illustration of the product packaging systems journey is found in the report on sustainable packaging by ECR (2009). Case specific differences exists regarding the actors a product packaging system encounters along the supply chain. Here, the supply chain includes consumers, as they in turn supply the recyclers with used packages and the chain can start all over again as a circular system. Thus a linear supply chain model is complemented with a "back flow" that encompasses the circularity in Figure 10, but is still presented in a traditional supply chain format. This model is regarded in this research as the second fundamental sub-system in sustainable packaging.

Packaging has traditionally been regarded as a necessary evil, although Simms and Trott (2010) argue that it can provide performance related benefits to all the actors in the supply chain:

"Its design can affect the performance of each one of them and can potentially positively influence their efficiency and effectiveness as the product is moving." (Simms and Trott, 2010, p. 404)

Thus, it becomes clear that packaging has a potential to create benefits or values in relation to the actors in the supply chain. However, these actors primarily encounter and handle a specific packaging level which means that their packaging demands and desires refer to just that level (see Table 2).

The consumers or users are not included in Table 2 by Hellström (2007). In spite of that, the presentation is a good illustration of how different actors have different needs related to the three packaging levels. User demands often relate to the primary package, and the packaging development literature highlights the importance of including them to improve the success rate of a new package (Krochta, 2007; Simms and Trott, 2010). The inclusion of consumer insights in the development process is growing in importance as consumers are increasingly more demanding (Löfgren, 2005).

Table 2: Packaging demands along the supply chain apart from consumer demands, adopted from Hellström (2007)

Supply chain members	Manufacturer		Distribution centre						Retail outlet		
Logistics processes	Filling process	Warehousing process	Transport	Receiving process	Storing process	Picking process	Shipping process	Transport	Receiving and shipping	Replenishing process	Reuse and recycle
Packaging system											
Primary	Packaging line efficiency Filling speed Label application Closing & sealing technology Flexibility									Handling efficiency Promoting sale Shelf adaptation Product identification	Handling efficiency Material
Secondary	Handling efficiency Packaging line efficiency					Handling efficiency Identification Ergonomics Protection Stability			Handling efficiency Identification	Handling efficiency Identification Protection Shelf adaptation Ergonomics	Handling efficiency Material
Tertiary	Handling efficiency Stackability	Handling efficiency Stackability Protection Stability	Cube utilization Stackability Weight & height Stability	Handling efficiency Stability Identification	Cube utilization Weight & Height	Handling efficiency Material	Handling efficiency Weight & height Stability	Cube utilization Weight & height Stability Stackability	Handling efficiency Material Stability	Handling efficiency Store concept adaption Product identification Promoting sale	Handling efficiency Material

Thus, the actors in the supply chain (including the consumers or users) all have their own demands on the product packaging system (Hellström and Saghir, 2007; Rundh, 2009; Simms and Trott, 2010) and potentially also demands related to its sustainability performance.

Packaging development from a packaging logistics perspective

In a packaging development process, consideration must be taken to the demands posed by (Krochta, 2007):

- authorities,
- supply chain actors including users or consumers,
- the product itself.

Packaging development is thus a balancing act. The key success factor is the ability to access, balance and transform the demands from different stakeholders into attractive packaging solutions (Rundh, 2009).

The term “packaging development” in this thesis is used to capture the process in which new or modified packaging solutions take form. “Packaging design” is a related term that is used interchangeably with “packaging development”; however, it can also be used to specifically refer to the packaging’s graphic design. The design terms used in this thesis are “graphic design” and “physical design” to avoid misinterpretations.

The packaging development process

The packaging development process is explored from a packaging logistics perspective in particular by researchers such as Klevås and Saghir (2004) and Bramklev (2007b). The packaging development process is less explored in the literature than the product development process (Bucci and Forcellini, 2007). Although almost all processed products have some kind of packaging, packaging is sparsely incorporated in product development models according to Bucci and Forcellini (2007). Still, some models specifically related to packaging development were found (Bramklev, 2007b; Bucci and Forcellini, 2007; DeMaria, 2000; Griffin et al., 1985; Klevås and Saghir, 2004; Paine, 1990; Soroka, 2002; ten Klooster, 2002). These models share similarities but also show disparities.

The majority of the packaging development models identified describe the packaging development process separately from the product development process. Three exceptions explicitly relate the processes to each other. The first examined the packaging development process from a packaging logistics perspective (Bramklev, 2007b). Bramklev (2007b) identified a lack of a generic and integrated product and packaging development process models and so proposed a generic and concurrent model. A process based on this model can be shortened (Krochta, 2007) and can optimize the entire product packaging system (Bramklev, 2007b). The concept “product packaging system” is explicitly integrated into Bramklev’s model. The second exception also relates the two development processes to each other; in addition it explicitly integrates sustainability considerations into the proposed model (Bucci and Forcellini, 2007). The third exception specifically focuses on packaging logistics in its packaging development model and proposes the integration of

packaging development in the early phases of the product development process (Klevås and Saghir, 2004).

These three packaging development models have been used to categorize and understand the different development processes identified in the empirically based data linked to the RQ 5 (Paper IV). However, in addition to creating an overview of the different processes, the models have served as a basis for elaborating on the abilities and restrains for brand owners to influence the sustainability performance of their packaging posed by the kind of development process.

Turning demands into values in the packaging development process

The many packaging demands of different supply chain actors can be translated into: “abstract formulations of the task the product must be able to perform” (Bramklev, 2007a, p. 10). The “product” referred to in the quote is in this context the packaging. This means that the packaging demands are translated into packaging tasks or functions to fulfill these demands.

In Roozenburg and Eekels’ model (1995), referred to in Bramklev (2007a), values and demands are related to specific functions realized by features of the product. This model is adapted to a packaging context in Figure 11.

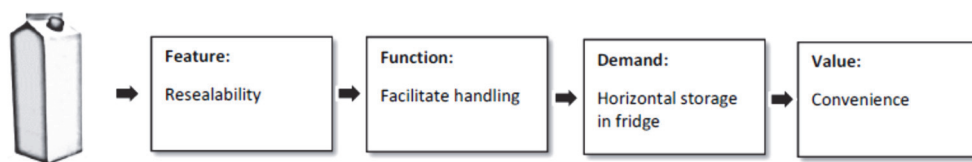


Figure 11: The relation between packaging, feature, function, demand and value. Inspired by Roozenburg and Eekels (1995)

The Roozenburg and Eekels’ model (1995) is illustrated by a consumer packaging example. It links one packaging feature – a resealable cap – via its function to facilitate consumers’ handling of the package to fulfill an identified consumer demand for horizontal storing of milk in the refrigerator and thereby create value in terms of consumer convenience.

The model by Roozenburg and Eekel (1995) is found useful also within packaging logistics for illustrating the connection between packaging functions, features and fulfilling the demands of consumers but also other actors in the supply chain. This in turn enables value creation not only for consumers but for all actors in the product packaging supply chain that come in contact with the packaging.

Value is explored by several researchers in different contexts. Olsson (2005) elaborates on different definitions of consumer/customer value from a packaging logistics perspective including functional value (quality and features of the product), transactional value (price

and availability), emotional value (confidence and emotions in the use situation) and social value (relations, status, image and identity). I acknowledge that consumer/customer value consists of an intricate mix of several aspects. Nevertheless, this thesis pays particular attention to the functional and the emotional values of sustainable packaging linked to the functions and features responding to demands along the supply chain.

Value created by the product packaging system is also elaborated on by (Löfgren, 2005; 2006), who concludes that the total offer to the consumer from a packaging perspective consists of the product (the content), the prerequisites for services and the physical package. Löfgren (2006) focuses on the creation of customer value of packaged consumer products and pays particular attention to the primary packaging. His reasoning is extended in Figure 12 to encompass the entire packaging system. The extension can thus cover value creation for a wider range of stakeholders, such as the different supply chain actors interacting with the packaging system.

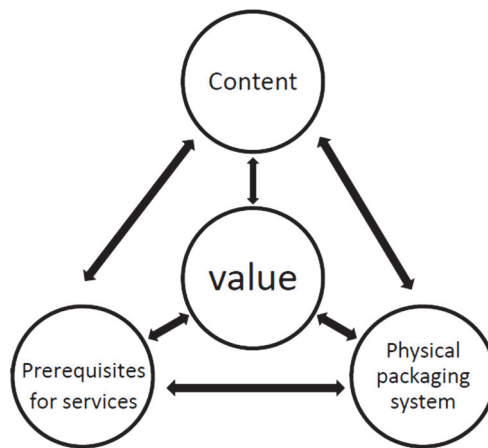


Figure 12: Value creation of packaging systems inspired by Löfgren (2006).

This extension of the model is particularly relevant to the conclusion by Simms and Trott (2010) that packaging can provide benefits to all the supply chain actors.

Sustainable development

The first and most widespread definition of sustainable development can be found in the United Nations' Brundtland Report and is used in this thesis:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Brundtland, 1987, p. 37)

The Brundtland Report established three important and interlinked goals or dimensions of sustainable development: environmental protection, social equity and economic prosperity. These were further developed in Elkington's (1997) “Triple bottom line” or care for “people, planet and profit” (3P) that go beyond traditional measures of profit by adding environmental and social values. There are several proposed systems approaches to grasp the multifaceted nature of sustainable development (Bossel, 1999; IISD, 2013).

These three dimensions of sustainability are further explained in the renewed *Strategy for Sustainable Development* adopted by the European Council in June 2006 (EC, 2006):

“ENVIRONMENTAL PROTECTION: Safeguard the earth's capacity to support life in all its diversity, respect the limits of the planet's natural resources and ensure a high level of protection and improvement of the quality of the environment. Prevent and reduce environmental pollution and promote sustainable consumption and production to break the link between economic growth and environmental degradation.

SOCIAL EQUITY AND COHESION: Promote a democratic, socially inclusive, cohesive, healthy, safe and just society with respect for fundamental rights and cultural diversity that creates equal opportunities and combats discrimination in all its forms.

ECONOMIC PROSPERITY: Promote a prosperous, innovative, knowledge-rich, competitive and eco-efficient economy which provides high living standards and full and high-quality employment throughout the European Union.”

From a systems perspective, sustainable development is based on a system comprising these three interlinked dimensions: environmental, social and economic (Figure 13). Thus a holistic perspective implies that all three dimensions be taken into consideration in sustainable development approaches (Tuazon et al., 2013). This thesis acknowledges that the three dimensions are needed to access a holistic picture of sustainable development. The model from the field of sustainable development with the three interlinked dimensions is regarded in this research as the third fundamental sub-system in sustainable packaging. It can at times be meaningful to highlight just one of the dimensions as long as you are aware that you are not taking in the whole picture.

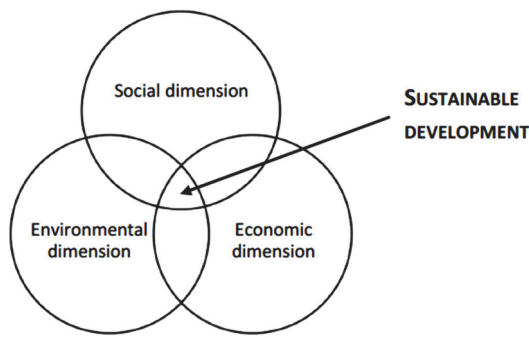


Figure 13: Sustainable development from a systems perspective comprising the three dimensions: social, environmental and economic, inspired by *The Sustainable Leader* (2013).

The European Council views sustainable development from a European Union perspective, whereas the United Nations views it from a global perspective in the Brundtland Report (1987). The UN finds that global actions towards sustainable development are needed because it is a global problem we are facing:

“Ecosystems do not respect national boundaries. Water pollution moves through shared rivers, lakes, and seas. The atmosphere carries air pollution over vast distances.”
(Brundtland, 1987, p. 33)

In the analyses of sustainability on a more local level in a country, household, neighborhood or company, caution has to be taken of the risks of sub-optimization and burden shifting. The two risks can be translated from general sustainability into the packaging context and constitute an important theoretical input from the sustainable development research area. Geographical boundaries make little sense in sustainability assessments according to Brundtland (1987). Transferred to a packaging context, boundaries in terms of organizational borders make little sense in the development or assessment of sustainable packaging. This is because burden shifting can occur in a packaging development context when one actor in a product packaging supply chain gains not only environmental but also economic benefits from reducing the amount of packaging material, whereas another actor later in the chain suffers from reduced quality and/or increased product loss due to impaired protection. A **life cycle perspective** has been suggested in prior research as a more relevant system boundary to avoid burden shifting (Fitzpatrick et al., 2012).

The circular approach has been identified as a fundamental principle in the sustainable development literature. This circularity is addressed in terms such as: “circular economy” and “cradle to cradle”. What is regarded as waste in the linear economy (cradle to grave) is regarded as raw material in the circular economy (Figure 14) where the focus is on using, returning and renewing products instead of consuming them (EMAF, 2015).

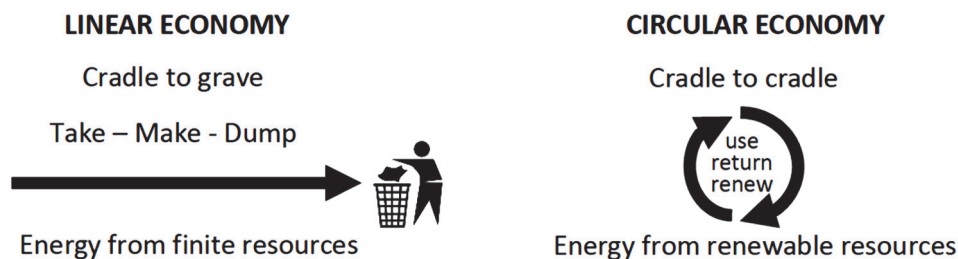


Figure 14: The principles of linear and circular economies. Inspired by McDonough and Braungart (2009) and EMAF (2015).

A cradle to cradle design concept was developed and presented in 2002 by McDonough and Braungart (2009). It is inspired by the way nature works in continuous cycles of “biological metabolism” and applies this to “technical metabolism” meaning that products and packaging can be designed for continuous recovery and reutilization as biological and/or technical nutrients within these metabolisms. This approach is built upon three principles: 1) elimination of waste since everything is a nutrition for something else, 2) power with renewable energy, and 3) respect diversity (McDonough and Braungart, 2009).

Strategies based on efficiency (doing things right) or simply aiming to “produce more from less” have been criticized for only delaying sustainability problems (Westerlo, 2011). Thus the concept of cradle to cradle design, based on a new strategy – effectiveness or “doing the right things” – can be regarded as a response to that criticism. Efficiency, though, is argued by Westerlo (2011) to be valuable if “implemented as a tool in an effective system” or as a transitional strategy.

The circular approach encompasses a life cycle perspective of the product packaging supply chain. Whether you confess to a cradle to grave or cradle to cradle approach, a life cycle perspective encompasses all the actors in the supply chain along the entire life cycle of the product, packaging, or product packaging system. “Life cycle” is defined by the Merriam-Webster dictionary as “a series of stages through which something (as an individual, culture, or manufactured product) passes during its lifetime”. Although a life cycle perspective covering a cradle to cradle approach (NLAMIE, 2011) is proposed from a sustainability perspective by McDonough and Braungart (2009), it is applied with a cradle to grave approach in the context of sustainable packaging development by Lewis et al. (2007):

“It needs to consider the entire lifecycle of the package from raw materials through to ultimate disposal...” (Lewis et al., 2007, p. 3)

The importance of a life cycle perspective in sustainable packaging development is however emphasized by Luttikhuis et al. (2014) and Lewis et al. (2007) due to the otherwise apparent risk of burden shifting:

“... to avoid problems being transferred from one part of the lifecycle to another.” (Lewis et al., 2007, p. 3)

The Life Cycle Assessment (LCA) is a “systematic approach for assessing the environmental impact of products of their whole life cycle” (NLAMIE, 2011) and it is defined as the:

“compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.” (ISO, 14040: 1997, p. 2)

Traditional life cycle assessment is a useful way to quantify the negative environmental effects of a product through its entire life cycle – from raw material extraction to disposal or recovery (Lai et al., 2008; Lewis et al., 2010; Wever and Vogtländer, 2013). However, it has limitations in assessments of products designed with a cradle to cradle approach (NLAMIE, 2011).

The LCA has limitations when it comes to evaluating sustainable packaging. One is that it currently only considers environmental aspects and not social or economic ones (Lewis et al., 2010; Wever and Vogtländer, 2013). It can only be used to compare different packaging designs that perform equally well regarding functionality and quality. For instance, it cannot consider how well the product performs in facilitating handling and how much convenience it contributes to the users (Wever and Vogtländer, 2013). A drawback concerning food packaging, according to Grönman et al. (2013, p. 198) is that “the food losses are often neglected”, which is a possible indirect effect of insufficient packaging. They argue that this is why “the packaged product would be important to include” in the analysis. The present shortcomings in the traditional LCA can, however, be compensated for by using the LCA in a combination with other methods or through further developments.

Sustainable packaging: The intersection of packaging logistics and sustainable development

Sustainable packaging was explored, described and analyzed from the theoretical point of departure that was adopted at the intersection of packaging logistics and sustainable development. Sustainable packaging is the main topic of knowledge development in this research. The terminology used in the field and the definitions of sustainable packaging

are explored, analyzed and described in this section. A holistic view of sustainable packaging is also put forward.

Terminology used

The term “sustainable packaging” is not agreed upon by all. According to ECR Europe (2009, p. 17), there is no such thing as “sustainable packaging”; it is instead argued that “There can only ever be a more sustainable way of manufacturing”. This thesis admits that sustainable packaging is a comparative concept in the sense that it can only be defined in relation to its context. This is in line with Brundtland (1987, p. 15):

“The concept of sustainable development does imply limits – not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities.”

Nor is sustainable development fixed over time “but rather a process of change” (Brundtland, 1987, p. 15). Despite this argumentation, “sustainable packaging” is frequently used in industry and academia.

There are also different terms found that parallel the use of “sustainable packaging” in practice and in academia. Some explicitly focus on the environmental dimension of sustainability. The frequency in use of seven terms was examined in a literature search (Table 3).

Table 3: Number of hits of a selection of terms found that are parallel to “sustainable packaging”, updated 2015-05-15

Terms	Google Scholar*	LUB Search**
Green packaging	3180	562
Sustainable packaging	1450	341
Environmentally friendly packaging	1220	320
Eco-packaging***	177	9
Environmentally sound packaging	59	6
Environmentally sustainable packaging	31	2
Environmentally conscious packaging	23	5

*Exact phrase, not including quotes or patents, 2000-2015. **Exact phrase, all text, academic journals only, 2000-2015. ***To avoid inclusion of hits referring to the medical term “eco packaging cells” hits including “cell” were removed.

“**Green packaging**” was the term used in most references found in Google Scholar and the Lund University search engine, LUB Search (Table 3). According to Mercier (2009), “green” has become an umbrella term and its actual meaning is not clear anymore as it has undergone a change from a term expressing environmental concern to include several attributes, attitudes, values and behaviors. “Green” is a code word for different

environmental concerns and is usually perceived as something positive (Rodrigue et al., 2001). Dapiran (2008, p. 426) agrees that the term “green” implies a positive connection to the environment, however, he goes on to state that the term is “vague to be almost meaningless”. “Green packaging” can be synonymous with “recyclable packaging” but it can likewise be even synonymous with “sustainable packaging”.

“**Sustainable packaging**” was the second most frequently used term in the references found using Google and with LUB (Table 3). It is the term that the Sustainable Packaging Coalition (SPC, 2011) and the Sustainable Packaging Alliance (Lewis et al., 2007) define and present practical guidelines for. It is frequently used in industry (Young, 2008a). However, it was found that most U.S. consumers (90%) were not familiar with the term and of those who claimed to be familiar, every other one mistook it for durable packaging. Thus, the term can be challenging to use in consumer communication.

The term “**environmentally friendly**” is also frequently used (Table 3) and considered to be well-known among consumers (Magnusson et al., 2003). However, less effort has been spent by industry and academia on defining and developing the term “environmentally friendly” in contrast to “sustainable packaging”; hence, it is vaguer.

A less frequently used term in comparison to “sustainable packaging” but still used is the ‘**eco-packaging**’ (Table 3). Eco-packaging can be regarded as a successful result of an eco-design process in packaging. However, there seems to be no uniform understanding of what “eco” means. “Eco-design” is argued to be synonymous with “sustainable design” and “eco-packaging” as synonymous with “sustainable packaging”, according to Lee (2013). But in the Eco-design Directive (2009/125), only the environmental dimension is included and Schischke et al. (2005) argue that “eco” stands for both ecology and economic. It thus remain unclear what eco-packaging really means.

In cases where the environmental dimension is in focus, terms such as “**environmentally sustainable packaging**”, “**environmentally sound packaging**” and “**environmentally conscious packaging**” are found, but are less common (Table 3). “Environmentally sound” can be considered synonymous with “environmentally friendly” and is a less defined term. “Environmentally conscious packaging” is linguistically difficult; people or organizations can be environmentally conscious in their actions or choices, but not a package itself.

The term “sustainable packaging” is used in this research, even though I agree that “sustainability” is a comparative concept over time and in relation to its context. “Sustainable packaging” is used with some minor exceptions as it is the most well defined term to differentiate packaging that has undergone a development process aimed at sustainable packaging, from packaging in general. The term is frequently used in industrial settings and academia, and has received considerable attention in research and in general. The use of “sustainable packaging” can be compared to the use of other well established terms related to sustainable development such as “sustainable forestry”.

“Miljövänlig” is the Swedish translation of “environmentally friendly” and was used in communication with consumers in the survey. The Swedish translation of “sustainable packaging” was not used, motivated by Young (2008a) recommendation to avoid misconceptions and confusion with “durable packaging”. The term **“environmentally sustainable packaging”** was used in cases where the environmental dimension was referred to in particular.

The development process for sustainable packaging is sparsely described in the literature and there is no consensus regarding the terminology. It has been addressed in terms of “sustainable packaging design” (Bucci and Forcellini, 2007; Grönman et al., 2013; Svanes et al., 2010; Vergheze et al., 2010) and “sustainable packaging development” (Nordin and Selke, 2010; Sonneveld et al., 2005; SPA, 2002) but not explicitly defined. There is more literature that covers the development or design of sustainable products in general. These processes are referred to as: “sustainable product development”, “sustainable design”, “design for sustainability” and “cradle to cradle”. “Design for environment” particularly emphasizes the environmental dimension in the design or development process.

“Eco-design” is also a related term. Eco-design is used specifically in relation to packaging by Holdway et al. (2002). However, there are inconsistencies regarding what dimensions the term “eco” includes. Eco-design focuses on environmental and economic aspects as integrative parts of the development process according to Schischke et al. (2005). Even though Schischke et al. (2005) argue that “eco” stands for both ecology and economic, several definitions of eco-design, including their own, only explicitly address the environmental dimension. Among these is the definition in the Eco-Design Directive:

“... the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life-cycle.” (EC, 2009/125, p. 16)

Because the term “sustainable packaging” has been used in this research, **sustainable packaging development** was chosen to describe development processes that aim towards sustainable packaging.

Definitions of sustainable packaging

There is no one single definition of sustainable packaging (Grönman et al., 2013; Lewis et al., 2010; Sonneveld et al., 2005; Vergheze et al., 2010; Wever and Vogtländer, 2013). However, the concept and its interpretation have been developed by different university and industry groups, such as the Sustainable Packaging Coalition (SPC), an industrial working group in the U.S.A.; the Sustainable Packaging Alliance (SPA), an alliance between two Australian universities and a consulting firm; the European Organization for Packaging and the Environment (EUROPEN), a trade association; and the Efficient Consumer Response (2009).

Sustainable packaging is defined by the SPC (2011, p. 1) by meeting the following criteria:

- A. “Is beneficial, safe and healthy for individuals and communities throughout its life cycle.
- B. Meets market criteria for performance and cost.
- C. Is sourced, manufactured, transported, and recycled using renewable energy.
- D. Optimizes the use of renewable or recycled source materials.
- E. Is manufactured using clean production technologies and best practices.
- F. Is made from materials healthy throughout the life cycle.
- G. Is physically designed to optimize materials and energy.
- H. Is effectively recovered and utilized in biological and/or industrial closed loop cycles.”

The SPA in its redefined version states that **sustainable packaging** should meet the following four principles (Lewis et al., 2007, p. 16-17):

“Effective: social and economic benefit (The packaging system adds real value to society by effectively containing and protecting products as they move through the supply chain and by supporting informed and responsible consumption.)

Efficient: doing more with less (The packaging system is designed to use materials and energy efficiently throughout the product life cycle. Efficiency can be defined through reference to world’s best practice at each stage of the packaging life cycle.)

Cyclic: optimizing recovery (Packaging materials used in the system are cycled continuously through natural or industrial systems, with minimal material degradation. Recovery rates should be optimized to ensure that they achieve energy and greenhouse gas savings.)

Safe: non-polluting and nontoxic (Packaging components used in the system, including materials, finishes, inks, pigments and other additives do not pose any risks to humans or ecosystems. When in doubt the precautionary principle applies.)”

According to the , 2009, p. 17) definition, the role of packaging in sustainable development packaging should:

- “be designed holistically with the product in order to optimize overall environmental performance,
- be made from responsibly sourced materials,

- be designed to be effective and safe throughout its life cycle,
- meet market criteria for performance and cost,
- meet consumer choice and expectations,
- be recovered efficiently after use.”

All these definitions differ but also share similarities. All include elements related to a **holistic sustainability perspective**: environmental, social and economic dimensions of sustainable development. They all share a **life cycle perspective**. The inclusion of the **product and the packaging system** is particularly apparent in the SPA definition as it explicitly includes a packaging systems perspective and the product. The ECR also includes the product but does not explicitly address the packaging system nor the levels of packaging.

Aspects related to **packaging functions, packaging material, and energy** are shared by them all although expressed differently. The definitions of the SPC and SPA were more specific than the ECR’s.

Packaging functions are referred to in all three definitions. Both the SPC and ECR state that sustainable packaging has to meet market needs concerning performance. The SPA specifies that sustainable packaging should effectively contain and protect products and support informed and responsible consumption. The SPC and SPA include packaging materials: efficient and optimized use of safe/healthy, renewable packaging materials easily recycled or effectively recovered. The third area shared is the efficient or optimized use of energy in both the SPA and SPC. The SPC adds that sustainable packaging ought to be “sourced, manufactured, transported and recycled using renewable energy”. The ECR does not express this in detail regarding packaging material or energy, but does state that packaging material ought to be “responsibly sourced” and the packaging as a whole should be designed to be effective, safe and “optimize its overall environmental performance”. The ECR definition thus leaves more up to the reader in the task of interpreting the definition.

A systems approach to sustainable packaging

Three perspectives – holistic sustainability, life cycle, and product packaging systems – were identified in the definitions of sustainable packaging. These perspectives are considered central and should be integrated in sustainability assessments of packaging, as well as in packaging selection and development processes in order to successfully approach sustainable packaging in line with the definitions by ECR (2009), SPA (Lewis et al., 2007) and SPC (2011).

Three aspects – packaging functions, packaging material, and energy – were also emphasized in the definitions of sustainable packaging. These aspects are thus argued important to consider and even decisive for accessing the package’s direct and indirect effects on sustainable development. These aspects are important to reflect upon and to pay particular attention to in the sustainability assessments of packaging, and in packaging selection and/or development process. These three perspectives and three aspects are in this research regarded as tokens of sustainable packaging.

In line with the systems approach, my understanding of the three perspectives are interpreted as different integrated levels in a holistic view of sustainable packaging as illustrated in Figure 15.

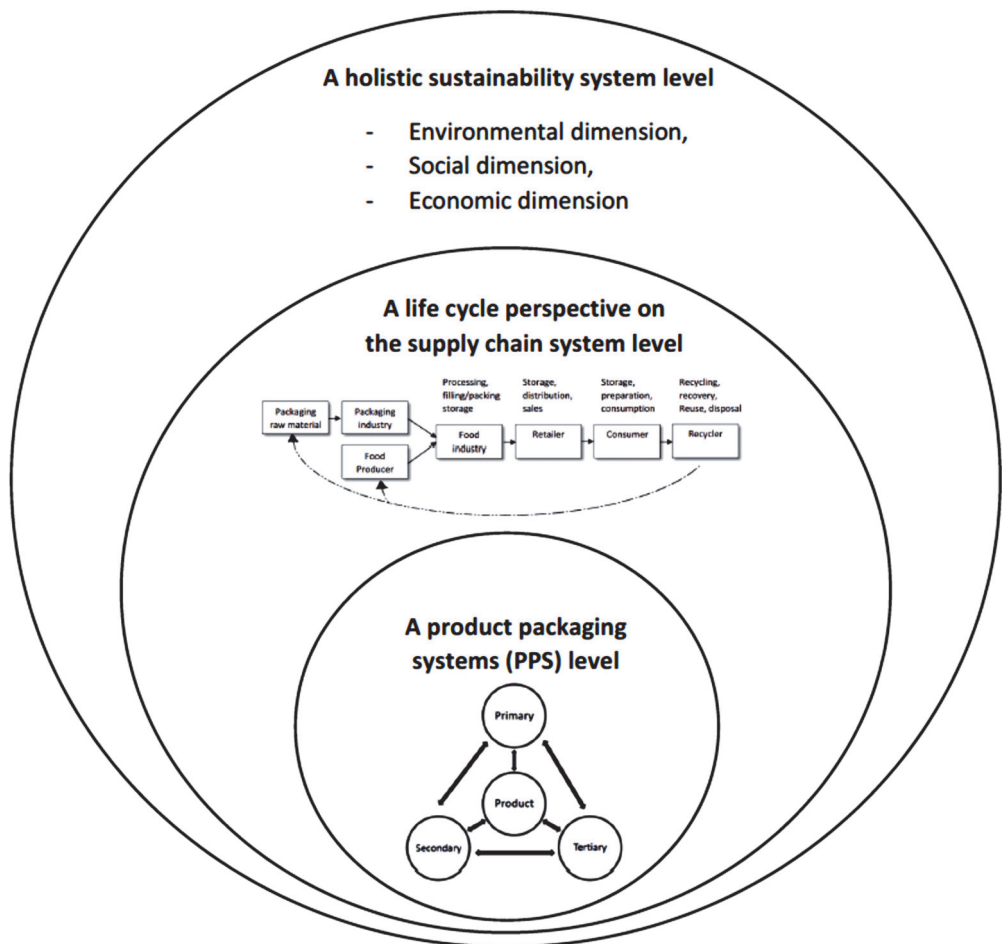


Figure 15: My holistic view of sustainable packaging with three integrated system levels.

The product packaging system perspective is the core of my holistic view of sustainable packaging. From a packaging logistics view, the packaging accompanies its content from filling to consumption along the supply chain, and the packaging and the product interact with each other in a product packaging system. This is important to include as these interactions can create synergies, but the opposite can also occur (Hellström and Saghir, 2007). The importance of integrating this perspective into the packaging selection and/or development processes is also supported by other researchers in the field of sustainable packaging (Fitzpatrick et al., 2012; Lewis et al., 2007; Svanes et al., 2010).

“It needs to consider interactions between the package and the product it contains so that the environmental impacts of the product-packaging system as a whole are minimized.”
(Lewis et al., 2007)

In relation to packaging content, previous research also shows that packaging has a great potential to contribute to sustainable development. It can do this in its function to protect the contents and thus decrease the amount of product wasted (Büsser and Jungbluth, 2009; Kooijman, 1993; Nilsson et al., 2011; Silvenius et al., 2014; Thurgood).

This integrative view of a product packaging systems perspective is argued to be important in the development of sustainable packaging and sustainability assessments of packaging. This is supported by Grönman et al. (2013) who concludes that indirect effects related to product waste are otherwise not considered. This is because the indirect effects linked to the services the packaging provides through its functions in relation to its content are easily overlooked if the product is not included. The product packaging systems perspective is also motivated because the product from the production stage (Franco, 2013) in general has a much higher environmental impact than the packaging per se (Kooijman, 1993; Lange et al., 2013; Luttikhuis et al., 2014; Silvenius et al., 2014; ten Klooster, 2002).

By adding a life cycle perspective to the supply chain, packaging (from a packaging logistics perspective) has proven to have great potential to contribute to sustainable development in relation to its content and in relation to the actors in contact with the product packaging system. For instance, it can enable efficient resource utilization in the supply chain (Emblem, 2012; Fitzpatrick et al., 2012; Hellström and Saghir, 2007; Holdway et al., 2002). This contribution can be explained by the extended version of Löfgren's model (2006) in Figure 12, which encompasses the entire product packaging system. During the different processes along the supply chain, the prerequisites for services arise that are linked to the use and handling situations in the different actors' interaction with the packaging system (primary, secondary or tertiary). For instance, it is when the supply chain actor experiences a given packaging feature that the packaging can not only fulfill its functional demand and generate functional value, but can also create a service for the actor that is linked to the situation at hand and generates emotional value (Löfgren, 2005; 2006; Olsson, 2005).

Environmental, social and economic dimensions are encompassed in a holistic sustainability perspective. Packaging has both direct effects on sustainable development, and also indirect effects that are linked to its prerequisites for services. The definitions of direct and indirect effects in this thesis are:

“Direct effect: the effect that occurs during the production of packaging materials, transport and recycling.” (Paper I)

“Indirect effect: the effect linked to the services that packaging provides for the content and the users in the supply chain including consumers.” (Paper I)

The value-adding services related to indirect effects of packaging functions are often less obvious, examples being their contribution to a reduction of product waste (Williams and Wikström, 2011) or to efficient transportation (Hellström and Saghir, 2007; Nilsson et al., 2011; Olsson and Larsson, 2009). These indirect effects have in general a significant and often greater impact with regard to the different dimensions of sustainable development than the direct effects linked to the packaging material, energy consumption or the package as such (Büsser and Jungbluth, 2009; Franco, 2013; Kooijman, 1993; Lange et al., 2013; Luttikhuis et al., 2014; Olsson and Larsson, 2009; Silvenius et al., 2014; ten Klooster, 2002).

The organic food context

The organic food segment was chosen as the context for the empirically based studies (Study 3-6) due to the particularly strong link between organic food and sustainable development in shared values such as health, environmental and ethical concerns. “Organic is a process claim rather than a product claim” according to the Food and Agriculture Organization of the United Nations (FAO, 1999), hence organic food is:

“A product which has been produced, processed, and/or handled in compliance with organic standards.” (IFOAM, 2014, p. 31)

It is worth noting that packaging in compliance with organic standards is at present not mentioned in the International Federation of Organic Agriculture Movements’ (IFOAM, 2014) definition. Several countries and private certification organizations have defined organic agriculture differently. As a response to the demand for consistency, this non-governmental organization established guidelines that have been widely adopted for organic production and processing (FAO, 1999).

“Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition,

innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.” (IFOAM, 2014, p. 31)

IFOAM is an international “umbrella organization which gathers organizations for farmers, scientists, educators and certifiers”. The Swedish KRAV organic standards and labeling organization is a member. (KRAV, 2014b)

Organic food labeling in Sweden

Packages for organic food can carry different organic labels conveying with the text, colors and pictures the organic message to the consumers and users. In Sweden alone, several different organic food labels are in use (KRAV, 2015b; NFAS, 2014). This thesis distinguishes between two kinds of labels: labels guaranteed by standardization organizations or authorities, and company-specific, private labels from the retailers’ own organic brands. It is the labels guaranteed by standardization organizations or authorities that are here regarded as organic food labels and put in focus.

Behind these organic food labels is a certification process that the brand owner has to undergo for each labeled product. The regulations of the product, the processes it undergoes and its packaging are dependent on the standard behind the label it carries. The two main organic food labels used in Sweden are symbolized by the EU Leaf and the KRAV label. They are further elaborated on in the next two sections.

The EU Leaf

Since 2010, the labels on organic food in Europe are required to have the EU Leaf (EU organic label), even when the package already carries a national organic label. “Organic” is a protected name which means that only certified products are allowed to be sold as organic. The EU legislation relating to organic food is legally binding, and in Sweden the responsibility for oversight is shared by the Swedish Board of Agriculture (agricultural issues); the Swedish National Food Agency (food processing and some marketing issues); the Swedish Consumer Agency (issues related to consumer marketing); and the Swedish Board for Accreditation and Conformity Assessment (Swedac) that accredits the control bodies (Cejie, 2013). There are a handful of different control bodies in Sweden such as: Aranea, SMAK, and HS Certifiering that have received Swedac accreditation. These bodies are authorized to manage the control and certification of EU organic food. In Sweden, the EU Leaf is the only governmental organic food label (Cejie, 2013).

The KRAV label

About 80% of all organic food in Sweden carries a KRAV label (Lundell, 2013). The KRAV label is the most well-known organic food label in Sweden for organically produced food and is reported to have a recognition rate of 99% among Swedish consumers (TNS_Sifo, 2010). The organic standards of KRAV fulfill or go beyond the

EU regulations for organic production (EC) No 834/2007 (KRAV, 2016a). The KRAV label signals that the food has been produced in an environmentally sustainable and ethical way. KRAV further stands for promotion of a natural environment, animal welfare, social responsibility, and health. (KRAV, 2014b)

KRAV was founded in 1985 and is organized as an incorporated association with 27 members. The members represent farmers, processors, trade, and NGOs that represent the interests of consumers, the environment and animal welfare. Several companies are certified according to the KRAV standards. Over 8 000 products are certified organic according to the standards by KRAV (KRAV, 2016b). Seven certification bodies (Debio, HS Certifiering, Intertek, Kiwa, ProSanitas, SMAK and Valiguard) carry out the KRAV standards inspections (KRAV, 2015a). These certification bodies are accredited by Swedac and approved by KRAV who put additional demands, for instance, related to their own internal environmental efforts (KRAV, 2014a).

The different sections in KRAV's organic standards are submitted to a review and updated every fourth year. A standards committee, constituted of different specialists and representatives of important groups of stakeholders, formulates the goal and purpose of the review with the KRAV staff. Thereafter, the board of KRAV approves the review plan. The review is then carried out in close collaboration with specialists, and a broad selection of stakeholders, such as representatives from companies, authorities, and NGOs. The new standard that is proposed is then sent to the members, authorities and trade organizations for consideration. During this stage, anyone is free to give feedback. The proposed standard is then reworked and the final decision to approve it is made by the board of KRAV. (KRAV, 2014c)

Organic food consumption in Sweden

The organic market is 5.6% of the total Swedish food market. However, it grew by 38% from 2013 to 2014, and during the first half of 2015, a 50% increase was recorded. The current increase in the organic market in Sweden is unique (Bodin, 2015; Ryegård, 2015; Ryegård and Ryegård, 2015). The potential for continued growth in Sweden is considered to be large (Cejie, 2013). The rapid increase has made the demand greater than the supply; organic food products sell out and several are back ordered at the wholesalers (KRAV, 2015c).

A majority of the Swedish population, 68%, are positive to KRAV (KRAV, 2015c). A consumer survey among Coop (Swedish retail food chain) members showed that 44% consider organic food products to be important (Ryegård and Ryegård, 2015). The number of consumers taking the step from a positive attitude to actual purchase is also on the rise: 30% state that they purchase organic food as often as possible (KRAV, 2015c). In a recent survey, a majority of Swedish consumers (70%) expressed a willingness to pay 1-20% more for organic food (Ryegård and Ryegård, 2015).

The sale of organic food appears to be triggered by a strong public debate on food, animal welfare, the environment and food production. During the lively debate on environment and pesticides in wine and bananas in 2013, a particular increase in organic food sale was noticed.

“Fruit and vegetables are the segment that has driven the growth in sales during the year and where we have increased the most. When the media focuses on pesticide-free products and link organic to health, we see big increases in sales, like when they were writing about pesticides in bananas.” (Author’s translation) Louise König, Head of Sustainable Development, KF (Ryegård and Ryegård, 2015)

A clear shift towards more healthy food is a new trend among Swedish consumers since 2014 (Jönsson, 2015; KRAV, 2015c; Söderqvist, 2014). In line with this, a report by the Swedish Food Federation shows a substantial increase in interest among Swedish consumers for better quality food (Söderqvist, 2014). Organic food products are often perceived to be well in line with desires for healthier food (Ryegård and Ryegård, 2015). Although the organic food trend is increasing, another report by the Swedish Food Federation shows that the origin of the product is even more important: three times as many consumers chose Swedish products over imported organic products (Livsmedelsföretagen, 2014).

Reasons why consumers choose organic food

The reasons why Swedish consumers choose organic products have been explored in several surveys reported by industry and a few in journal articles. The influential factors found include health, environment, taste, along with ethical motives, such as social responsibility and animal welfare (KRAV, 2015c; Livsmedelsföretagen, 2014; Ryegård and Ryegård, 2015; Shepherd et al., 2005; Urtekram, 2014). However, there is no consensus as to what is the greatest influence among Swedish consumers. Two academic studies were located: one conducted in 1998, reported in Magnusson et al. (2003), and a comparative study based on the previously mentioned study complemented by a similar survey by the same research team conducted in 2001, reported in Shepherd et al. (2005). These two studies indicate health to be the strongest motive. In contrast, more recent surveys reported by industry indicate environmental concerns to be the strongest motive (Livsmedelsföretagen, 2014; Ryegård and Ryegård, 2015; Urtekram, 2014).

Organic food consumers are not a homogenous group and their rationales for purchasing organic food products differ (Magnusson et al., 2001; Shepherd et al., 2005). Studies further indicate that the reasons why consumers purchase organically differ depending on product category (KRAV, 2015c):

- Meat – animal welfare and origin
- Eggs – animal welfare, origin and price
- Fruit and vegetables – no pesticides, environment and health
- Coffee and tea – no pesticides and social responsibility

From organic consumer attitudes to organic purchase

Swedish consumers are in general positive to organic food products (Aertsens et al., 2009; KRAV, 2015c; Ryegård and Ryegård, 2015; Vermeir and Verbeke, 2006); however, this, in relation to the relatively low share of the organic market (5.6%) in relation to the total Swedish food market, indicates a discrepancy between consumers generally positive attitudes towards organic food products and their actual purchase behavior. Consumer behavior has been studied in many different contexts with different focuses and in particular, outside the organic food context. Prior research shows that there is a general discrepancy between consumer attitudes and their intentions to purchase, and from these purchase intentions to actual behavior (Barber, 2010; Nordin and Selke, 2010; Rokka and Uusitalo, 2008; WBCSD, 2008; Vermeir and Verbeke, 2006) (Figure 16).

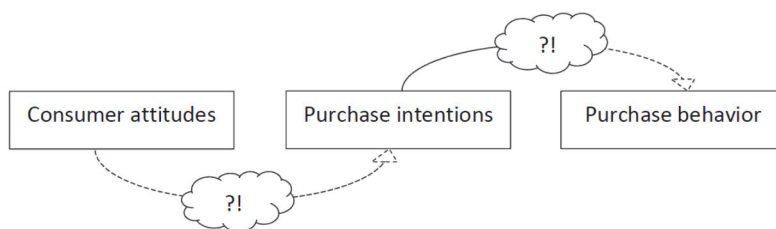


Figure 16: Discrepancy between consumer attitudes and their intentions to purchase, and between the purchase intentions and actual purchase behavior.

Sheeran (2002) found in his review that intentions only explain future behavior to some extent, but he concluded that intentions will remain a key indicator. This discrepancy was also studied by Aertsens et al. (2009) in the organic food context. In their review, they found several studies that showed a positively significant relationship between attitudes and purchase intentions. They also reported on studies where the relationship between purchase intentions and actual behavior was significant.

Arvola et al. (2000) also studied the discrepancy between consumer attitudes and actual purchase behavior of organic products. They found that the general positive consumer attitudes are not necessarily reflected in consumer purchases. Their explanation was that other purchasing criteria, such as taste, shelf life, health, and price, are rated higher than the organic criteria (Arvola et al., 2000). A review by Shepherd et al. (2005) indicated that possible causes of the discrepancy are: price, consumer satisfaction with conventional food, and limited availability. The importance of price and availability is confirmed in a recent consumer survey reporting that 80% would purchase more organic products if the price was the same as conventional products, and 40% would buy more organic products if the selection was greater (Urtekram, 2014).

Vermeir and Verbeke (2006) concluded after studying the discrepancy between consumer attitudes and purchase intentions, that the following three aspects have a significantly positive impact on consumers' attitudes: 1) sustainability involvement (the consumer's

perceived personal importance of the product, service, or promotional message in meeting important needs, goals, and values), 2) certainty (trust in sustainability claims), and 3) perceived consumer effectiveness (the extent to which the consumer believes that his efforts can contribute). The aspects also strongly correlated with consumers' purchase intentions. The study by Vermeir and Verbeke (2006) further showed that "involvement, perceived availability, and perceived consumer effectiveness, can be successfully influenced through communication efforts and the provision of information".

Specifically regarding packaging, Gidlöf et al. (2013) concluded after studying eye-tracking, that consumers have difficulties making purchasing decisions that are in line with their intentions. Possible explanations are shortcomings in knowledge of the product attributes, the little time and/or effort spent on each decision, misleading packaging information, and the layout of the product display.

Thus summing up, the sale of organic food has a strong potential for further growth. Prior studies indicate that packaging can influence this growth. Packaging can contribute to bridging the gap between consumer intentions and their actual purchase of organic food. This can be achieved primarily through the package's communicative abilities. These abilities include conveying product and packaging information responding to how the product packaging system measure up to the consumers' needs and values to ensure trustworthiness and to highlight the importance of the individual consumer's choices and actions.

Chapters 4 and 5 present the results and analysis of the two theoretically based studies: “Formalized approaches towards sustainable packaging” (Study 1) and “Proposed terminology on packaging functions, features and their related indirect effects” (Study 2).

4. Formalized approaches towards sustainable packaging (Study 1)

What support can companies get that have the power and desire to choose or develop more sustainable packaging? What formalized approaches in terms of frameworks, models, methods, guides, guidelines and tools are provided by academia and/or trade associations? How do these approaches support the use and development of more sustainable packaging? Prior attempts to compare and contrast such formalized approaches are found in the literature (Azzi et al., 2012; Grönman et al., 2013; Pålsson et al., 2013; Svanes et al., 2010). Their analyses were conducted from different perspectives and they are all delimited to comparing approaches found in academic literature. The previous comparative studies include limited sets of aspects in relation to the ones identified as tokens of sustainable packaging. This chapter presents a theoretically based study in the form of a literature review, and responds to RQ 1: **How is a contribution of packaging to sustainable development potentially supported in formalized approaches provided by academia and/or trade associations?** The analysis, results and conclusions from the review are presented in this chapter and an overview of the results of the analysis is presented in Appendix C.

The formalized approaches – an analysis

Eighteen different formalized approaches were identified in the form of frameworks, models, methods, guides, guidelines and tools intended as support for companies in the use and development of more sustainable packaging. Half of these were proposed by academia (referred to as academic approaches) and half by trade associations (referred to as industry approaches).

To determine the support a formalized approach could provide, it was analyzed on the basis of three perspectives (holistic sustainability, life cycle and product packaging systems) together with three aspects (packaging functions, material, and energy). These are the six tokens of sustainable packaging that were identified in the definitions of sustainable packaging (Chapter 3).

The formalized approaches were analyzed to see if they included the three perspectives. A holistic sustainability perspective meant the inclusion of the environmental, social and/or economic dimensions. The inclusion of a life cycle perspective was indicated by the system boundaries of the approaches. The product packaging systems perspective was divided into two parts in the analysis: the packaging system comprising the three levels of packaging, and the inclusion of the product.

The approaches were analyzed to see if they included parameters or categories of parameters that consider packaging functions, packaging material and energy aspects.

The inclusion of indirect effects of packaging were analyzed in a separate category because the literature indicated the importance of indirect effects (Büsser and Jungbluth, 2009; Fitzpatrick et al., 2012; Holdway et al., 2002; Kooijman, 1993; Nilsson et al., 2011; Silvenius et al., 2014; Williams and Wikström, 2011).

The results from this review are structured and presented below in an overall description of the formalized approaches and the categories derived from the tokens of sustainable packaging: dimensions of sustainable development, system boundaries, levels of packaging, product inclusion, inclusion of parameters related to packaging functions, material and energy aspects, and to indirect effects.

Overall description of the formalized approaches

The academic approaches all aim to assist as a tool for decision support in the evaluation of packaging solutions or design alternatives in packaging selection or in development (Colwill et al., 2012; Grönman et al., 2013; Lewis et al., 2010; Luttikhuis et al., 2014; Pålsson et al., 2013; Svanes et al., 2010; Vergheze et al., 2010; Wever and Vogtländer, 2013; Wikström and Williams, 2010). It is important to integrate sustainability considerations in early phases of the packaging development process, since it is much more costly to make changes at the end of the process (Colwill et al., 2012; Luttikhuis et al., 2014). Despite this, most of the academic approaches are perceived to come in rather late in the packaging development process because their aim is to evaluate and compare different design concepts with each other and/or with the current solution. Two of the academic approaches (Colwill et al., 2012; Grönman et al., 2013), however, contribute by also proposing a process for sustainable packaging development and in so doing, contribute throughout the entire development process.

The aim of a majority of the industry approaches is to assist companies in the development process and/or in the selection of new packaging solutions. In all but one, this is conducted by providing guidance in the form of checklists and/or through additional design considerations. SPC (2009) is the exception among the industry approaches because it focuses on metrics and indicators.

A majority of the academic approaches were at least partly based on life cycle assessment (LCA) or streamlined LCA, in contrast to the industry approaches where a minority were based on LCA. LCA based assessments “requires much and detailed data that is simply uncertain or not available during the earlier phases of the development” process, thus the “degree of sustainability is determined in hindsight” according to Lange et al. (2013, p. 857). The traditional LCA is a way to quantify the negative effects of a product or package through its entire life cycle (i.e., from raw material extraction to disposal or recovery) (Lai et al., 2008; Lewis et al., 2010; Wever and Vogtländer, 2013). But when it comes to evaluating sustainable packaging, LCA it has limitations. One is that it currently only considers environmental aspects and not the social or economic (Lewis et al., 2010; Wever and Vogtländer, 2013). In addition, product waste is usually not included in packaging LCAs according to Grönman et al. (2013). The present shortcomings in LCAs are addressed in some of the approaches and compensated for through the involvement of additional methods (Grönman et al., 2013; Lewis et al., 2010; SPC, 2009; Svanes et al., 2010).

The formalized approach by ECR (2009) is more positive to packaging than the other ones and aims “to maximize the contribution of packaging to sustainability along the value chain.” This stands in contrast to the other approaches that on the whole aim to decrease the negative effects of packaging on sustainable development. This is especially apparent in the industry approaches that focus either on packaging material in terms of reducing, reusing and recycling, which is in line with the EU’s Packaging and Packaging Waste Directive (Brookes and Vrolijk, 2006; Incpen, 2008; ITC, 2012; SPA, 2010; SPC, 2006), or on a combination that minimizes the negative effects due to water use, energy use and material use (APC, 2010; SPC, 2009; TCGF, 2011).

Dimensions of sustainable development

Although sustainable development in its first and most widespread definition encompasses the three interrelated environmental, social and economic dimensions (Brundtland, 1987), only half of the eighteen approaches examined did so. The environmental dimension is the one that receives the most attention overall, and is included in all of the approaches. This is followed by the economic and then the social dimension. The level of inclusion varies among the approaches. Of those that include all the dimensions, four are academic (Colwill et al., 2012; Grönman et al., 2013; Lewis et al., 2010; Svanes et al., 2010) and six are industry (APC, 2010; ECR, 2009; SPA, 2010; SPC, 2006; 2009; TCGF, 2011).

System boundaries

When it comes to system boundaries, all of the eighteen approaches claim to apply some kind of life cycle perspective. However, what is actually included within these boundaries differs. The importance of a life cycle perspective is emphasized in sustainable packaging development because the consequences that are generated later in the package's life cycle need to be considered in early stages of the development process (Lewis et al., 2007; Luttikhuis et al., 2014). A life cycle perspective also reduces the risk of shifting the burden from one actor in the supply chain to another (Fitzpatrick et al., 2012).

Four of the approaches explicitly include a product packaging life cycle perspective (Grönman et al., 2013; Luttikhuis et al., 2014; Svanes et al., 2010; Wikström and Williams, 2010), whereas most of the approaches focus on the packaging life cycle. In some cases, consumers or users are left out entirely from the packaging life cycle (Verghese et al., 2010), or mentioned very briefly, or only included in one or two parameters. Brookes and Vrolijk (2006), for instance, conclude in their introduction that packaging is important for consumers, and especially the environmentally aware ones, but they leave it at that.

Levels of packaging

In packaging development, the three levels of packaging (primary, secondary and tertiary) have to be regarded as an integrated system because it is the sum of these interrelated levels that has to meet the packaging demands in relation to the content (Hellström and Saghir, 2007; Johansson et al., 1997; Krochta, 2007; Olsson and Larsson, 2009; Pålsson et al., 2013). The interrelation means that changing one level will impact the others. Thus, in sustainable packaging development, the three levels need to be regarded as an integrated system to avoid sub-optimizations.

All nine of the industry approaches and five of the nine academic ones encompass to some extent the three levels of packaging in their approaches. Among the academic approaches, Colwill et al. (2012) explicitly state that they only include primary packaging, whereas others do not mention the levels of packaging at all (Luttikhuis et al., 2014; Wever and Vogtländer, 2013; Wikström and Williams, 2010).

Product inclusion

From the moment the primary package is filled or packaged with the product, the package and the product become a unified unit that will usually not be separated until they reach the point of consumption (Fitzpatrick et al., 2012; Hellström and Saghir, 2007). Svanes et al. (2010) thus argue that it is the product packaging system as whole (i.e., the three packaging levels and the product) that must be optimized to avoid sub-optimizations. It

is even claimed that the packaging system cannot be assessed or evaluated separately from its content (2009; Grönman et al., 2013). In addition, the indirect contribution of packaging to sustainable development is more easily overlooked if the packaging system and the product are regarded separately.

The importance of integrating the packaging system and the product is emphasized in sustainable packaging development (Williams et al., 2008). However, such an integrated perspective is not apparent in all the reviewed approaches: Three out of four (six academic and seven industry) include the product in their analyses, but the actual level of inclusion differs (APC, 2010; 2009; Grönman et al., 2013; Incpen, 2008; ITC, 2012; Lewis et al., 2010; Luttikhuis et al., 2014; Pålsson et al., 2013; SPA, 2010; SPC, 2009; Svanes et al., 2010; TCGF, 2011; Wikström and Williams, 2010). In the remaining five approaches, the packaging perspective largely leaves out the product.

Inclusion of packaging functions, material and energy aspects

All but two of the approaches explicitly include specified parameters or groups of parameters as the basis of their sustainability evaluation. These parameters mainly concentrate on the environmental dimension of sustainable development, followed by the social and economic. The parameters were analyzed to see if they included “packaging functions”, “packaging material” and “energy” in their considerations. Eight of the 18 approaches considered packaging functions; 15 considered packaging material; and 15 considered energy.

None of the approaches have **packaging functions** as their point of departure, although prior research has argued that the actual potential of packaging to contribute to sustainable development can be revealed by considering these (Fitzpatrick et al., 2012). However, almost half of the approaches include parameters related to packaging functions.

Three of the approaches that include packaging functions have a holistic inclusion on an overall but abstract level and provide no further specification or guidance (APC, 2010; Lewis et al., 2010; SPA, 2010). APC (2010), for instance, states that packaging should reach a “required level of functionality”, but does not provide assistance on what features to include. Four approaches include parameters related to a limited set of packaging functions (Incpen, 2008; ITC, 2012; SPC, 2006; Svanes et al., 2010). Two approaches had a greater focus on packaging functions: ECR (2009), which provide a list of several different packaging features related to packaging functions (but they do not include any of these among the parameters in their proposed example of sustainability measures). The most explicit inclusion of packaging functions is found in Grönman et al. (2013). They also provide guidance by listing a set of questions that cover a selection of packaging features specifically related to food packaging.

Pålsson et al. (2013) include fill rate, a packaging feature that could be but is not explicitly related to packaging functions. Wever and Vogtländer (2013) include the customer

perceived value of the packaging in their analysis, which is influenced by how well a specific feature of the packaging contributes to fulfilling a desirable function. However, they assume this value to be the same as the market price and thus, the packaging functions and features only implicitly influence the value. Thus, neither of these two approaches explicitly include parameters specifically related to packaging functions.

Parameters related to the **packaging material** were more prevalent than those related to packaging functions: fifteen of the eighteen approaches contained packaging material parameters. These were often expressed in terms of reducing, reusing and recycling the packaging material (APC, 2010; Brookes and Vrolijk, 2006; Incpen, 2008; ITC, 2012; Lewis et al., 2010; SPA, 2010; SPC, 2006; 2009; TCGF, 2011). The 15 approaches recognize, to varying degrees, the need for packaging to have functional criteria as a balance to reducing, reusing and recycling. Reducing the need for packaging material is also suggested in the design phase in some of the industry approaches (APC, 2010; ITC, 2012; SPC, 2009). Other approaches emphasize an optimized instead of a minimized use of packaging materials (ECR, 2009; Grönman et al., 2013; Svanes et al., 2010; Wever and Vogtländer, 2013).

Other material related parameters included in the approaches were:

- the health impact of packaging material (APC, 2010; Grönman et al., 2013; Lewis et al., 2010; SPA, 2010; SPC, 2006; 2009; TCGF, 2011),
- packaging material from renewable sources (APC, 2010; ITC, 2012; Lewis et al., 2010; SPA, 2010; Svanes et al., 2010; TCGF, 2011),
- inclusion of a widespread system for recycling of the packaging material (Lewis et al., 2010; SPA, 2010),
- one material (Lewis et al., 2010; SPA, 2010), and
- material sourcing (APC, 2010; Brookes and Vrolijk, 2006; ECR, 2009; Incpen, 2008; SPC, 2006; 2009).

Energy is mentioned in all of the approaches and fifteen of them include parameters specifically related to energy. These parameters are expressed in terms of:

- sourcing (APC, 2010; Incpen, 2008; Lewis et al., 2010; SPA, 2010; SPC, 2006; 2009),
- efficiency (APC, 2010; SPA, 2010; SPC, 2006),
- energy use (APC, 2010; ECR, 2009; Grönman et al., 2013; Incpen, 2008; ITC, 2012; Lewis et al., 2010; Pålsson et al., 2013; SPA, 2010; SPC, 2009; Svanes et al., 2010; TCGF, 2011; Verghese et al., 2010; Wever and Vogtländer, 2013; Wikström and Williams, 2010), and
- energy recovery (Incpen, 2008; SPC, 2009; Svanes et al., 2010; TCGF, 2011; Wever and Vogtländer, 2013; Wikström and Williams, 2010).

Efficiency in the use of energy is included and/or proposed to be measured in relation to different processes in the life cycle: sourcing of raw material, production, filling, transportation, storage, consumption and recycling (APC, 2010; Incpen, 2008; ITC, 2012; Lewis et al., 2010; Pålsson et al., 2013; SPA, 2010; SPC, 2006; 2009; Svanes et al., 2010; TCGF, 2011). Energy needs to be considered and minimized (ITC, 2012; Lewis et al., 2010) or optimized (SPC, 2009) already in the design of the packaging.

The sourcing of energy is also brought up (APC, 2010; Incpen, 2008; Lewis et al., 2010; SPA, 2010; SPC, 2006; 2009). Some propose the use of renewable energy (APC, 2010; Lewis et al., 2010; SPA, 2010; SPC, 2006; 2009). SPC (2006) proposes the use of energy from known and responsible sources without further specification.

Energy audits are suggested by The Consumer Goods Forum (TCGF, 2011), although no audit content is explained. SPC (2009) also suggests energy audits and offers suggestions of the metrics to include.

Indirect effects

Indirect effects of packaging on environmental sustainability are included in most of the approaches but to varying extent. Most frequently mentioned are product waste/loss/shrinkage (APC, 2010; ECR, 2009; Grönman et al., 2013; Incpen, 2008; ITC, 2012; Lewis et al., 2010; Pålsson et al., 2013; SPA, 2010; SPC, 2006; 2009; Svanes et al., 2010; TCGF, 2011; Wikström and Williams, 2010). Although product waste was frequently mentioned in the approaches it was only included as a parameter in less than half (Grönman et al., 2013; Lewis et al., 2010; Pålsson et al., 2013; SPA, 2010; SPC, 2009; Svanes et al., 2010; TCGF, 2011; Wikström and Williams, 2010). Transport efficiency is the second most frequently mentioned and included indirect effects (APC, 2010; Grönman et al., 2013; Incpen, 2008; Lewis et al., 2010; SPA, 2010; SPC, 2009; Svanes et al., 2010).

Indirect effects are deliberately excluded by Verghese et al. (2010) to make the analysis of the packaging system easier. Indirect effects, according to the definition applied (Chapter 3), are not included in Colwill et al.'s (2012) and ITC's (2006) approaches.

In conclusion: the contribution formalized approaches can make to sustainable packaging development

The 18 academic and industry approaches identified in the review all aim to support sustainable packaging development. But they differ in how to go about doing so and in what aspects they encompass. This review concludes that most of the approaches focus on decreasing the negative effects of packaging rather than increasing the positive

contribution of packaging to sustainable development. They do this even though prior research reports the need for a more positive approach to packaging in its contribution to sustainable development (Büsser and Jungbluth, 2009; Verghese et al., 2010; Wever and Vogtländer, 2013). Another overall finding is that the assistance from academic approaches usually comes in late in the packaging development process, despite the fact that the early integration of sustainability considerations is shown to be beneficial and less costly (Cecimo, 2012; Colwill et al., 2012; Schischke et al., 2005).

The formalized approaches by Grönman et al. (2013) and Svanes et al. (2010) are the ones that cover all of the following: holistic sustainability, life cycle and a product packaging systems perspective; aspects related to packaging functions, packaging material and energy. However, although they include packaging function parameters, they do not do so extensively.

Not all of the approaches assist companies in their quest for more sustainable packaging related to the three dimensions of sustainable development: Only half took a **holistic approach to sustainable development**. All eighteen approaches did encompass the environmental dimension, whereas sixteen included the economic, and ten included the social dimension. A holistic approach is more frequent in the industry approaches.

All of the approaches have some kind of **life cycle perspective**, which is important in the development of sustainable packaging (Lewis et al., 2007; Luttikhuis et al., 2014). Most of the approaches have a packaging life cycle perspective and four of the academic approaches have a product packaging life cycle perspective (Grönman et al., 2013; Luttikhuis et al., 2014; Svanes et al., 2010; Wikström and Williams, 2010). The inclusion of a product packaging life cycle perspective can indicate a greater integration of the product and the packaging levels into one system.

The **product packaging systems perspective** is important in the development of sustainable packaging according to the literature review. The entire packaging system – made up of the primary, secondary and tertiary levels of packaging and the product – is included in ten of the eighteen approaches, and more frequent among the industry approaches than the academic ones.

Several researchers state the importance of **packaging functions** in relation to sustainable development (Fitzpatrick et al., 2012; Oki and Sasaki, 2000; Simms and Trott, 2010; Verghese et al., 2010). Despite this, the review indicates that the inclusion of packaging function parameters is by far not as frequent as the inclusion of **packaging material** and **energy** parameters. Nor does the literature provide a general overview of the packaging functions parameters that should be included. ECR (2009) attempts to do so when they elaborate on and list different packaging features related to functions. Grönman et al. (2013) also contribute by providing a selection of relevant features to consider as parameters. However, these are specifically directed to food packaging. Neither ECR (2009) nor Grönman et al. (2013) link the features specifically to their possible effects on sustainable development. Thus, the approaches reviewed could benefit from further

research that presents an increased, general overview of packaging functions divided into different packaging features and their contributions to sustainable development.

This study also indicates that there is a gap in the formalized approaches between the great potential of packaging to contribute indirectly to sustainable development, and the actual inclusion of packaging's indirect effects. For instance, product waste has a significant indirect effect on sustainable development, one that is often greater than the effect of the package per se, but only half of the approaches in Study I include product waste as a separate parameter. The indirect effects included are mostly limited to product waste/loss and transport efficiency. This is the case even though the services that packaging provides for the product and/or the users in the supply chain through its functions reaches beyond these two.

5. Proposed terminology on packaging functions, features and their related indirect effects (Study 2)

Packaging functions are argued to be the key to previously hidden indirect environmental, social and economic benefits of packaging (Fitzpatrick et al., 2012). Despite their importance, the previous chapter reveals that less than half of the eighteen reviewed formalized approaches towards sustainable packaging include packaging functions parameters in their assessments. Those that do either do so in a holistic but abstract manner that lacks further guidance, or includes parameters related to a limited set of functions. It remains unclear how packaging functions are linked to the indirect environmental, social and economic benefits of packaging. This chapter responds to this limitation by addressing RQ 2: **How can considerations of packaging functions in the packaging selection and/or development process potentially contribute to sustainable development?** Study 2 is further described in Paper I.

Common terminology of packaging functions and features

Many researchers in the last thirty years have mentioned and elaborated on packaging functions or the role of packaging. In spite of this, there are still differences in terminology and perspectives in academia as shown in the literature review carried out in Study 1. Paper I presents an overview of the results of the literature review on packaging functions. There is also a lack of a common terminology in practice among the many different professionals involved in the packaging development process such as: packaging specialists, product developers, logisticians, marketing experts, and among the different stakeholders such as: product producers, packaging suppliers, brand owners, distributors, retailers, consumers and authorities (Boks, 2006; Lockrey, 2015; Pascual et al., 2003). In order to propose a common terminology, the following definitions of packaging function and feature are provided in Paper I:

Function: “An assigned duty or activity or a specific role” (Dictionary, 2012). A packaging function is what the packaging does and is described by using a verb (Stone and Wood, 2000).

Feature: “A prominent or distinctive quality or characteristic” (Dictionary, 2012). Packaging features are the specific characteristics that a package has to fulfill its functions.

Paper I proposes a generic terminology on packaging functions and features in response to the existing differences and the need that has been identified for a common terminology (Boks, 2006; Karlsson and Luttrupp, 2006; Lockrey, 2015; Pascual et al., 2003; Zhang et al., 2013). The proposed terminology in Paper I is based on the three clusters of functions identified in the literature – protect, facilitate handling, and communicate – and on the 19 corresponding packaging features. The features were identified and grouped under the functions based on an analysis.

The contribution of packaging functions and features

The conclusion of Study 2 is that packaging functions can contribute to sustainable development by their abilities to indirectly affect consumption patterns, amount of product and packaging waste, efficiency in production, handling, storing and transport and reducing risks (among others). Packaging features affect the performance of the package in fulfilling its functions. The indirect contribution of packaging through its functions by means of its features to the environmental, social and economic dimensions of sustainable development are considered on a societal level (Paper I). Fourteen potential ways of contributing were identified and organized, according to the packaging features and are presented in Tables 5-7 under each of the three packaging functions: protect, facilitate handling, and communicate.

Protect

Packaging has a great potential to contribute to sustainable development through its function to protect. The packaging features grouped under this function are: mechanical, barrier, thermal and sealing properties. Packaging protects its content from the point of filling to the point of consumption, and the function is carried out by an integrated approach where the primary, secondary and tertiary packaging together offer the appropriate protection of the content (Pålsson et al., 2013; Silvenius et al., 2014). The contributions of the function to protect are linked to how well the packaging protects its content and thus prevents the content and packaging from being wasted before they reach the point of consumption. The contribution is also linked to how well the package protects the surrounding environment, users, workers and others in contact with it, especially in the case of potentially hazardous products. In conclusion, considerations of the function to protect can contribute to the environmental, social and economic dimensions of sustainable development through its indirect effects (Table 4).

Table 4: Potential indirect effects contributing to sustainable development as the result of a sufficient packaging protection function, divided into its features, and classified according to the three dimensions of sustainable development: [E]=Environmental, [S]=Social, [Ec]= Economic, adapted from Paper I.

Function: Protect		
Features	Descriptions	Potential indirect effects contributing to sustainable development
Mechanical properties	Mechanical protection against outer physical impacts (shock, vibration, compression, puncture, insects, rodents, theft, pilferage, tampering).	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec] Reduced risk for environmental hazards [E, Ec] Reduced risk for human health hazards [S, Ec] Increased occupational safety and health [S, Ec] Maintained product quality [S, Ec]
	Child protective closures.	Reduced risk for human health hazards [S, Ec]
Barrier properties	Protection against undesired transmission, permeation, migration and absorption of for instance light, gases, moisture, flavor, odor, particles and microorganisms.	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec] Reduced risk for human health hazards [S, Ec] Maintained product quality [S, Ec]
Thermal properties	Keeping the product at a desired and even temperature.	Decreased product waste [E, Ec] Reduced risk for human health hazards [S, Ec] Maintained product quality [S, Ec]
	Maintaining the properties of the packaging.	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec] Increased process efficiency (in packing) [E, Ec]
Sealing properties	Keeping the packaging tight to avoid product leakage.	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec] Reduced risk for environmental hazards [E, Ec] Reduced risk for human health hazards [S, Ec] Maintained product quality [S, Ec]

Facilitate handling

Through its physical and graphic design, a package can influence how it is handled in production, transportation, storage, usage and disposal. Different features can be included to make the handling easy, convenient and safe (Emblem, 2012). On the basis of the analysis performed the following features were included: weight, unitization, apportionment, fill rate, processability, openability, resealability, unpacking/emptying, gripability, integrated use, second use and recyclability. When designed successfully, the packaging can increase efficiency during production, transportation, handling and storing. It can reduce the number of products and packages wasted, increase the occupational

safety and health, add value (Williams et al., 2008) and offer convenience to users and other actors along the supply chain. Study 2 (Paper I) shows that considerations of the facilitate handling packaging function can contribute to all three dimensions of sustainable development through its indirect effects (Table 5).

Table 5: Potential indirect effects contributing to sustainable development as the result of a sufficient function to facilitate handling of packaging, divided into its features, and classified according to the three dimensions of sustainable development: [E]=Environmental, [S]=Social, [Ec]=Economic, adapted from Paper I.

Function: Facilitate handling		
Features	Descriptions	Potential indirect effects contributing to sustainable development
Weight	The weight of the product packaging system (i.e., the gross weight).	Increased transport efficiency (inbound and outbound) [E, Ec] Increased occupational safety and health [S, Ec]
Unitization	Grouping of items in larger units.	Increased handling efficiency [Ec] Increased transport efficiency [E, Ec] Increased occupational safety and health [S, Ec]
Apportionment	Offer products in the right quantity for different needs/ dosing	Decreased product waste [E, Ec] Increased consumer satisfaction [Ec] Reduced risk for overdosing [E, S, Ec]
Fill rate	The fill rate is a measure of the volume utilization.	Increased transport efficiency (inbound and outbound) [E, Ec] Increased handling efficiency [Ec] Increased storing efficiency [E, Ec] Increased resource utilization [E, Ec]
Processability	Degree of fulfillment in processing, filling, sealing and loading.	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec] Increased process efficiency [E, Ec]
Openability	The ability to open with or without tools.	Decreased product waste [E, Ec] Increased handling efficiency [Ec] Increased consumer satisfaction [S, Ec]
Resealability	Ability to reseal package after it has been opened.	Decreased product waste [E, Ec] Maintained product quality [S, Ec] Increased consumer satisfaction [Ec]
Unpacking/ emptying	The ability to access the product, and to pour or in another way take it out from the package, without loss.	Decreased product waste [E, Ec] Increased consumer satisfaction [Ec]
	Easy and fast product access	Increased process efficiency [Ec] Increased occupational safety and health [S, Ec]
Gripability	The ability to grip a package is dependent on	Decreased product waste [E, Ec] Decreased packaging waste [E, Ec]

	its size, shape, weight, material stiffness, handles and surface.	Increased handling efficiency [Ec] Increased occupational safety and health [S, Ec] Increased consumer satisfaction [Ec]
Integrated use	The package is an integrated part in the usage of the product.	Increased resource utilization [E, Ec] Reduced risk for human health hazards [S, Ec] Reduced risk for overdosing [E, Ec]
Second use	The use of packaging after its primary product has been emptied.	Decreased packaging waste [E, Ec] Increased resource utilization [E, Ec]
Recyclability	Easy to sort into possible different waste streams/fractions.	Increased consumer satisfaction [Ec] Increased recycling ratio [E, Ec]
	Easy to fold or compress after use.	Increased transport efficiency [E, Ec] Increased handling efficiency [E, Ec] Increased storing efficiency [E, Ec]
	Easy to rinse	Increased recycling ratio [E, Ec]

Communicate

The third function of packaging to communicate with consumers or users and supply chain actors from the point of product production and filling to the end of life (Emblem, 2012; Grönman et al., 2013). Three features were included in this function: product information and instructions, package information and instructions, and product packaging system information and instructions. The messages that packaging communicate can be regarding its content, such as net weight, producer, volume, potential risks, using, handling and disposing instructions. They can also include packaging-related information, such as material, producer, origin and instructions such as how to assemble, open, use and recycle the package. The third kind of communication is related to the product packaging system, such as gross weight, shelf life and instructions as how to store, handle and take out products. The communication can have different purposes, such as strictly informative. It can also market the product to sell.

The study shows that through communication the packaging, if successful, can facilitate, enable and inspire correct and efficient use, handling and storage of the product and package. Communication can prevent incorrect handling, storage or use of products and packages, which can result in decreased product and packaging waste. The package also has the potential to safeguard human health through prevention of unintentional misuse of products, injuries due to unintentionally incorrect handling of the product or opening of the package. Considering the packaging's function to communicate can contribute indirectly to all three dimensions of sustainable development (Table 6).

Table 6: Potential indirect effects contributing to sustainable development as a result of a sufficient communicative function of packaging, divided into its features, and classified according to the three dimensions of sustainable development: [E]=Environmental, [S]=Social, [Ec]=Economic, adapted from Paper I.

Function: Communicate		
Features	Descriptions	Potential indirect effects contributing to sustainable development
Product information and instructions	Easy accessible information: textually, graphically or electronically readable.	Decreased product waste [E, Ec]
		Decreased packaging waste [E, Ec]
		Reduced risk for environmental hazards [E, Ec]
		Reduced risk for human health hazards [S, Ec]
		Increased consumer satisfaction [Ec]
Package information and instructions	Easy accessible information: textually, graphically or electronically readable.	Increased recycling ratio [E, Ec]
		Decreased product waste [E, Ec]
		Decreased packaging waste [E, Ec]
		Increased process efficiency [E, Ec]
		Increased handling efficiency [Ec]
Product packaging system information and instructions	Easy accessible information: textually, graphically or electronically readable	Increased consumer satisfaction [Ec]
		Increased recycling ratio [E, Ec]
		Increased resource utilization [E, Ec]
		Decreased product waste [E, Ec]
		Decreased packaging waste [E, Ec]
Product packaging system information and instructions	Easy accessible information: textually, graphically or electronically readable	Increased handling efficiency [Ec]
		Reduced risk for human health hazards [S, Ec]
		Maintained product quality [S, Ec]

In conclusion: the contribution packaging functions can make to sustainable development

Study 2 with its point of departure in packaging functions highlights the great potential for packaging to contribute to the environmental, social and economic dimensions of sustainable development. Packaging can do this on the basis of its indirect effects. This contribution is determined by how well the package fulfills its functions in relation to its content and/or the users or actors in contact with the product packaging system. Study 2 thus contributes theoretically by complementing the existing formalized approaches on how the consideration of packaging functions can render indirect effects on sustainable development. The study also contributes practically by providing inspiration and guidance with numerous examples (in Paper I) of how such considerations can contribute to sustainable development. It also contributes by addressing the identified need for a

common language and understanding in the proposed common terminology on packaging functions and features.

Extensive lists are presented in Tables 4-6 of 14 potential positive indirect effects in total, categorized under the three packaging functions and 19 packaging features.

Reduced product waste is linked to 13 of the 19 identified packaging features and is thus the most frequently appearing effect. This is also in line with recent previous research emphasizing the importance of reducing product waste in contrast to reducing packaging material. However, Study 2 shows that reducing product waste is an intricate matter in packaging development because it involves engagement in several different packaging features related to several different actors along the supply chain. Tradeoffs often have to be made between the needs and desires of the different actors involved. Reducing product waste has great potential to contribute to sustainable development from both an environmental and an economic perspective.

Twelve of the identified packaging features have an effect on the social dimension of sustainable development. Packaging can have features that protect those in contact with the package, that enhance the communication and that adapt the handling to the user or workers along the supply chain. This can result in a reduced risk of human health hazards, reduced risk of overdosing, and increased occupational safety and health for the workers who handle the packages. Study 2 further indicates that eleven of the identified features can increase the efficiency in process, transport, handling and/or storing. This increased efficiency has both an economic dimension and in some cases an important environmental dimension (e.g., reduced need for trucks with increased fill rate).

Study 2 indicates that the environmental and social dimensions identified also have a beneficial economic dimension, although not necessarily on the company level but in a greater perspective.

In chapters 6, 7 and 8, the results and analysis are presented of the three stakeholders – organic standardization organizations, consumers, and brand owners – that were studied empirically in an organic food context.

6. The contribution of organic standards (Study 3)

All organic food in Sweden is labeled with the EU Leaf, and four out of five organic food products are also labeled with KRAV. But what packaging regulations do the organic standards behind these labels include? How can these regulations encourage the use and development of sustainable packaging? This was analyzed in terms of the tokens of sustainable packaging: the three central perspectives (holistic sustainability, life cycle, product packaging systems), and the three aspects related to packaging (functions, material, and energy). This chapter responds to RQ 3: **How is the use and development of sustainable packaging potentially encouraged by regulations in organic standards?** This was explored by means of a document review, interviews, attendance at seminars and at workshops and is reported in this chapter.

EU packaging regulations – no specific ones for organic

The EU regulation on organic production and the labeling of organic products (EC, 271/2010; 834/2007; 889/2008) has no regulations directly regarding packages from a sustainability perspective. The EU only imposes general regulations concerning packaging, labeling and sealing to avoid the mixing or substitution of organic and conventional products.



Packaging, packaging materials and substances are further regulated in the European Union. However, these regulations cover packages in general and not organic food packaging in particular. For instance, there is a general regulation on materials that come in contact with food but it is not limited to packaging materials (EC, 1935/2004), and another on good manufacturing practice for materials and articles intended to come into contact with food (EC, 2023/2006). There are also regulations on specific materials and substances that come in contact with food. The European Union imposes regulations on all packaging in the Union in the Packaging and Packaging Waste Directive (EC, 1994/62). The purpose of this is to improve the environmental performance of packaging through: minimization of packaging weight and volume to an adequate amount to maintain the necessary level of safety, hygiene and acceptance for product and consumer;

minimization of dangerous substances and materials; and the development of reusable or recyclable packages.

Packaging regulations by KRAV – a process of evolution

During my five years of research in organic food packaging, the packaging requirements imposed by KRAV have developed, especially in the latest version that entered into force January 1, 2015. From January 2016 companies are obliged to motivate their packaging selections on the basis of these regulations. The packaging regulations by KRAV are found under “General Regulations” in section 3.5 (KRAV, 2015d).



When I initiated my research in organic food packaging in 2010, little attention and efforts were paid to the packaging in the organic standards by KRAV. The 2010 standards version expressed the minimization of packaging material as desirable, complemented by an abstract call for the use of packaging materials suitable for the environment and a desire to remove PVC (polyvinylchloride) and other chlorate plastics (KRAV, 2010). There were no absolute regulations concerning the packaging; rather KRAV pointed out a desired direction. One of the informants in Study 3 stated that they imposed “rather diffuse regulations” when it came to packaging. The certification bodies also expressed difficulties in following up the packaging regulations. Thus, the standard was weak in its encouragement of using or developing more sustainable packaging.

A joint project had already been initiated in 2007 by KRAV and Svenskt Sigill with LRF and the food producers Milko, Lantmännen, Scan and Skånemejerier. The project lasted until 2012. Its aim was to reduce the climate effect of food and food packaging. (Richert, 2012) The proposed standards based on this project were, however, never implemented. KRAV concluded that it was becoming too complex to formulate standards that would reduce the climate impact. They focused instead on letting the KRAV label include a broader range of environmental aspects that were not limited to climate impact. KRAV also saw the risk of hampering future development with standards that were too detailed.

One informant in Study 3 stated that they are not packaging specialists and that larger companies usually have more extensive competence than KRAV when it comes to minimizing or optimizing the packaging material. This informant concluded that the larger companies also have put in considerable work towards such changes and that these changes are also driven by economic incentives. A challenge for KRAV as they see it, is how they can support the many small producers that have limited power in relation to the large packaging industry. A further challenge noted by KRAV is that consumers regard the packaging per se as the environmental problem, not its potential functional shortcomings such as deficient product protection. Yet another challenge is that

consumers “expect KRAV labeled products to be perfect in every way” although “when it comes to climate smartness there is probably no big difference between organic and conventional products” as expressed by one of the informants.

KRAV's interest and engagement in standards for packaging has grown stronger over the years. They have also noticed an increasing interest for packages among consumers. Packaging, and in particular packaging materials, raises questions and ideas among consumers.

KRAV thinks the process of moving towards more sustainable packaging for organic food is difficult and has to be taken gradually over a longer period of time. The board of directors took a policy decision a couple of years ago to update their standards on packaging and to be in the forefront, in particular from a health perspective. Even though the latest revision resulting in the 2015 version focused on health and a removal of hazardous substances, KRAV sees a potential in packaging as a contributor to the environmental dimension of sustainable development especially by reducing food waste. The recent public debate on the migration of BPA (Bisphenol A) and the risk for future potential scandals concerning packaging substances migrating into food products is a strong driving force for KRAV. In addition, the inclusion of relevant packaging standards is a question of defending the credibility of the KRAV label. The packaging of KRAV labeled products ought to be better than the ones posed by legislation. However, there also has to be a balance between the number of regulations placed on the KRAV labeled products and the brand owners' ability to follow them all.

The 2015 version of KRAV standards for packaging

The new KRAV packaging standards from 2015 have further developed two areas: resource efficiency, and avoidance of health and environmental hazardous materials and substances (KRAV, 2015d). With these new packaging standards, KRAV feels that they are more in line with consumers' expectations than before. The addition of resource efficient packaging brings packaging functions and features into the picture. The protective function of packaging is emphasized in terms of reducing food waste throughout the supply chain. Features that enhance efficient transportation and enable the complete emptying of the packaging are also included. However, how the packaging should be chosen or developed with consideration of functions and features is not addressed. Despite the addition of packaging functions and features, the focus on packaging material remains strong in this standard as does the minimization of packaging material. This standard also requires renewable packaging material and recyclable packaging material when possible (KRAV, 2015d).

A reduction of the risk of migration of hazardous substances into packaged food is very important for KRAV. This is included in the new standards in section 3.5.2 *Avoiding Substances and Materials that are Harmful for Human Health and the Environment*, where

KRAV specifies the restrictions on packaging materials. The previous standards expressed the desirable avoidance of “chemicals that can constitute an environmental or health hazard”. The new standards link the chemicals to be avoided to the “chemicals included in the SIN list” (The *Substitute It Now* [SIN] list is a list of potentially hazardous chemicals proposed by the International Chemical Secretariat). The KRAV standards have also been sharpened from expressing the removal of PVC in packaging as a goal, to forbidding the use of PVC in packaging after January 1, 2017. There is a similar regulation for BPA: it must not to be used in packaging after January 1, 2018. (KRAV, 2010; 2015d)

Developing standards has been the core competence of KRAV over time. However, the desired changes for the removal of PVC and BPA, for instance, have not been made at the expected speed and to the expected extent. Thus KRAV has decided to require a phasing out plan for companies that use packages with these substances in order for their products to continue to be certified. KRAV also has decided to better support the member companies by working more intensively with the market to bring forward alternative solutions.

A continuous process

KRAV's ambitions when it comes to developing packaging standards do not end with the new standards that entered into force in 2015. KRAV finds it difficult to impose absolute regulations on packaging due to its multifaceted nature. That is why a guiding document will complement the standards and describe a desirable way to reason about packaging. KRAV aims to work harder with guidance and information because they know that product producers have difficulties determining what materials and substances their packages contain. The guiding document will be based on input from the expert group in packaging and will be launched in 2016.

The encouragement in organic standards – an analysis

The EU and KRAV standards on organic food packaging share some similarities. Both include regulations regarding information on consumer packages. For instance, the use of the organic label is controlled in both standards, such as its placement on the package, color and size. Other information on primary packages such as origin, certification bodies and the use of certain terms (such as organic) is also found; however, these kinds of packaging regulations related to the labeling are not considered or analyzed in the scope of this research.

The EU and KRAV standards on organic food packaging also differ. The KRAV packaging regulations are integrated into their organic standard; the EU standards have no regulations specifically related to organic food packaging. As this analysis focus on

packaging regulations in organic standards the regulations by KRAV are the ones analyzed in the rest of this section.

How KRAV encourages the use and development of sustainable packaging by the organic food standards was analyzed in relation to the six tokens of sustainable packaging: the three central perspectives (holistic sustainability, life cycle, and product packaging systems), and the three packaging aspects (functions, material, and energy) (Table 7).

Table 7: Overview of the packaging regulations, analyzed according to the tokens of sustainable packaging.

	Holistic sustainability perspective	Life cycle perspective	Product packaging systems perspective		Packaging aspects
			Packaging levels	Product	
KRAV	Environmental (Social)	Implicit	Primary	Partly	Functions Material Energy

Holistic sustainability perspective

At present, KRAV regulations that specifically deal with packaging are related to the environmental dimension of sustainable development. Social regulations are found in a separate general section, 3.1 *Social Responsibility for KRAV Licensees*, in the organic standards requiring companies to respect human rights and follow the Swedish legislation on employment conditions (KRAV, 2015d). However, there are no regulations regarding the social dimension of sustainability specifically related to packaging. The economic perspective of sustainable development is not explicitly addressed in the 2015 version of the organic food standards by KRAV (2015d).

Life cycle perspective

A life cycle perspective is central in sustainable packaging development. The packaging regulations posed by KRAV (2015d) do not explicitly require a life cycle perspective. But this perspective shines through in the regulations. Examples are the statement that the product ought to be protected in all stages until the point of consumption; and the statement that the renewable packaging materials used should be made of recyclable materials that are easy to fraction and re-use or recycle in existing systems.

Product packaging systems perspective

A product packaging systems perspective is needed in sustainable packaging development to encompass the interactions between the packaging and the product to avoid sub-optimizations (Lewis et al., 2007; Svanes et al., 2010). This inclusive perspective appears in the sense that the protection and preservation of the product is considered. The KRAV (2015d) packaging regulations, though, do not explicitly include the three levels of packaging that make up the entire packaging system; rather, the regulations imply here and there that they are only referring to the primary packaging level.

Packaging functions

Packaging is argued by an increasing number of researchers to possess a great potential to contribute to sustainable development, especially by adhering to packaging functions (Simms and Trott, 2010; Verghese et al., 2010; Wever and Vogtländer, 2013).

The 2015 KRAV standards present the regulations on packaging functions shown in Table 8. Packages should according to KRAV (2015d) be chosen or developed based on their ability: to preserve and protect the content; to facilitate recycling; and to empty completely. All but the facilitation of recycling are related to the package’s ability to reduce the amount of food wasted. The protective function and other packaging features that contribute to reduced food waste are of particular importance because food products in general have a greater negative environmental effect than the packaging per se (Kooijman, 1993; Lange et al., 2013; Lutikhuis et al., 2014; Silvenius et al., 2014; ten Klooster, 2002).

Table 8: Overview of the packaging functions addressed in the KRAV packaging regulations, divided into features and categorized under the three functions of packaging.

	Protect	Facilitate handling	Communicate
KRAV	Protection and preservation of the content is expressed in general terms; specific features are not stated.	2 of 12 features are addressed: Unpacking/emptying Recyclability	Not mentioned

The facilitate handling function can be supported by twelve different packaging features that can render positive effects related to the environmental, social and economic dimensions of sustainability (Paper I). The present standards bring up two of these twelve: opening/emptying and recycling.

There are no KRAV regulations on the communicative function of packaging, apart from the visibility of the KRAV label. The results of Paper I, though, show that the communicative function of packaging can contribute positively to the environmental, social and economic dimensions of sustainability. Communication can contribute in

terms of facilitating, enabling and inspiring the correct and efficient use, handling and storage of the product and package and thus decrease product and packaging waste. Communication can also contribute to the social dimension of sustainability by safeguarding human health through the prevention of unintentional misuse of products, and the reduction of injuries due to unintentional incorrect handling of the product or packaging (Paper I).

A stronger emphasis on packaging functions and better guidance on how packaging features can contribute to sustainable development by fulfilling the functions can make the previously hidden benefits of sustainable development more visible to the companies with certified products. This is in line with the argumentation of Fitzpatrick et al. (2012).

Material

The regulations on packaging materials are the most dominating ones in the KRAV packaging standards. These material regulations include reducing the use of packaging materials; the use of renewable, recycled and recyclable packaging materials; the reuse of packages; and the use of safe (with regard to human health and environment) packaging materials. The regulations on safe and healthy packaging materials as well as the ones regarding the use of renewable, recycled and recyclable packaging materials are well aligned with the aspects listed in the definitions studied in Chapter 3. The minimization of packaging materials posed by KRAV, however, stand in contrast to the optimization advanced by the SPC (2011) and the SPA's (Lewis et al., 2007) definitions of sustainable packaging. An optimization of the amount of packaging materials used is also promoted by researches with regard to its important functions. A reduction in packaging materials can only be made to a certain optimum point without functional losses (Grönman et al., 2013; Oki and Sasaki, 2000).

Energy

KRAV encourages packaging that contributes to energy efficient transport solutions. Energy considerations are implicitly included in the overall regulations for resource efficient and climate efficient packaging, but are not explicitly stated. Thus KRAV packaging regulations do not have a life cycle perspective on energy considerations as is expressed in the SPA definition of sustainable packaging (Lewis et al., 2007). Nor does KRAV bring up the sourcing of energy in contrast to the SPC definition of sustainable packaging, which includes the use of renewable energy throughout the entire life cycle.

In conclusion: the contribution organic standards can make to the use and development of sustainable packaging

The conclusion of Study 3 presented in this chapter is that the KRAV organic food standards have not strongly encouraged the use and development of more sustainable packaging for organic food products in the past. The organic standards behind the EU Leaf do not specifically encourage the use and development of more sustainable packaging at all. In contrast to the EU, KRAV expresses a desire to push and guide companies with KRAV certified products step by step towards a greater use and development of more sustainable packaging alternatives. Time will tell if the new KRAV standards from 2015 together with their forthcoming actions and guiding document will have such an effect.

The regulations at present encourage the use and development of packaging primarily to reduce potential adverse health impacts, but the decreased negative environmental effects of packaging are also emphasized in terms of striving for decreased food waste and in taking packaging materials and energy efficient transportation into consideration.

However, with regard to the tokens of sustainable packaging, the analysis shows that the packaging regulations by KRAV, despite recent efforts, have a potential for further improvements. These need to match the tokens of sustainable packaging identified in the literature (Chapter 3) as important in efforts towards sustainable packaging. This could improve KRAV's ability to assist and guide organic food companies towards sustainable packaging. If the areas identified are considered in forthcoming reviews of the standards and/or in future guiding documents, they will have to be balanced against what is feasible to require of the companies.

The analysis indicates that areas for further improvements regard first and foremost the widening of the following perspectives of sustainable packaging:

- A sustainability perspective beyond its present environmental focus.
- A more explicit inclusion a life cycle perspective of the product packaging system.
- Covering the entire product packaging systems perspective, from its present implicit focus on the primary package and to some extent the product.

The analysis indicates that areas for further improvement of the inclusion of packaging functions, materials and energy are:

- More in-depth inclusion of packaging functions, for instance, by addressing the wide range of packaging features that assist packaging in fulfilling its functions.
- A transition from the strong material minimization focus to optimization focus.
- An extension of the regulations on energy efficiency beyond transportation and consideration of the sourcing of energy.

7. The contribution of consumers (Study 4)

The environmental effects of packaging are an issue on the minds of many consumers. Packaging raises more and more questions and is of growing interest among consumers. How important is environmentally sustainable packaging for consumers? What packaging aspects do consumers claim to consider in purchase? What do they perceive as environmentally sustainable packaging? This chapter summarizes the main findings responding to RQ 4: **How can consumer perceptions and knowledge of environmental aspects of food packaging contribute to the use and development of sustainable packaging?** This was explored in a survey based study, Study 4, that is presented in Paper II. This chapter is organized according to two themes: 1) consumer perceived importance of environmentally sustainable packaging, and 2) consumer perceptions of environmentally sustainable packaging: packaging functions, material and energy.

Consumer perceived importance of environmentally sustainable packaging

The survey show that more than 80% of the consumers state that the environmental status of food packaging influences their selection of food products; however, the degree of influence differs. It plays a medium or higher role for about 60% of the consumers. Few consumers, less than 15%, claim that food packaging is not important from an environmental perspective in their selection of food products. Study 4 also finds that for consumers that regard themselves as frequent consumers of organic food (organic consumers), the package plays the largest role from an environmental perspective, while it was least important for the non-organic consumers.

The perceived importance of packaging from an environmental perspective among consumers is also confirmed by their stated willingness to pay. The results of Study 4 showed that a clear majority (86%) were willing to pay extra for environmentally sustainable packaging, although the amount varies. The willingness to pay was found to be highest among organic consumers and lowest among the non-organic consumers. The mean value that the 86% claimed they were willing to pay extra for environmentally sustainable packaging of food products that cost 15 SEK was 0.94 SEK or 6% more. In

the organic food consumer group, who were willing to pay statistically significantly more, the mean value was 1.25 SEK or 8% more.

The high level of perceived importance of the environmental status of packaging among consumers can, through their claimed willingness to pay, be regarded as a potential contribution to an increased use and development of sustainable packaging.

Consumer perceptions of environmentally sustainable packaging

The consumer responses regarding the packaging aspects they claim to consider in their choice of food products were grouped according to the aspects identified in sustainable packaging: packaging functions, material and energy. 72% responded that they consider one or several features that facilitate handling; 58% consider material; 20% consider communication; 11% consider product protection; and 1% consider energy (consumers could respond with several aspects in their free text answers).

The results of Study 4 provide new insights on the extent to which Swedish consumers automatically assume that packaging for organic food is environmentally sustainable: 21% assume it to be so, 23% do not, and 56% state that they are uncertain. Organic consumers to a greater extent than others tend to assume packages for organic food products are environmentally sustainable, although a majority of the organic consumers are uncertain. Thus, more than every other consumer indicates shortcomings in his or her ability to determine the environmental status of packaging. This signals a need for knowledge enhancements and/or guidance with regard to the environmental impact of packaging for consumers to be able to make environmentally based informed choices about food packaging, and thereby contribute to an increased demand for more sustainable packaging.

Packaging functions

When it comes to packaging considerations, Study 4 thus indicates that the packaging features consumers in general consider the most are the ones that facilitate the handling of products. These features were not primarily mentioned on the basis of their environmental effects, but rather because of their convenience. However, these choices can unintentionally contribute in many cases to an increased use and development of sustainable packaging, an example being when 27% of the consumers chose resealable packaging for increased convenience in home storing. Resealability also better maintains product quality and increases the likelihood of consumption, thus conceivably contributing to reduced food waste (Marsh and Bugusu, 2007; Mena et al., 2011). The

benefits of increased protection of the actual product, though, have to be balanced against the drawbacks in terms of the potential increase in packaging material that a feature such as resealability may require. Case specific judgements are emphasized by Williams and Wikström (2011), as they conclude that sustainability gains related to increased protection of the product are not the same for all products.

Another example is packaging size, which is mentioned by 24% of the consumers, mostly in the sense of convenience in fitting into the fridge or other storage spaces at home. An additional 3% mention size in the sense of apportionment (i.e., suitable volume in relation to consumption rate). Previous research has proven that apportionment has a great environmental effect (Williams and Wikström, 2011; Williams et al., 2012). Although it is only a small percentage that consider size in terms of apportionment, this percentage along with the greater percentage of consumers who consider size in terms of convenience can contribute to an increased demand for more sustainable packaging. But only if they chose packages that fit not only for their storage spaces but also that suit their rate of consumption. Consumers may be unaware of it, but for many food products, an investment in more packaging material and smaller packages is motivated if this results in a reduction in the amount of food that is wasted (Wikström et al., 2014; Williams and Wikström, 2011).

Material

The three most frequently mentioned material considerations are related to: material selected, 27%; amount of packaging material, 20%; and recyclable material, 18%. The consumers' preferences in material selection were for specific materials and/or the avoidance of others. Most consumers' preferences for amount of packaging material concerned the avoidance of double packing; others indicated a general dislike of what they perceive as too much packaging material. Some explicitly mentioned the packaging of fruit and vegetables, which they found to be excessive per se.

Study 4 further shows that organic food consumers state to take packaging material considerations into account in their selection of food products to a statistically significantly higher extent than non-organic consumers: 76% compared to 50%. However, consumers who base their choices on material considerations may assume this to be an environmentally based choice, but in reality it can have the opposite effect.

Consumers who select unpacked fruit and vegetables to minimize the use of packaging material instead risk generating more food waste due to insufficient product protection. This in turn results in a higher negative environmental impact in total. This is true when the product has a higher negative environmental impact than the packaging, which is generally the case (Franco, 2013; Hanssen, 1998; Kooijman, 1993; Lange et al., 2013; Luttikhuis et al., 2014; Nilsson et al., 2011; Silvenius et al., 2014; ten Klooster, 2002; Turner et al., 2008; Williams and Wikström, 2011). This is also an example of how

consumers overlook the packaging's protection function, even though product protection is considered to be the most important potential for packages to indirectly contribute to the environmental dimension of sustainable development (Grönman et al., 2013; Nordin and Selke, 2010; van Dam and van Trijp, 1994).

The results of Study 4 clearly show that Swedish consumers' environmental concerns about packaging are almost exclusively related to material considerations. Paper-based packaging are strongly perceived to be environmentally advantageous, whereas plastic and metal are not (Figure 17).

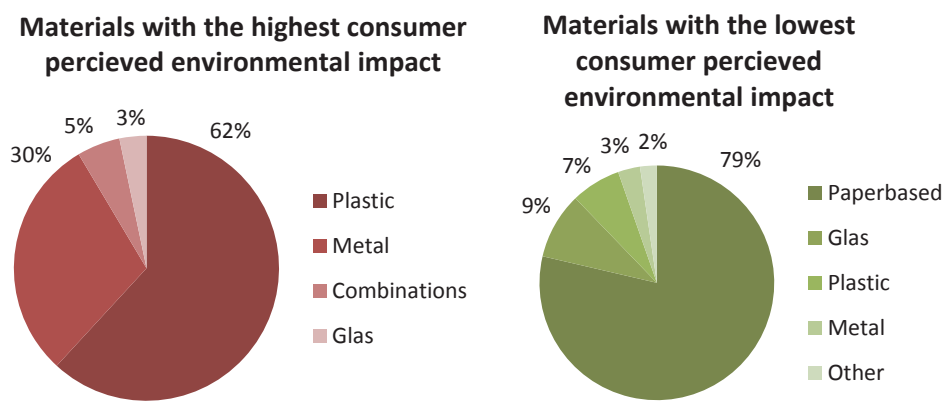


Figure 17: Materials consumers perceive to have the lowest vs. highest environmental impact.

The consumer focus on material related aspects is thus clear, although contrary to these consumer perceptions, recent research has shown that packaging material in most cases represents a relatively small part of the environmental impact of a packaged product (Hanssen, 1998; Kooijman, 1993; Luttikhuis et al., 2014; Silvenius et al., 2014; ten Klooster, 2002; Turner et al., 2008). Hence, there is a discrepancy between Swedish consumers' perceptions in relation to what prior research has shown: that the indirect effects of packaging functions, such as protecting food from loss or waste and contributing to efficient transport (i.e., aspects overlooked by almost all consumers), in general have a greater environmental impact than the packaging material itself.

Study 4 concludes that most consumers believe that the environmental impact of packaging is a matter of material although research shows it is not.

Energy

Two consumers stated in their free text answers that they consider the packaging's energy consumption in their selection of food products. One consumer related the energy consumption to the production of the packaging, and the other stated that he or she prefers light weight packages for more energy efficient transportation. These two responses are presented in Paper II, however the first was categorized under packaging material (resource efficient) and the second under function (weight).

There was no particular focus in the survey on energy considerations. It was only in the free text answers about packaging shape, material and function and the environmental effect packages have that answers related to energy considerations could come up. The packaging-related issues regarding energy are mainly related to energy consumption and energy sourcing, issues that are more closely linked to processes and decisions upstream the supply chain than to consumers. Had specific questions about energy been posed in the survey, the responses about energy-related aspects would most likely have been more frequent.

In conclusion: the contribution consumers can make to the use and development of sustainable packaging

Consumers in general and organic food consumers in particular care about the environmental impact of packaging and are willing to pay for improvements, but they generally view it as a matter of material and rarely relate it to packaging functions. This stands in contrast to the research showing that the indirect effects generated by packaging functions and overlooked by consumers are far more important than the direct effects linked to the packaging material and energy considerations. Their expressed willingness to pay could be viewed as a contribution to sustainable packaging because it is a potential incentive for brand owners (and the packaging industry).

The results of Study 4 also indicate that, when it comes to packaging considerations, a majority of consumers select food products based on their perceptions of how the package can facilitate their handling of the product and thus contribute to their convenience. These choices can in many cases unintentionally contribute to an increased use and development of sustainable packaging when features contributing to convenience are aligned with sustainable values of the packaging. In contrast, consumers who base their choices on material considerations (significantly more frequent among organic food consumers) may assume this to be an environmentally based choice, but in reality it can have the opposite effects because the consumers overlook the importance of packaging functions and the need for such as product protection.

The consumers' material focus and lack of knowledge of other aspects show that they do not have access to a life cycle perspective of packaging and to a product packaging systems perspective. The consumer responses are focused on their own handling of the (primary) packaging. Handling aspects related to other actors along the supply chain are seldom mentioned. Prior research claims that most consumers regard packaging as being integrated with the product, as long as the product is not consumed (Ampuero and Vila, 2006; Olsson and Larsson, 2009; Prendergast and Pitt, 1996; Venter et al., 2011). The consumers in Study 4 specifically regard the *primary* packaging to be integrated with the product, which is not surprising since that is the package they most often see and handle. This implies that they lack a holistic overview of the entire product packaging system. Study 4 did not explore whether or not they consider all three dimensions of sustainable development in their packaging selection.

In conclusion, consumers have a potential to contribute to the use and development of environmentally sustainable packaging by creating a demand for it. This is because they are interested and willing to pay for environmentally sustainable packaging. Another conclusion is that their ability to contribute through informed choices is limited by their lack of knowledge. Study 4 thus indicates the need to enhance consumer knowledge and guidance. This can enable consumers to make environmentally informed choices in the future. One way would be to offer packaging guidance on organic labeling that include the packaging-related aspects in the organic food standards.

8. The contribution of brand owners (Studies 5 & 6)

The strong growth in organic consumption among Swedish consumers (Ryegård, 2015; Ryegård and Ryegård, 2015) is aligned with their increased interest in health (Jönsson, 2015; KRAV, 2015c; Söderqvist, 2014), environmental and ethical values (Rokka and Uusitalo, 2008). The package is a means for brand owners to convey important messages and values to consumers (Fernqvist et al., 2015). Are the organic values of the product and the production of the same also considered in the brand owners' packaging selection and/or development processes? Do brand owners pay particular notice when selecting or developing packages for organic food products? What ability do brand owners have to contribute to the use and development of sustainable packaging for their products? What challenges and opportunities do they experience? This chapter presents the main findings that respond to RQ 5: **How can organic food brand owners contribute to the use and development of sustainable packaging through their ability to affect the packaging for their products?** This was explored initially in Study 5, which focused on SME brand owners and smaller brand owners. One large brand owner was included as a reference case. Study 5 is described in Paper III. Study 6 extended Study 5 to cover a broader range of brand owners and is described in Paper IV. An overview of the brand owners and the informants included is found in Appendix B.

Brand owners' ability to affect the packaging

Study 5 indicated that small- and micro-sized brand owners do not have the technical capacity, knowledge or authority in the supply chain to influence packaging selection and/or development. The results of an analysis also indicated that the brand owners lack a holistic perspective of sustainable packaging. The analysis was based on a framework of holistic sustainable packaging inspired by Svanes et al. (2010). On the basis of the large reference case included, Study 5 indicated that large brand owners also face challenges in influencing the use and development of sustainable packaging presented in Paper III. Thus, Study 6 went on to examine the challenges and enabling factors of a larger sample of brand owners. Study 6 showed that the brand owners' abilities to contribute to the use and development of sustainable packaging for their products are influenced by: 1) the

nature of the selection or development process at hand, 2) the existing packaging lines, 3) the brand owners' relationship with their suppliers, and 4) the power and influence of other actors such as customers and consumers. The results are presented in Paper IV and are organized according to these four factors: the packaging selection and/or development process, existing packaging lines, the brand owners' relationship with the supplier, and other supply chain actors.

The packaging selection and/or development process

The nature of the packaging selection and/or development process, its goals and how it is initiated is decisive for the brand owners' ability to contribute to the use and development of sustainable packaging. Four kinds of selection and/or development processes that take their points of departure either in the product or the packaging were distinguished from the data material. The categorization based on the scope of the selection and/or development process was inspired by Griffin et al. (1985) and Soroka (2002). These four processes allow the brand owners with different levels of ability to contribute to the use and development of sustainable packaging as illustrated in Figure 18.

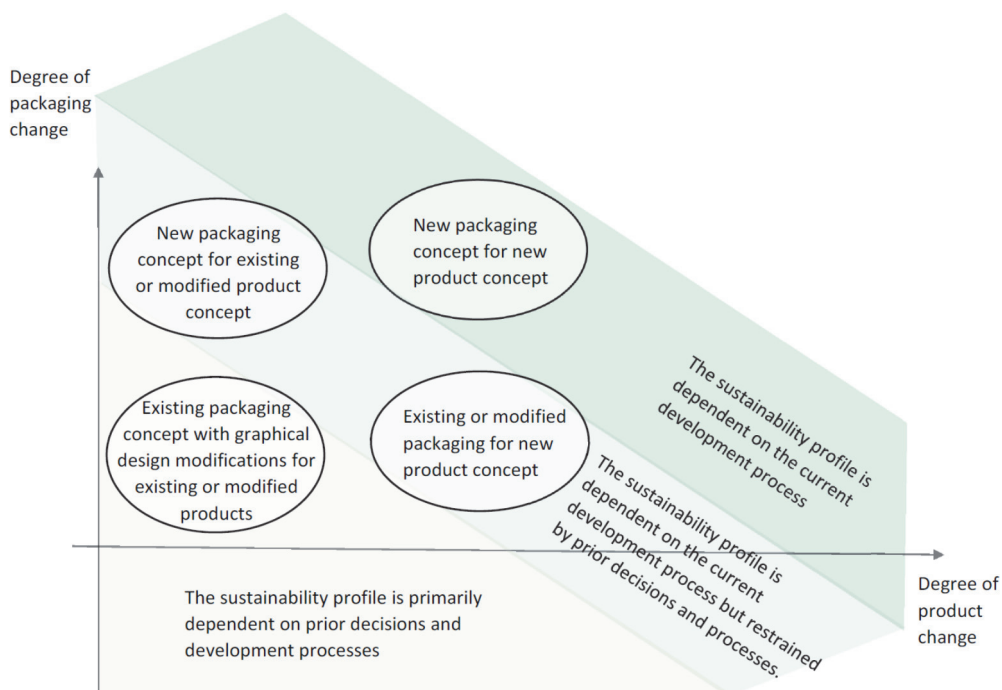


Figure 18: A schematic illustration of brand owners' potential to influence the sustainability profile of the packaging dependent on the kind and extent of the packaging selection and/or development process.

The brand owners' packaging influence in the lower left process is limited to changes in the graphic design within a given design format. The process allows the brand owner primarily to influence the communicative function of the packaging since other aspects are already set by prior decisions and development processes. The brand owners can influence how sustainable the packaging is through their selection of features that affect how well the package fulfills its communicative function.

In the upper left and lower right processes, the brand owner can influence the graphic design of the packaging and possibly make modest changes in the packaging material and/or its physical design. This means that the process gives the brand owner the potential to influence all three packaging functions: protect, facilitate handling, and communicate. The brand owner's abilities, though, are restrained by prior decisions and processes.

In the upper right process, the brand owner is able to influence all packaging parameters (graphic design, packaging material and physical design) in a radical way because they encompass a full product and packaging development process. Thus the development process offers unlimited possibilities to make decisions about the three functions of packaging: protect, facilitate handling and communicate.

The packaging selection and/or development process alone does not restrain the brand owners' abilities to influence the sustainability profile of the packaging of their products.

Existing packaging lines

Informants from most of the companies studied, independent of company size, report a constraint from existing packaging lines. This refers to packaging lines in-house as well as at the supplier site. In general, packaging lines are reported as being inflexible and requiring heavy investments that ought to last; one informant stated up to forty years. However, the informants also point out that their long-lasting lines were "selected for their reliability and durability". Several informants state that the existing packaging lines set the constraints for what they regard as possible packaging solutions. They state that they are "limited by the machines" in their packaging selection and conclude that this leaves them only able to "express themselves in the graphics of the package". Some packaging lines can accommodate such as alternative sizes, or opening features, whereas others are entirely fixed.

The brand owners' relationship with the supplier

The brand owners' position in the supply chain – in terms of their closeness to the packaging supplier and the level of supplier integration in the packaging development process and the power situation in their supplier relation – also effects their ability to influence the use and development of sustainable packaging for their products.

A typology with four types of brand owners was distinguished from the empirically based data. The four constructed types are referred to as: 1) At the mercy of the food supplier, 2) The flip side of small-scale production, 3) At the mercy of the packaging producers, and 4) On an equal footing. The typology was formulated on the basis of two main influential factors that were found to be related to the brand owners' context: relation with the packaging supplier, and brand owner size in relation to supplier (Figure 19). These two factors were identified in the data as having an influence on the brand owners' ability to influence the use and development of sustainable packaging.

Relation with packaging supplier	Direct	At the mercy of the packaging supplier	On an equal footing
	Indirect	At the mercy of the food supplier	The flip side of small-scale production
		Small	Large
		Brand owner size in relation to supplier	

Figure 19: The four types of brand owners positioned in relation to the two main factors and their dimensions.

The description of the brand owners' organizational context, in terms of sources of power, their power situation in their supplier relation, and the level of supplier integration in the packaging development process is described in the types and linked to their ability to influence the use and development of sustainable packaging for their products. This is summarized for the four types in Table 9. The power of brand owners in their supplier relation appears to increase or decrease according to: length of relationship, trust, company size, sales and purchase volumes, packaging expertise, uniqueness of resource, supplier alternatives and lock-ins in existing packaging lines. This complies with the power sources identified by Kähkönen (2011) in general buyer-supplier relations. For more detailed descriptions of the four types, the reader is directed to Paper IV.

Table 9: Characteristics of the supplier relationship in the different brand owner types and their packaging influence in the packaging development process (PkDP). The table structure is inspired by Kähkönen and Lintukangas (2010).

Type	Relationship, size	Level of supplier integration in PkDP	Power situation	Brand owner power sources	Supplier power sources	Packaging influence
At the mercy of the food supplier	Brand owner < food supplier	Primarily or entirely supplier driven.	Food supplier dominance	Length of relationship Trust	Company size Volume of sales Uniqueness of product	Delimited to graphic and textual communication on the packaging solutions offered by the food supplier.
The flip side of small-scale production	Brand owner > food supplier	Primarily or entirely supplier driven.	Brand owner, but limited ability to use it.	Company size Purchase volume Packaging expertise	Length of relationship Trust Uniqueness of product	Limited to graphic and textual communication on the packaging solutions offered by the food supplier unless they invest in direct supplier development.
At the mercy of the packaging supplier	Brand owner < packaging supplier	Primarily or entirely supplier driven	Packaging supplier dominance	Length of relationship Trust	Packaging expertise Company size Volume of sales Lock-ins	Delimited to graphic and textual communication and selection among the alternatives offered by the packaging supplier.
On an equal footing	Brand owner ≈ packaging/ (food) supplier	Formalized supplier integration	Balanced	Purchase volume Packaging expertise	Company size Volume of sales Packaging expertise	Not restrained in packaging selection and/or development by their supplier relationship.

The results show that the brand owners' abilities to select and/or develop packaging for their food products are influenced by their supplier relationship. The four different types have substantially different relationships with their suppliers and also different abilities to influence their packaging.

Other supply chain actors

The brand owners are also dependent on other actors such as consumers and customers. These can influence to varying degrees the brand owners' packaging selections or development. Several brand owners state that maintaining packaging traditions is important to them. Partly linked to this, as Soroka (2002) also elaborates, can be the fear of changing the packaging beyond consumer recognition. The resistance to change can also be linked to the generally inflexible and long-standing packaging lines. One informant also concludes that changes have to be made to keep with trends but should not get too far ahead of progress.

Most brand owners also follow the moves of their competitors in packaging selection and/or development, although the extent to which they let it influence their own decisions

varies. Some state that they go their own way because they want to be in the packaging front line; others admit to being inspired by their competitors.

The signals from the customers (i.e., the retail chains ICA, Coop, Axfood and Bergendahls) influence several of the brand owners in their packaging selections and/or development processes. These signals are considered important due to the brand owners' fear of not being included in the product range of the retail chains. This kind of customer influence may be particularly strong in Sweden due to the high consolidation rate among food retailers, where almost 80% of the market is concentrated in five supermarket chains (Dobson, 2003).

Brand owners' actions towards more sustainable packaging

Study 6 shows that two out of three brand owners with both conventional and organic products do not take special actions in the packaging selection and/or development process to align the packaging with the values of their organic products, apart from considering the package's graphic layout and labeling.

Five brand owners in total reported that they particularly consider the environmental impact in their selection or development of packaging for their organic food products. Examples provided are: generally smaller packages for organic food because of its shorter shelf life; less packaging material such as no plastic screw cap on organic products and thinner film in packages since thicker films did in the mentioned case not protect better but look better on the shelves. One brand owner claimed to have stricter demands in general on packages for organic products, although provided no examples.

Although the actions towards more sustainable packaging specifically related to organic food products were few, general actions related to packaging were common. All of the brand owners mention general packaging actions for an increased use and/or development of sustainable packaging. Many of the actions reported by the brand owners are taken from both an environmental perspective and an economic one. Few brand owners report that they take packaging-related actions specifically motivated by a social sustainability perspective. The actions reported are presented in Table 10, categorized according to brand owner type and aspect (packaging functions, packaging material, and energy)

Table 10: Overview of brand owners' descriptions of their packaging considerations related to their examples of actions taken in packaging selection and/or development categorized according to brand owner type and aspect, (n.m., not mentioned).

	At the mercy of the food supplier	The flip side of small-scale production	At the mercy of the packaging supplier	On an equal footing
Packaging functions:	<i>Protect</i>	In general	In general Mechanical properties Barrier properties	In general Mechanical properties Barrier properties
	<i>Facilitate handling</i>	Weight Apportionment Processability Recyclability	Unitization Apportionment, Fill rate Processability Openability Resealability Unpacking/ emptying Second use	Unitization Apportionment Fill rate Processability Openability Resealability Unpacking/emptying Recyclability
	<i>Communicate</i>	Product information and instructions Package information and instructions (info how to recycle, text to facilitate opening)	Product information and instructions	n.m.
	<i>Material</i>	n.m.	Selection	Amount Selection Sourcing
<i>Energy</i>	n.m.	n.m.	n.m.	n.m.

The packaging considerations reported by the brand owners indicate differences in focus between the different brand owner types in line with the descriptions of the types. The ones with the least packaging influence and most distant relation to the packaging supplier ('At the mercy of the food supplier' and 'The flip side of small-scale production') clearly focus on communicative considerations. Whereas the other two brand owner types mention a wider range of packaging considerations in the actions they take in relation to the aspects identified as important to consider in packaging selection and/or development processes towards more sustainable packaging.

The function to protect

Product protection is emphasized by most brand owners as the most important aspect to consider, in line with reviewed packaging literature (Paper I). One of the informants stated: "The later in the supply chain a product is wasted, the more energy is wasted and the greater negative environmental impact it has had." Thus, brand owners pay particular attention to finding packaging materials that provide sufficient protection for their

products and enables them to keep the guaranteed shelf life. The importance of a long shelf life is emphasized to keep down the amount of food wasted.

The use of the click-sound in jar caps is reported to ensure that the package has not been opened, thereby ensuring the quality of the contents.

The function to facilitate handling

The brand owners also mentioned actions that they take to facilitate the handling of their products during filling, transportation, retailing, consumption and recycling. These actions also improve the sustainability profile of the packaging. Most of the brand owners report economic motives but environmental motives are also mentioned.

Striving for forgiving graphic designs is an applied strategy that is reported to reduce the amount of packages wasted during filling and decrease the efforts required in adjustments of the filling process. Other examples are also reported of how the efficiency in processing and packaging influences brand owners' packaging selection. One example of a PET package was mentioned as being more even in size than its paper based alternative, and thus more efficient in the brand owners' processes. The PET packages are also more efficient to stack in inbound transportation and thus reduce the number of trucks by about 2/3. However, the brand owner stated that a drawback is that the PET used is not a renewable material and their consumer response indicates that consumers dislike plastic packaging.

Several brand owners report efforts towards efficient packaging and optimization of their packaging for transport. Transport efficiency "is also an economic issue as we pay per item, thus it is a very good incentive for us to do everything we can." The weight of the packaging is a consideration as is high fill rate achieved by one of the brand owners through brick-shaped packages with no air in.

Brand owners also mention actions they take to facilitate handling in retail, such as perforations and "tear-off flaps" on secondary packages for fast, easy exposure with little packaging material for the retail staff to waste. Light weight packaging are also specifically motivated to improve the occupational health of workers.

Several different features that facilitate consumers' handling of their packaging were mentioned: openability, resealability, apportionment, and being able to completely empty. Actions that in various ways facilitate for consumers in opening their packages were noted by several brand owners; some also mentioned actions taken to prevent product waste during the opening of packages. Resealability is a feature that brand owners like because it maintains the quality of the product. The down side of resealability is that it can require additional packaging material and cost.

Some brand owners mentioned the use of apportionment (i.e., adapted packaging size to estimated consumption rate of targeted consumers) to avoid the negative environmental effects of wasted food. It is a challenge for them, though, to sell smaller quantities because

these in general have a higher price per unit. Some brand owners also have larger packaging alternatives for heavy users and larger families.

Features that facilitate emptying the packaging completely are desirable. Some brand owners have been successful in achieving this while others are striving to do so.

Facilitating recycling was mentioned. One example given was of a carton package that was entirely made of a cellulose based material, including its transparent window. This means that the entire package can be recycled as paper-based packaging. Packages that are easier for consumers to flatten also facilitate recycling.

The function to communicate

Examples are found where brand owners improved the sustainability profile of the product through communication on the packaging. The packaging can then assist consumers in recognizing the content, opening, and recycling the package. Values and qualities of the product are expressed through transparent windows or realistic photos to ensure an honest communication of what is inside. This enables content recognition. Instructions such as “open here” assist consumers in easily opening the package. Brand owners have also added information on how to recycle their packaging. One brand owner commented that providing recycling instructions is “the least we can do to encourage it to end up in the right place.” Another stated that despite the information provided on their packaging, they still get questions on how to recycle it. Another brand owner mentioned actions related to packaging communication not being directed to consumers but to retailers to facilitate their handling of the packaging.

Packaging material

Considerations related to the packaging material included examples of replacing packaging materials with more sustainable alternatives, and avoiding the addition of unnecessary and harmful substances to the packaging material.

Some brand owners expressed frustration over the fact that they have not yet been able to remove PVC and bisphenol A from their packages. Regarding the development of new more sustainable packaging materials, one brand owner stated, “Nothing much happens unless a political decision is made that is enforced”. The amount of packaging material can be decreased as much as possible by reducing thickness without losing the desired properties of the packaging, or by removing unnecessary double packaging. One brand owner changed to unprinted inside to reduce the amount of ink. The reduction of packaging material and ink is driven by environmental and economic reasons according to the brand owners.

A gradual transition to more renewable packaging materials was mentioned by some. The use of recycled packaging material was brought up as one example for packages that are not in direct contact with the food products. Some requested biodegradable plastics, although they had not found any with the desired qualities and in the required quantity.

One brand owner specifically concluded that such packaging material would be in line with the organic food profile. A drawback of the biodegradable plastics is that the consumer benefit cannot be realized as long as the plastic cannot be recycled with compostable food waste. A tradeoff between optimal packaging materials from an environmental point of view and economically feasible alternatives was also mentioned.

A transition to FSC-labeled (Forrest Stewardship Council), paper-based packaging material ensuring that the environmental, social and economic dimensions are considered in the forestry industry were mentioned. Some brand owners also include the social dimension of sustainability in that their suppliers have to sign a code of conduct that ensures, for instance, fair working conditions and no child labor.

Energy

Few of the informants mention actions specifically related to energy considerations in relation to packaging. However, several informants elaborate on packaging considerations that also implicitly concern energy-related aspects, primarily related to the amount of energy consumed.

In conclusion: the contribution brand owners can make to the use and development of sustainable packaging

The results of Study 5 presented in Paper III indicated that brand owners independent of their company size face challenges when it comes to influencing the use and development of sustainable packaging.

Study 6 concludes that there is a potential for all brand owners with the desire and competence to contribute to the use and development of more sustainable packaging through their ability to affect the packaging of their products. It is concluded that some brand owners use their potential more than others.

As illustrated in the constructed typology, packaging selection and/or development is influenced by brand owners, but in most cases it is not entirely up to the brand owner. The brand owner types identified have different capabilities to affect the packaging and its sustainability profile, but for most of the brand owners it is constrained. These constraints vary greatly depending on the process, existing packaging lines, relationship to suppliers and the influence of other actors in the supply chain. The ability to affect the product packaging ranges from being limited to the graphic design and text, to full flexibility regarding the graphic design, packaging material and physical design.

The results of Study 6, presented in Paper IV shows that the brand owners' ability to influence the packaging of their products and the packaging's sustainability profile is constrained by:

- The process
 - The nature of the packaging selection and/or development process, its goals and how it is initiated.
- Existing packaging lines
 - Lock-ins in packaging lines either at supplier sites or in-house.
- The brand owners' relationship to the supplier
 - The brand owners' position in the supply chain, in terms of their closeness to the packaging supplier.
 - The brand owners' power situation in their supplier relationship that is increased or decreased by: length of relationship, trust, company size, sales and purchase volumes, packaging expertise, uniqueness of resource supplier alternatives, and lock-ins in existing packaging lines.
- Other supply chain actors
 - The brand owners' dependence on other actors, such as customers and consumers.

The Study 6 results show that brand owners in the "On an equal footing" type are the ones with the greatest power to influence packaging selection and development of their products. This makes them important in driving the general development towards more sustainable packaging. Other brand owners to a large extent rely on their food or packaging suppliers for their packaging, and thus also its sustainability profile.

A majority (67%) of the brand owners do not make any particular efforts to match the values of the product with their packaging of the organic food products. However, all companies report that they have taken general steps towards the use and development of more sustainable packaging. The findings also indicate a potential for additional actions even within the identified existing constraints.

9. An integrated perspective of sustainable packaging: extended analysis and discussion

Chapters 4-8 have provided the reader with insights into sustainable packaging in general, and organic food in particular. Chapter 9 depicts and elaborates on sustainable packaging from a holistic view by integrating the findings from the six studies in an extended analysis and discussion.

Approaching the proposed holistic view of sustainable packaging with a packaging logistics perspective

The eighteen formalized approaches proposed by academia and/or trade associations that were analyzed in Study 1, were able to assist companies to some extent in sustainability assessments of their packaging and/or in the selection and/or development of sustainable packaging. The formalized approaches all have their strengths and weaknesses regarding their inclusion of the six tokens of sustainable packaging (Appendix C). Overall, though, they share weaknesses regarding the inclusion of packaging functions and their related indirect effects on sustainable development. The proposed terminology on packaging functions and features and their related indirect effects that contribute to sustainable development (Study 2, Paper I) can serve as a complement to the existing formalized approaches.

The formalized approaches of Grönman et al. (2013) and Svanes et al. (2010) were identified in Study 1 as being the most extensive ones in their inclusion of the six tokens of sustainable packaging. Because of this, a combination or integration of either of the two with the terminology proposed in Study 2 (Paper I) is preferable from a packaging logistics perspective. These combinations or integrations are further elaborated here.

An integration with the formalized approach of Grönman et al. (2013) is the most easily achievable solution in its present state. The proposed terminology from Study 2 could directly be used as a checklist in Grönman et al.'s step 4 (the feasibility study) but also as inspiration in the first two steps in the specification and ideation phase.

It would be more difficult to directly integrate the proposed terminology in Study 2 into the formalized approach of Svanes et al. (2010). The integration would require an adaption to the quantitative approach in their assessment. However, the terminology could be used as a source of inspiration in determining which parameters to include in Svanes et al.'s assessment of user friendliness. The features in Study 2 listed not only under the function to facilitate handling but also under the function to protect and to communicate can influence Svanes et al.'s user friendliness along the supply chain and are thus appropriate to include (Paper I).

The formalized approaches by Grönman et al. (2013) and Svanes et al. (2010) are different. Grönman et al. (2013) propose a sustainable packaging development process model in different stages where sustainability-related considerations are integrated in the different stages. Svanes et al. (2010) focus more on describing a combination of different methods that can be used in sustainability assessments when comparing different packaging concepts. Thus, the context, purpose and available resources at hand are decisive in terms of which of these two formalized approaches are preferable to combine with the proposed terminology of Study 2 (Paper I).

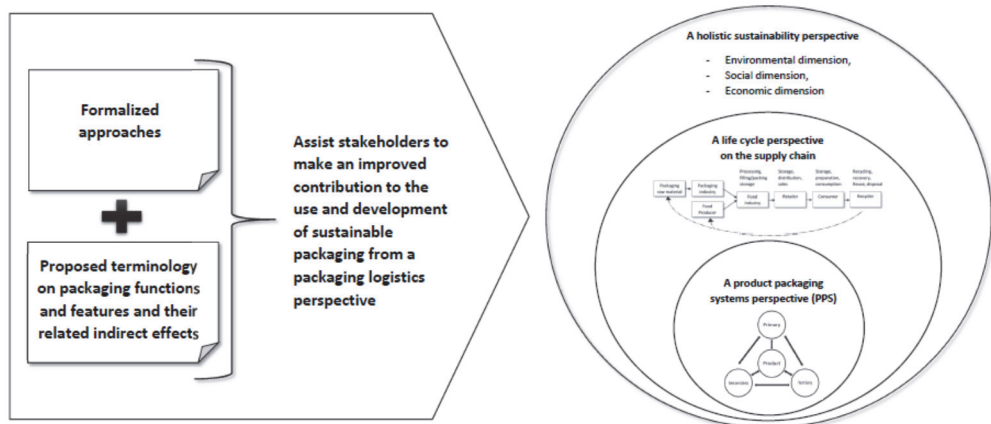


Figure 20: The contribution to use and development of sustainable packaging by the existing formalized approaches complemented with the proposed terminology in Study 2 (Paper I) in relation to the proposed holistic view of sustainable packaging from a packaging logistics perspective.

Either of the two formalized approaches (Grönman's or Svane's) in combination with the proposed terminology from Study 2 (Paper I) can assist the stakeholders in making an improved contribution to the use and development of sustainable packaging (Figure 20). This is because the two approaches: 1) address a holistic sustainability perspective since they include the environmental, social and economic dimensions; 2) apply a life cycle perspective to the supply chain, since they consider aspects that affect the actors along the entire supply chain; and 3) build on a product packaging systems perspective, since the product and packaging are regarded as an integrated and interdependent system.

Thus, the theoretically based Studies 1 and 2, if implemented, can be regarded as a step towards sustainable packaging from a packaging logistics perspective. The packaging logistics perspective is inherent in the product packaging systems perspective that encompasses the interactions along the entire supply chain (Figure 20).

The empirically based studies, 3, 4, 5 & 6, also consider packaging functions and their indirect effects on sustainable development as a sustainability potential. These considerations have an unexploited potential in the drive towards sustainable packaging; for organic standardization organizations in encouraging the use and development of sustainable packaging, for consumers to consider in their purchase decisions, and for brand owners to consider in their packaging selection and/or development processes.

The contribution of the stakeholders

The six studies of this thesis are integrated with a systems approach to a holistic picture illustrating the interplay between different stakeholders in Figure 21. All the stakeholders studied can contribute to use and development of more sustainable packaging for the organic food products of tomorrow.

Organic standardization organizations are able to influence brand owners and consumers in a more sustainable direction. This can be accomplished through regulations and other forms of communication. This can inspire, guide, encourage and push brand owners and consumers on the basis of their knowledge and strength towards use and development of sustainable packaging.

The current EU organic standard does not include any regulations on packaging, but KRAV does. Thus, the EU organic standard does not use this identified potential to influence consumers and brand owners on packaging sustainability. The packaging regulations included by KRAV in their 2015 version enhance the alignment of the sustainability profile of the packaging with the organic values of the food products. However, even these packaging regulations have a potential for further development regarding inclusion of the six tokens of sustainable packaging, especially packaging functions.

The tokens of sustainability – the three perspectives (holistic sustainability, life cycle and product packaging system) and the three aspects of packaging (functions, material and energy) – are well covered by either the Grönman et al. (2013) or the Svanes et al. (2010) approaches when they are combined with the terminology from Study 2 (Paper I). The alignment of the sustainability profile of the packaging and its content has the potential to become stronger with one of the two formalized approaches combined with the terminology from Study 2 (Paper I).

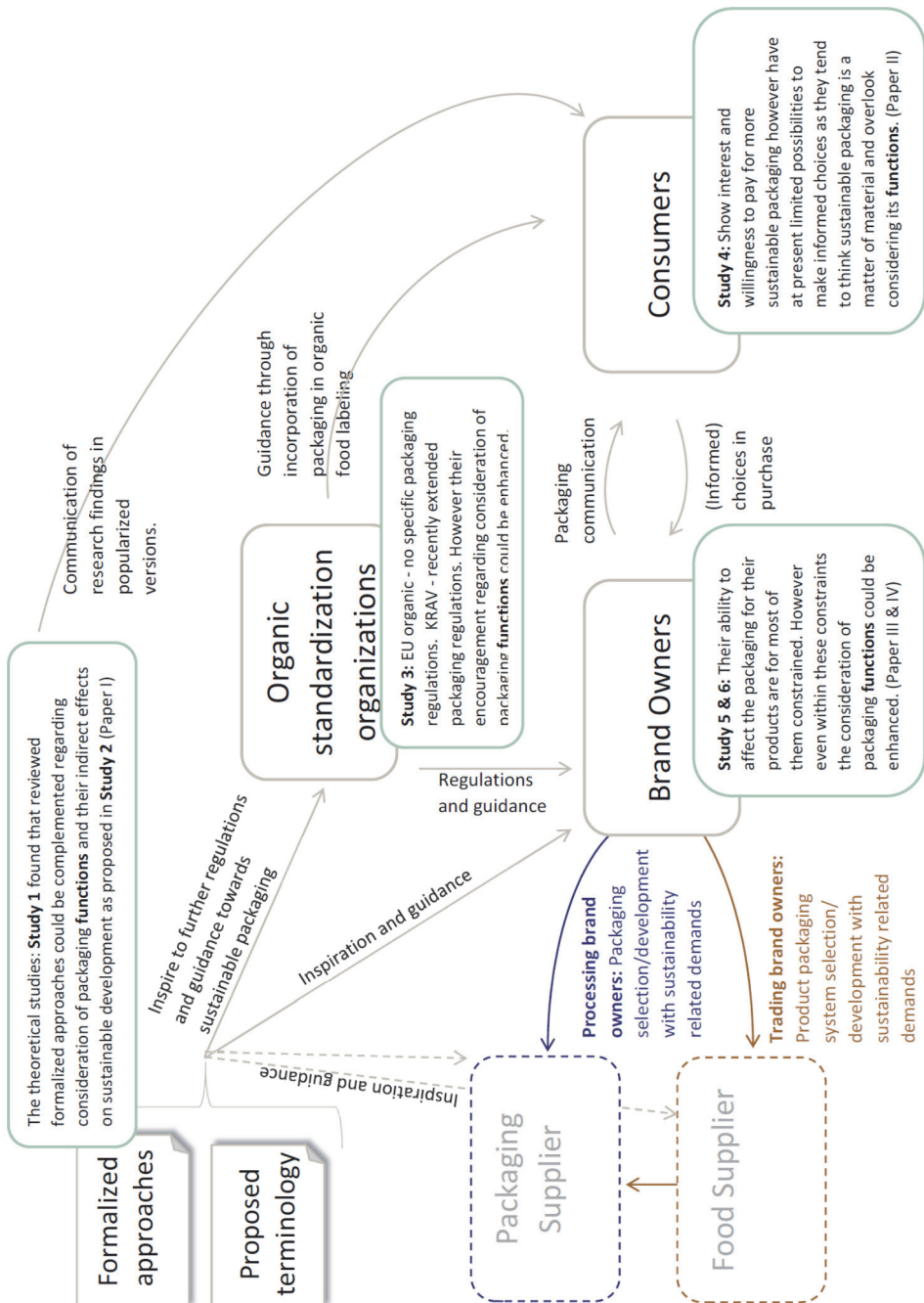


Figure 21: The integrated view of the six studies.

Organic standardization organizations can find inspiration in either of these combinations, particularly in encouraging consideration of more features contributing to facilitate handling and packaging communication. Many of the communicative features of packaging are particularly easy to influence even for brand owners, whose influence over packaging is otherwise limited. However, there is an intricate balance between the packaging regulations and brand owners' perceptions of the feasibility of the regulations. If they are perceived as unreasonable or unfeasible, brand owners will ignore them, thus counteracting their intended purpose. But as one brand owner put it, "Nothing much happens until a political decision is made that is enforced." The importance of packaging regulations by organic standardization organizations is not to be neglected as a driving force. A greater alignment can also present a more unified impression of organic food and its packaging towards consumers.

The integration of packaging regulations into organic food standards is a response to the need for such guidance among consumers. Organic food labeling is able to offer consumers guidance that facilitates their ability to make informed choices based on the sustainability profile of the packaging.

Extending consumers' knowledge and perceptions of the environmental aspects of packaging beyond its material aspects improves their ability to make informed choices and, in turn, potentially creating an increased demand. The formalized approaches combined with the proposed terminology can contribute to this: research findings can be communicated in popularized versions, information from organic standardization organizations such as KRAV, communication by brand owners via their packaging. The integration of sustainable packaging guidance in organic food labels could also be extended to more organic standards such as the EU's.

This could be argued to be particularly important in relation to organic food. Organic food consumers to a larger extent than others base their packaging choices on material considerations. Other consumers' choices are predominantly convenience based. Although organic consumers may assume that their material choices are environmentally based, these choices can in reality counteract the consumers' intentions because they overlook more important aspects of packaging, such as the need for product protection.

This lack of knowledge and misperceptions among consumers is not a new phenomenon. Twenty years ago, van Dam (1996) discovered in a consumer survey a discrepancy between consumer beliefs of what environmentally sustainable packaging is and the lowest negative environmental impact. More than ten years later, Young (2008b, p. 30) concluded from a consumer study in the U.S. that although consumers "care about the environment, they simply don't know enough to make the 'right' choices at this point". Now in 2016 this thesis concludes that the discrepancy still exists in Sweden: consumers think that environmentally sustainable packaging is a matter of material even though current research has proven that other aspects are more important. van Dam (1996, p. 612) claimed that a reason for this discrepancy was that consumers overlook the "possible environmental effects due to the production of packaging materials, and the

environmental consequences of packaging material for production, transportation and storage of the packaged product.” I would rather phrase the primary discrepancy of today as a lack of understanding and insights of the important functions packaging has to fulfill along the entire journey through its life cycle.

This discrepancy can generate additional challenges for brand owners in cases where consumer beliefs and what has been proven to be environmentally sustainable packaging diverge, since it then is “not sufficient to adhere to the environmental assessment.” Brand owner also have to adhere to the consumer beliefs and preferences and make efforts to convince consumers of the environmental soundness of the chosen packaging solution (van Dam, 1996), a challenge that some of the brand owners also spontaneously reported experiences of.

Because the environmental aspects were found to be significantly more important to organic food consumers, who are also willing to pay the most, this research indicates that organic food products are an appropriate segment for brand owners to initiate efforts towards sustainable packaging within. The way and extent to which brand owners can contribute vary. Their contribution depends on their ability to influence the packaging for their organic food products. Depending on the brand owner company’s characteristics and context, the four brand owner types identified face different challenging and enabling factors that influence their ability as shown in Studies 5 and 6 (Papers III and IV). However, all brand owners have a potential to contribute even within their existing constraints. If organic food brand owners in general were more aware of how their abilities to contribute are influenced by the packaging selection and/or development process, the existing packaging lines, the relationship to the supplier, and the influence of other supply chain actors, their ability to take further actions towards sustainable packaging could improve within the existing restrains, and could also influence these restrains.

The regulations of organic standardization organizations such as KRAV enable many brand owners to speak with a more uniform and stronger voice about general sustainability-related packaging demands. The brand owners can communicate their demands either directly to their packaging suppliers or indirectly through their food suppliers, who are generally dependent on their position in the supply chain. By gathering several brand owners in the name of KRAV behind general sustainability-related packaging demands that emanate from KRAV’s packaging regulations, they can achieve a greater ability to influence the sustainability profile of the packages the packaging industry has to offer.

From a packaging logistics perspective, the sustainability profile of packaging is argued to be context specific. This means that it is not sufficient for the packaging industry to make efforts to increase the sustainability profile of the packages they supply. It is also important that brand owners with insights about their particular product and their unique context have access to knowledge and inspiration that enables them to make judgements of the sustainability profile of the packaging for their products. The combination of one of the formalized approaches (Grönman’s or Svane’s) and the proposed terminology on

packaging functions in Study 2 (Paper I) could assist in such endeavors. The extensive lists of packaging functions, features, examples and their indirect effects provided in Study 6 (Paper IV) can further inspire to action, even within the existing restrains.

This thesis offers brand owners an opportunity to actively integrate the features that consumers find attractive (Study 4, Paper II) into packages with a sustainability profile. This can impact sustainable development by increasing the value perceived by consumers of sustainable packaging and possibly increase their demand for sustainable packaging.

The stakeholders' potential to contribute to the use and development of sustainable packaging is also dependent on the numerous interactions between them as illustrated in Figure 20. Communication is fundamental. The terminology proposed in Study 2 (Paper I) can facilitate packaging-related communication because it enables a shared understanding of packaging functions and features among the stakeholders. The proposed terminology could thus enhance dialogue and cooperation between stakeholders and thereby influence the outcome.

10. Concluding remarks

Conclusions and contributions

This thesis builds on existing research claiming that packaging has a potential to contribute to sustainable development. It adds to the existing research by showing, from a packaging logistics perspective, that there is even more unexploited potential when one takes packaging functions into consideration. This is one way to enhance the contribution of packaging to sustainable development. The research presented confirms that packaging functions are the key to hidden sustainability benefits, as reported in previous research (Fitzpatrick et al., 2012). This research provides extensive lists of packaging functions and features and by linking them to their potential indirect effects, contributes to the three dimensions of sustainable development. This complements the existing formalized approaches that support sustainable packaging but that do not consider packaging functions as extensively.

The results of the empirically based studies show that efforts can and are being made by consumers, by brand owners and by organic standardization organizations, to contribute to the use and development of sustainable packaging in the Swedish organic food market. However, the empirical evidence also indicates that the potential of packaging to contribute even more by taking packaging functions into consideration has not been fully exploited from a packaging logistics perspective in Sweden today.

This thesis also contributes to academia and practice by:

- Enabling enhanced and facilitated communication of packaging functions and features by means of the proposed terminology provided in Paper I.
- Providing an overall illustration of how the different stakeholders, organic standardization organizations, consumers, brand owners, academia and trade associations can contribute to the use and development of sustainable packaging. The analyses elucidate and elaborate on the abilities these stakeholders have to contribute to and the challenges they face.
- Providing insights into the present packaging regulations included in organic food standards in Sweden, and by indicating potential areas for further development of these regulations.

- Offering increased insights into consumers' perceptions and knowledge of the environmental aspects of food packaging in an organic food context in Sweden, indicating a need for information or guidance (Paper II).
- Providing consumer insights as to how sustainable packaging can be made more attractive for consumers to select (Paper II).
- Offering insights and typologies that characterize brand owners' ability to influence the packaging of their products as well as challenging and enabling factors met by the brand owners (Papers III, IV). An increased understanding can contribute to a greater awareness among brand owners of their situation and strengthen their capabilities by focusing their efforts on feasible changes towards sustainable packaging.
- Offering assistance and inspiration in particular to SMEs in defining their demands regarding packaging features on the basis of the desired packaging functions (Paper I). This could improve their ability to select packaging from the standard solutions offered by their suppliers.

At the outset of my research journey, sustainable packaging of organic food was considered to be a possible myth among Swedish consumers. However, the research results presented indicate that this is probably not the case since most Swedish consumers are uncertain about the environmental sustainability of organic food packaging.

This research shows that few brand owners make special efforts in packaging selection and development for organic food, the organic standards by EU pose no specific regulations on the sustainability profile of the packaging, and the new and extended packaging regulations by KRAV are too recent to show any effects. One interpretation is thus that packaging for organic food in Sweden today is not necessarily more sustainable than packaging for conventional food. Although sustainable packaging may not yet be a reality in the Swedish organic food context, this research points out the potential for future enhancements.

Ideas for further research

Ideas for further research were also identified during my research journey. More detailed studies need to be carried on the ways and means to guide and/or enhance the knowledge of consumers about the sustainability profile of packaging that respond to the needs identified. This research also indicates a potential for brand owners to influence consumer choices regarding the sustainability profile of food packaging by communicating the features attractive to consumers. However, it is for future research to determine successful ways for brand owners to formulate such communication.

Another interesting challenge is how the packaging lines of tomorrow can become more flexible, thus enabling brand owners and food suppliers to more easily adapt to changing consumer demands, future knowledge enhancements and forthcoming trends.

How to integrate the packaging functions and features identified into packaging development processes models and/or assessment models, and how to implement them in practice are also topics to investigate in greater detail.

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Appendix A

Complementing research descriptions of Study 1 & 3

Two of the studies in the thesis research are not published in separate papers: *Formalized approaches towards sustainable packaging* (Study 1) and *The contribution of organic standards* (Study 3). More thorough descriptions of how they were conducted are thus presented here:

Study 1: Formalized approaches towards sustainable packaging

A literature review was conducted to access the current status of how sustainable packaging development is supported through different formalized approaches. The review explored and pointed out gaps in existing formalized approaches provided by academia (academic approaches) and those provided by trade associations (industry approaches). Formalized approaches in terms of frameworks, models, methods, guides, guidelines and tools for sustainable packaging development were included.

Searches for the formalized approaches were carried out in two ways:

The academic ones were searched for in academic journals using the Lund University search engine, LUB Search. It is a search engine that covers an excessive array of different databases including those judged to be relevant for the topic at hand: Science Direct, EBSCO, Elsevier, Scopus, Web of Science, Sage, Springer and Wiley. The searches were performed with different combinations of the search words “packaging”, “sustainability”, “sustainable”, “framework”, “model”, “method”, “guide”, “guideline” and “tool”. The criteria for inclusion were research articles that were published in academic journals and that aimed to develop or propose an overall sustainable packaging framework, model, method, guide or guideline. An article was included based on my analysis of the title and abstract; when uncertainties arose, I read all or parts of the entire article to determine if it should be included. This procedure resulted in nine journal articles relevant for inclusion. The search structure and the relevant references are presented in Table 11.

Table 11: Literature search of sustainable packaging frameworks, models, methods, guides and tools in academic journals (LUB Search), search words in abstract, number of hits and the ones found relevant based on the criteria for inclusion.

Search word	Search word	Search word	Hits	Relevant references
Packaging	Sustainability	Framework	27	Grönman et al., 2013; Lewis et al., 2010
		Model	37	Pålsson et al., 2013; Wever and Vogtländer, 2013
		Method	42	Wever and Vogtländer, 2013; Grönman et al., 2013; Svanes et al., 2010
		Guide/ guideline	7	--
		Tool	19	Luttikhuis et al., (2014); Svanes et al., 2010; Lewis et al., 2010
	Sustainable	Framework	28	Grönman et al., 2013; Colwill et al., 2012
		Model	39	Pålsson et al., 2013; Wikström and Williams, 2010; Verghese et al., 2010
		Method	71	Grönman et al., 2013; Svanes et al., 2010; Verghese et al., 2010; Colwill et al., 2012
		Guide/ guideline	6	--
		Tool	29	Verghese et al., 2010; Colwill et al., 2012; Svanes et al., 2010

A search was carried out in Google for the formalized approaches provided by trade associations. The same search words and structure were used as for the academic ones. In some, the relevant documents were not found directly but by navigating further into the webpage of the trade association identified in the initial search. The following list of trade associations and documents were found relevant for inclusion in this review:

- Australian Packaging Covenant – *Sustainable Packaging Guidelines* (APC, 2010)
- ECR Europe, EUROPEN – *Packaging in the Sustainability Agenda: A Guide for Corporate Decision Makers* (ECR, 2009)
- The Consumer Goods Forum – *Global Protocol on Packaging Sustainability 2.0* (TCGF, 2011)
- Sustainable packaging Coalition
 - *Design Guidelines for Sustainable Packaging* (SPC, 2006)
 - *Sustainable Packaging Indicators and Metrics Framework* (SPC, 2009)
- Sustainable Packaging Alliance – *Principles, Strategies & KPIs for Packaging Sustainability Framework* (SPA, 2010)

Three additional documents were included in the analysis that matched the criteria for inclusion and were found by further searching and nesting from references found in the review:

- International Trade Centre – *Packaging for Organic Foods* (ITC, 2012)

- Incpen – *PackGuide: A Guide to Packaging Eco-Design* (Incpen, 2008)
- WRAP, Soil Association – *Reduce, Re-use, Recycle: A guide to minimizing the environmental impact of packaging* (Brookes and Vrolijk, 2006)

In total, 18 formalized approaches were included in the analysis and listed in an Excel spreadsheet. The approaches were analyzed with regard to their inclusion or consideration of the six tokens of sustainable packaging identified in the literature: the three perspectives (holistic sustainability, product packaging system, life cycle); and the three aspects (packaging functions, packaging material and energy). To reach an increased level of detail in the presentation of the findings, the product packaging systems were presented in two separate categories, although these adhered to one interlinked system. The analysis was complemented with a general description of each approach.

Study 3: The contribution of organic standards

This study was initiated with visits to three local retail stores in Lund that represent a majority of the Swedish retail chains (ICA, Coop and Willys). The aim was to get an overview of the organic food labels on existing organic food products in Sweden and the kinds of packages in which they were packed. The labels were compared to those found in the literature (KFS, 2011) to ensure none were missing. The organizations or authorities behind these labels were studied. The two most commonly appearing labels in Sweden by far were the EU Leaf and the KRAV label. These two were thus selected for further analysis of how they can encourage the use and development of sustainable packaging in their organic food standard. The basis of the analysis was the inclusion or consideration of the six tokens of sustainable packaging that had been identified.

The organic standards behind the EU Leaf and the KRAV label were examined to determine the regulations they include concerning packaging. This was accomplished by reading but also by computer based searches of the standards for the terms: “pack”, “package” and “packaging”. The sections of the regulations that concerned packaging were highlighted and read thoroughly. The sections that concerned graphic design in terms of placing and the dimensions of the organic label on the package were excluded from the analysis.

In my years of research, I noticed a change not only in how KRAV incorporated packaging into their organic food standards but also their increased interest and attention to packaging. This change was noticed, although a longitudinal study was not intended or carried out. My first contact with the KRAV organization was during a seminar held by the Standards Director that I attended in 2010. More in-depth data were later collected in 2014 through semi-structured interviews with two key informants from KRAV, both highly involved in the project of reviewing their standards regarding the further incorporation of packaging considerations. The interviews were transcribed shortly after and analyzed following content analysis procedures (Patton, 2002). Based on my research

focus, I was subsequently invited by KRAV in 2014 and 2015 to participate in their expert group for packaging along with other researchers in the field, representatives from organic food brand owners, packaging developers, consultants and the Swedish Society for Nature Conservation (Naturskyddsföreningen). The purpose of this group was to contribute to the further development of the KRAV standards and a guideline on packaging for organic food products. I participated in three workshops, one seminar and submitted written feedback in between.

Appendix B

Brand owners and informants included in Studies 5 & 6

Brand owners 1-5 were included in Study 5 and reported in Paper III. Brand owners 1-20 were included in Study 6 and reported in Paper IV.

#	Primary food category as brand owner	Interview date	Organic in relation to conventional products	Size	Function of informant	In-house processing	In-house packaging
1	Coffee	April 9, 2010	73%	Micro	Purchase, product development manager	No	No
2	Wide range	May 7, 2010	86%	S	CEO, part owner	No	Partly
3	Cereal	April 16, 2010	Partly	S	Marketing, product and development manager	No	Partly
4	Vegetables	March 11, 2010	Partly	M	Quality manager of R&D department	Yes	Yes
5	Spices	April 12, 2010	Partly	L	a) Purchase manager packaging materials b) Packaging developer	Partly	Partly
6	Alternative Dairy	April 27, 2011	40%	S	Marketing director	Partly	Partly
7	Vegetables	March 6, 2013	100%	Micro	Part owner	Partly	Partly
8	Wide range	March 6, 2013	Partly	L	Packaging manager	Yes	Yes

9	Vegetables	March 18, 2013	20%	S	Purchaser	Partly	Partly
10	Dairy	March 3, 2013	7-8%	M	Dairy manager /Production manager	Yes	Partly
11	Dairy	March 21, 2013	5%	L	R&D and quality director	Partly	Partly
12	Candy	April 4, 2013	100%	Micro	a) Part owner b) Part owner	No	No
13	Mediterranean	April 3, 2013	6%	L	a) Product and buying manager b) Senior product and buying manager	No	No
14	Wide range	April 5, 2013	100%	M		Partly	Partly
15	Coffee	April 5, 2013	20%	M	Production manager	Yes	Yes
16	Egg	April 9, 2013	15-20%	M	Production manager packaging	Partly	Partly
17	Meat	April 10, 2013	100%	S	a) Part owner b) Part owner	No	No
18	Cereal	April 11, 2013	Partly	L	Purchasing manager	Partly	Partly
19	Meat	April 15, 2013	Partly	L	Project manager packaging	Partly	Partly
20	Private label, wide range	April 15, 2014	100%	L	Former design project manager EMV	No	No

Appendix C

Results from the analysis of the formalized approaches in Study 1

Overview of the results from the review of 18 formalized approaches that support sustainable packaging development including: description, dimensions of sustainable development, system boundaries, levels of packaging, product inclusion, inclusion of packaging parameters, and indirect effects. The first 9 approaches are proposed by academia, the second 9 by trade associations.

Reference	Description	Dimensions of sustainable development	System boundaries	Levels of packaging	Product inclusion	Inclusion of parameters (functions, material, energy)	Indirect effects
Colwill et al., 2012	A holistic, integrated sustainability framework that interlinks strategic (strategic evaluation), tactic (material specification) and operational (sustainability assessment) levels. Provides decision support in evaluating comparisons of bio-polymer and conventional polymer packaging. Involves LCA analysis.	Environmental Social Economic	Packaging life cycle	Primary	No	Specific parameters are not presented.	No
Grönman et al., 2013	A guiding framework in six steps for sustainable food packaging design to assist packaging designers in decision making. Combines several methods such as studying packaging regulations and requirements, SWOT analysis, consumer/user study and LCA.	Environmental Social Economic	Product packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
Lewis et al., 2010	Framework for decision support based on strategies and KPI's for informed decision making and broader sustainability analysis based on LCA in combination with qualitative data analysis. Applied to plastic carry bags.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes

Luttkhuis et al., 2014	An actor network approach for early integration of sustainability considerations. It enables life cycle simulations and depiction of future scenarios supporting designers in decision making in the design and development of product package systems as a complement to existing sustainability tools.	Environmental Economic	Product packaging life cycle	N.m.	Yes	Specific parameters are not presented.	Unclear
Pålsson et al., 2013	Evaluation model for comparative analysis of packaging systems applied to component supply. It encompasses six groups of parameters. Intended for managers.	Environmental Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging material Energy	Yes
Svanes et al., 2010	A holistic methodology that integrate a number of different analytical methods whereof LCA is one. A number of indicators grouped into five categories enable decision support through quantitative comparisons between different packaging solutions in the design process.	Environmental Economic Social	Product packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
Verghese et al., 2010	A streamlined LCA tool, PIQUET, for quick evaluation of packaging to assist packaging design or decision process.	Environmental	Packaging life cycle, leaves out the user	Primary Secondary Tertiary	No	Packaging material Energy	No
Wever and Vogtländer, 2013	A method to determine the eco-costs/value ratio (eco-costs calculated through LCA; value is the price) for the environmental assessment and comparison of packaging design alternatives.	Environmental Economic	Packaging life cycle	N.m.	No	Packaging material Energy	No
Wikström and Williams, 2010	A model that calculates the balance between the environmental impact of a new packaging solution, and the impact caused by its change in food loss. Based on LCA and food waste data from the consumer phase. Aimed for packaging developers.	Environmental	Product packaging life cycle	N.m.	Yes	Energy	Yes
APC, 2010	Guidelines and checklists for review and optimization of consumer packaging to assist in design, manufacture and end-of-life management of packaging.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
ECR, 2009	Guide for packaging design considerations and examples of measures are provided for corporate decision makers to maximize the contribution of packaging to sustainable development. The approach can involve LCA.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging material Energy	Yes

TCGF, 2011	A framework providing attributes with related metrics, life cycle indicators and a corporate performance checklist for sustainable packaging development. The approach can involve LCA.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging material Energy	Yes
SPC, 2006	A guide to incorporating four new sustainability driven design objectives to the four conventional (technical performance, cost, appearance and regulatory compliance) in the packaging design and development process complemented with checklists. The approach is directed to packaging designers and developers.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	No	Packaging functions Packaging material Energy	Yes
SPC, 2009	A framework of 60 indicators and metrics divided into eight performance categories assisting primarily brand owners and retailers in measuring progress against the criteria in the SPC definition of sustainable packaging. LCA analyses can be included in some parts although the framework also includes sustainability metrics for which there are no LCA standards yet.	Environmental Social Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging material Energy	Yes
SPA, 2010	Four principles and corresponding strategies and KPI's are suggested for sustainable packaging in a checklist format for assistance in packaging selection or development.	Environmental Social Economic	Unclear	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
ITC, 2012	A guide for packaging selection in eight steps, checklist and information on packaging requirements of organic food packaging. Assisting exporters, packers and producers towards more sustainable packaging. Provides an extensive array of environmentally relevant aspects. It further provides extensive information on different packaging material options.	Environmental Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
Incpn, 2008	A guide and checklists for product and packaging designers and managers to combine eco-design principles with packaging functionality through adding sustainability to traditional design considerations.	Environmental Economic	Packaging life cycle	Primary Secondary Tertiary	Yes	Packaging functions Packaging material Energy	Yes
Brookes, Vrolijk, 2006 WRAP, Soil Association	A guide, checklists and best practice towards minimized environmental impact of packaging through packaging waste minimization. Assisting organic food companies to meet the Soil Association's standards for packaging	Environmental Economic	Packaging life cycle	Primary Secondary Tertiary	No	Packaging material	No

