

Chapter 4

Embedding a Sustainability Focus in Packaging Development Processes



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Abstract Despite packaging sustainability aspects often being embedded in companies' strategic aims, the structured implementation of such targets is limited at the operational level, where a product's commercial viability (strategic fit, business case feasibility, and a limitation of commercial risks) and development aspects (timing issues, material use, and supply chain efficiency) are prioritized over desired sustainability goals. Packaging acts not as an isolated entity but as a part of a symbiotic product-packaging combination, of which the development is the shared responsibility of stakeholders with different backgrounds and interests. With the development and design process of product-packaging combinations being a concatenation of decisions made by multidisciplinary teams in various organizations, the structured integration of sustainability-related considerations in product-packaging development can benefit from a synthesized focus on development teams' efforts, decision-making processes, stakeholder interaction and dynamics, and trade-offs. This research addresses a vision on an approach to explore, understand, and analyze this field, specifically its key characteristics that act as enablers and barriers of product-packaging sustainability. This is targeted by interactively modelling the decision-making processes of product-packaging development, both within multidisciplinary development teams, companies, and product-packaging chains, by means of a collection of interactive tools. Key within these tools is the ability to address the multidisciplinary nature of stakeholders, the decision-making processes within and beyond development teams, and the proposed and realized inclusion of sustainability-related considerations, all within a framework of tacit and explicit knowledge.

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4.1 Introduction

Attention towards sustainability- and circularity-related aspects in product-packaging development is increasing. Various targets are set, ranging from potential recyclability to the use of recycled materials and an overall reduction in packaging quantities. However, the structured implementation of such targets is often limited on the operational level. To take such aspects into account during the development process, trade-offs with other packaging features need to be made by product-packaging development teams. Even though sustainability aspects are often embedded in companies' strategic aims, the alignment of the strategic and operational levels of development shows to be limited. Therefore, design integration and inclusion of multiple stakeholders, disciplines, and perspectives shapes the core aim of this research's direction; synthesis over analysis as intervention towards improvements. This research addresses a vision on an approach to explore, understand, and analyze this field, by means of identifying the current problems and describing design research-based options for efforts to target these. This article aims to share insights which act as a foundation for this vision, with a focus on the reasoning behind synthesis-based interventions aiming to bridge the gap between academic understanding and industry challenges. We aim to enable development teams in ensuring the structured implementation of sustainability- and circularity-related considerations in product-packaging development, for which this vision paper provides a substantiation.

Within our scope, the main subject is the process of packaging development, with the synthesis of design interventions targeting the structured implementation of sustainability- and circularity-related considerations as a core aim. Following, this research's first quest is to explore this field's key characteristics, trade-offs, and boundaries that act as enablers and barriers of product-packaging sustainability and circularity. Secondly, the research focuses on adapting and improving the current situation by means of design interventions towards implementing sustainability considerations in product-packaging development processes. In the development process towards these interventions, synthesis follows analysis-focused, pattern-recognizing research steps, which renders this scope as solution-focused design research (Cross 1982; Buijs 2003; Pahl et al. 2007; Eekels and Roozenburg 1991; Swann 2002).

4.2 Point of Departure

4.2.1 *Product-Packaging Sustainability*

Within this research vision, we consider packaging as (a set of) physical artefacts that temporarily or unremittably assumes the functions of preserving, protecting, enabling use and handling, and conveying formal and informal information about the related product (de Lange et al. 2013). Packaging acts as an object which is subservient to its contents, undertaking functionalities of the standalone product, in order to provide the ability to bridge time and distance from manufacturer/producer to consumer (ten Klooster 2002). Following, packaging cannot be regarded as an isolated entity, but acts as a beneficial add-on to the product, which fulfils functions during different steps of a supply chain (Motte et al. 2007; de Koeijer et al. 2017b). A product-packaging combination shapes a symbiotic, interrelated entity in a complex and multidisciplinary network of stakeholders (de Lange et al. 2013; Oude Luttikhuis et al. 2014; Molina-Besch et al. 2014). Consequently, the interlinked life cycles of both the packaging and the product must be considered during the development process (de Lange et al. 2013; ten Klooster 2002; Oude Luttikhuis et al. 2014; Bramklev 2009). It is therefore incorrect to consider the environmental impact of packaging separately from the environmental impact of the product contained within the packaging (de Koeijer et al. 2017a). The isolated consideration of packaging as a separate entity leads to suboptimal solutions—therefore, the integrated development of product and packaging is important to develop optimal product-packaging combinations (ten Klooster 2002; Bramklev 2009; Olander-Roese and Nilsson 2009). Even though the environmental aspect of a package as an isolated entity is important, the scope of sustainable development should be broader than merely optimizing certain existing aspects of the packaging design. Within any supply chain—especially when a sustainability focus plays a role—this integrated perspective is essential. Sustainable considerations should cover the impacts of the entire product-packaging combination and should be targeted at all levels of detail—from added value and functionality to product definitions and materials, and end-of-life considerations.

4.2.2 *Product-Packaging Development Processes*

We regard the development process of product-packaging combinations as a subsection of ‘traditional’ product development. Both are characterized by iterative processes of analysis, synthesis, simulation, and evaluation steps (Buijs 2003; Eekels and Roozenburg 1991; Swann 2002; Cross 2000).

The development of a product-packaging combination is the shared responsibility of different stakeholders with various backgrounds and interests. Consequently, the entire development and design process of a product-packaging combination is a concatenation of decisions made by multidisciplinary teams in various organizations

(de Lange et al. 2013; Sheldrick and Rahimifard 2013). For this reason, the dynamics within those teams are of high value, this determines the extent to which desired sustainability aspects are expressed in the final product-packaging combination, as the result of the development process (de Koeijer et al. 2017a).

Most existing efforts regarding packaging sustainability—both in academia and industry—focus on minimizing the negative environmental impact of packaging materials, which is a blueprint eco-efficient view on the perceived superfluous nature of packaging as an isolated entity (de Koeijer et al. 2017b). This ignores the facilitator perspective of packaging as a subpart of an integrated product-packaging combination. In many cases, this materializes in late-stage optimizations, aiming for the reduction and elimination of packaging elements from supply chains. In addition, the adoption of one design strategy or key focus over another may result in trade-offs between sustainability- and circularity-related aspects, and other indicators, such as a product's commercial viability (strategic fit, business case feasibility, and a limitation of commercial risks) and development aspects (timing issues, material use, and supply chain efficiency) (de Koeijer et al. 2017a), visualized in Fig. 4.1. Strategic-level corporate packaging sustainability objectives (“desired sustainability”) may influence the weighting of specific life cycle impacts and thus influence ultimate operational design strategies [“perceived and achieved sustainability” (de Koeijer et al. 2017a)]. In general, sustainable product-packaging design calls on designers to balance factors and optimize them, while keeping in mind that optimizing for one parameter may shift but not necessarily limit the negative environmental burden of the product-packaging combination.

4.2.3 Packaging Within Societal Boundaries

The increasing attention towards sustainability- and circularity-related aspects in product-packaging development can be illustrated with a number of societal trends. More and more packaging producers apply recycled content into their packaging designs or allow better separability of different packaging materials, and actively communicate about this. Producers of packed products (brand owners and co-packers) are also becoming more aware of packaging's indirect environmental impact: food waste as a result of insufficient packaging. This contrasts the direct environmental impact of packaging (expressed by the packaging material contents' environmental impact) and is therefore a sensitive subject when considering product-packaging combinations as symbiotic integrated systems.

The behaviour of consumers plays a significant role in this, both by means of ‘correct’ (designed) use of packaging, and by the general unbalanced view on packaging as being superfluous or excessive, by focusing on features that become apparent after purchase (de Koeijer et al. 2017b). The design of packaging influences consumer behaviour during the process of purchasing a product-packaging combination (Magnier and Crié 2015; Steenis et al. 2017), also when specifying this to the influence of perceived environmentally sound packaging elements (Rokka and

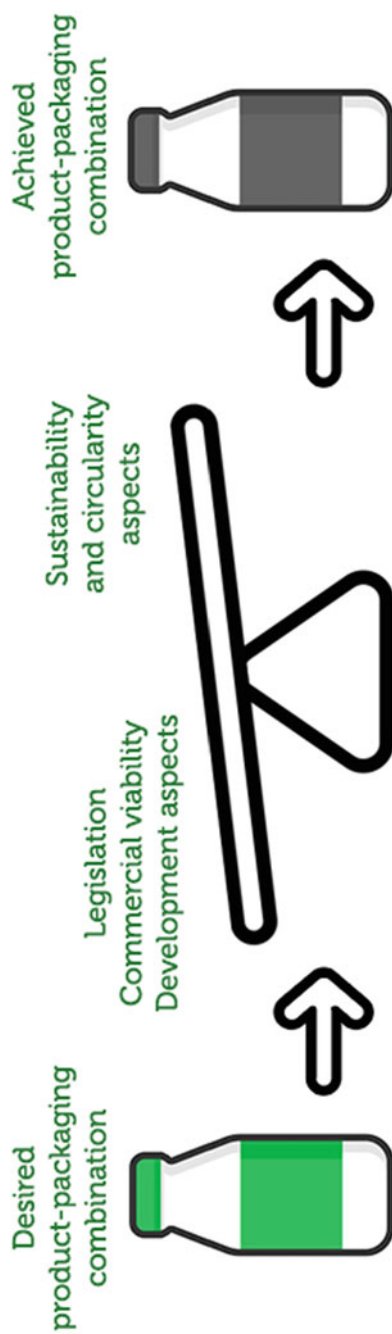


Fig. 4.1 Balancing sustainability- and circularity-related trade-offs

Uusitalo 2008; Magnier et al. 2016; Magnier and Schoormans 2015). Packaging communication, understandability, and reliability regarding environmental issues are important, even when gaps between the perceived packaging sustainability by consumers contrasts the ‘measurable’ packaging sustainability score (Steenis et al. 2017). Also with regard to the recycling process, packaging design plays an important role, it can be regarded as a tool to promote recycling among individuals who do not necessarily intend to engage in this behaviour (Verschoor et al. 2018). Additionally, it is important that consumers are informed how several parts of the packaging should be separated and discarded (Borgman et al. 2018). During the decision-making process which determines the product-packaging design, it is therefore of great importance to take environmentally-focused packaging features and the subsequent consumer behaviour into account.

Besides the consumer behaviour aspect, governmental regulations define a significant influencer of product-packaging sustainability. In addition to policies which target packaging waste, such as EU directives 94/62/EC (European Parliament and Council 1994) and 2015/720 (European Parliament and Council 2015), recent endeavours identify plastics as a key priority in the EU’s circular economy action plan (European Commission 2018). It proposes the reduction of the impact of plastics in the environment (mainly targeting marine litter) (European Commission 2018) and in The Netherlands a ban on giveaway plastic bags (Dijkema et al. 2015). Even though these efforts are not by definition erroneous, they do address current issues in a merely eco-efficient manner, of which the appropriateness is up for debate. Next to those policies, in the Ellen MacArthur Foundation’s publication ‘The New Plastics Economy’ (Ellen MacArthur Foundation 2016), the entire value chain of plastic packaging—in which design plays a vital role—is described as an essential element, with a direct and significant impact on the economics of collection, sorting and recycling. The choice of packaging materials, colours, formats and other design factors determines whether a package can generate positive after-use revenues if it is recycled, or if it will end up in low-grade disposal and lead to additional costs.

4.2.4 Point of Departure: Conclusion

The preceding sections explore the realm of product-packaging sustainability, which lead to a number of points that are relevant for a structured inclusion of front-end sustainability considerations, contrasting the current eco-efficient late-stage integration of sustainability- and circularity-related considerations. Design and redesign are important instruments to improve product-packaging sustainability. Even though potential design changes which are targeted at four problematic segments in plastic packaging are presented (e.g. in ‘The New Plastics Economy’), there is no further indication explaining the consequences for the design process and how design teams should apply this knowledge. For multidisciplinary product-packaging development stakeholders, the decision-making processes revolve around a multitude of issues, both within and beyond the described societal boundaries. Finding a balance between

these aspects and the accompanying trade-offs poses a key challenge. Therefore, the inclusion of these issues within decision-making is essential, but currently a struggle for product-packaging development teams. Structured interventions are required, especially targeting decision-making processes and stakeholder interrelations.

4.3 Research Method

Our proposed method of researching, synthesizing, and overcoming the addressed issues revolves around interactively modelling the decision-making processes of product-packaging development, within multidisciplinary development teams, companies, and product-packaging chains, in case-study settings. We apply a selection of tailor-made tools and techniques, both currently available and under (re)development, to simulate a product-packaging development process with a diverse team, including various roles with expertise on numerous subjects. Key within these tools is the ability to address the multidisciplinary nature of stakeholders, the decision-making processes within and beyond development teams, and the proposed and realized inclusion of sustainability-related considerations, all within a framework of tacit and explicit knowledge. The aim of the tools is to map development processes, and to provide practical insights into the integration and inclusion of sustainability-related requirements and decisions during development processes, how this affects other requirements, and how to deal with trade-offs. We aim to form a bridge between product-packaging value proposition, and materials and processes, which must result in applicable interventions for development teams to ensure the structured implementation of sustainability- and circularity-related considerations in product-packaging development, linking desired, perceived and achieved sustainability (de Koeijer et al. 2017a).

4.3.1 Research Phases

The research is conducted by means of various (recent) product-packaging development cases, executed by industry. In each case, the cooperation between the researchers and the company is spread out over four phases:

1. *Inventory*

Defining the research cooperation, involved stakeholders/parties, and goal setting. This phase targets the overall clarification of the main focus of the research.

2. *Audit*

Mapping the current situation. This phase is executed by means of an interactive visualization tool (described in the next section), by means of which we map the design landscape (an analysis of involved stakeholders, actions, decision-making

processes, and criteria), and benchmark this. The result of this phase is a timeline of the design process for a specific case, specifically targeting (potential) bottlenecks relating to the previously defined research focus.

3. *Synthesis*

Combining the collected insights, and developing these into interventions which specifically aim to reach the defined goals, related to the company's current position in the design landscape. Primary points of focus are the stakeholder interrelations and decision-making processes.

4. *Implementation*

Transitioning from theory to practice, aiming (1) to progress towards the structured implementation of sustainability- and circularity-related considerations in product-packaging development, and (2) to make these options explicit and clarify potential risks and bottlenecks related to the actual practical implementation.

The result of these phases is a collection of tools and interventions by means of which the company under consideration can accelerate the transition towards more well-defined sustainable product-packaging combinations. Within this approach, we explicitly focus on the interest of the company under consideration, in order to (co-)define the main goals and aims. This research is not targeted to 'how things must be done', but rather to assist in aligning desired and achieved sustainability; aligning the strategic and the operational level of product-packaging sustainability.

4.3.2 *Tools and Techniques*

In phases 2 and 4, specific tools are applied to conduct the research:

Visualization Tool (Phase 2)

The visualization tool we apply is based on the tool as described by de Koeijer et al. (2017a, b). This tool is developed to address the implicit interrelations between actors, actions, decisions, and criteria, and non-linearity and iterations in development processes—which are often difficult to grasp by means of traditional (semi-structured) interviews—and is based on a selection of cards. In three stages, the interview addresses a deeper level of stakeholder involvement: stage 1 addresses a stakeholder's main project contributions for the case under consideration, stage 2 addresses a synopsis of the project ("scenes"), stage 3 builds towards a network of interrelations, by means of the interview questions, answers, and various cards. Figure 4.2 illustrates the elements of the visualization tool in an example post-interview configuration.

In each case, we apply this visualization tool in interview sessions with individual stakeholders. This results in isolated insights in each stakeholder's perspectives on a project, of which the synthesis is the sole responsibility of the researchers, in research phase 3. The application of this visualization tool mainly results in advantages related to the active involvement of an interviewee in the interviewing process, and the

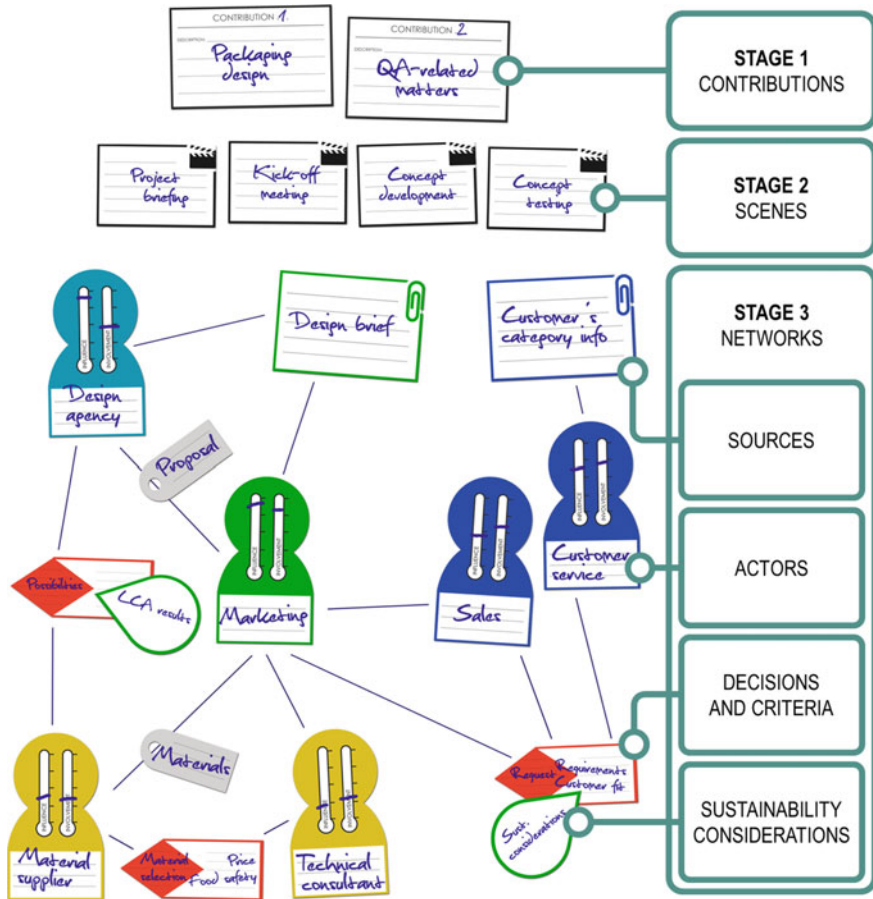


Fig. 4.2 Visualization tool elements. Adapted from de Koeijer et al. (2017a)

creation of a ‘talking piece’, limiting the necessity of creating a mental image and interpretation of the discussed development process by the researchers (de Koeijer et al. 2017a).

Serious Gaming Intervention (Phase 4)

The tool we plan to apply in phase 4 is a serious gaming concept, specifically focused on addressing stakeholder mapping and decision-making as an intervention towards improvements. This concept is currently subject to re-iteration and redevelopment. The game simulates a product development process executed by a multidisciplinary team and serves as a mapping model and intervention tool for those processes. The

participants of the game resemble a development team existing of different stakeholders. During the game itself, participants are asked to develop a product, in sequential development steps. This involves interpreting a client's design brief, designing product concepts, and production and assembly steps (de Koeijer et al. 2016). Key within this serious gaming concept (currently addressed as 'design game') is the ability to address the combined multidisciplinary of stakeholders in one session, the decision-making processes within and beyond development teams, and the proposed and realized inclusion of sustainability-related considerations.

4.4 Discussion and Conclusions

With a significant part of a product-packaging combination's impact determined during the design and development phase—as environmental lock-in (de Koeijer et al. 2017b)—and that phase being the shared responsibility of various stakeholders, the dynamics within those teams are highly influential to the achieved sustainability of a product-packaging combination. However, with the currently identified limited alignment of a company's strategic aims with the operational results (perceived and achieved sustainability), further efforts are required to target this in a more structured way. By means of this research effort, we aim to provide the industry with interventions targeting stakeholder interrelations and decision-making processes, with development team dynamics and role divisions as key points of focus. With the aid of the visualization tool and design game, we can provide the packaging industry with more solid insights into their own development processes, and determine the adjustments required to further structurally implement sustainability- and circularity-related aspects. We explicitly do not aim to prescribe 'what must be done' in the realm of packaging sustainability, but rather aim to assist in aligning strategic targets and aims with operational development efforts.

This article not only acts as a vision on our exploration approach in this field, but it is also a call for action. We hope that this vision paper calls out to academic partners willing to further explore this field and its options for interventions, together with us (CRiSP, the Center for Research in Sustainable Packaging), to accelerate the structured integration of sustainability- and circularity-related considerations in the development processes of a key element of nowadays society: product-packaging combinations.

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