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"Misalignments between users and designers as source of inspiration: A novel hybrid method for physical new product development"

Giulia Granato *, Arnout R.H. Fischer, Hans C.M. van Trijp

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ABSTRACT

This paper replies to the call for more agile-stage-gate hybrid methods in the context of physical innovations. By showing how some of the characteristics of conventional linear stage-gate methods and of the agile approaches can be integrated, we propose and test a new form of hybrid method for the physical new product development process (NPD).

Distinguishing itself from the conventional NPD methods and practices, biased towards alignments between companies and consumers as the key to market success, our method focuses on the innovation potential intrinsic to misalignments. Through a qualitative research applied in an existing European consortium of innovators, the present work guides companies in the systematic identification and exploration of misalignments between their designers and users.

By identifying misalignments at specific level of the NPD process, our method provides companies with a deep analytical insight into how, where and why (mis)alignments between their designers' decisions and users' demands might occur. Our method revealed to be a strategic learning and reflection tool to support companies in the proactive management of the identified misalignments, as informative, beneficial and inspirational aspects of the NPD process.

1. Introduction

Innovation, the strategic adjustment of business propositions to changing market conditions, is essential to the company's profitability, growth and continuity (Anderson et al., 2014; Baregheh et al., 2009), and particularly in times of high market turbulence (Bodlaj and Čater, 2019). One kind of innovation is product innovation that we conceptualise as the translation of a business idea into a physical novel "artefact" (Grunert and van Trijp, 2014). As a novel bundle of physical features, innovative artefacts gain meaning and relevance through perception; through the instrumental and perceptual associations that the concrete product features hold with the benefits that the company aims to deliver and communicate (Grunert and van Trijp, 2014). Product innovations differ in innovativeness, ranging from imitation (existing features signaling established benefits in the marketplace), to incremental innovation (new features or a novel combination of features that better fulfill existing benefits), to radical innovation (new features signaling new benefits) (Chandy and Tellis, 2000; van der Duin et al., 2014). The development and introduction of new carefully selected features-benefits combinations is so vital for companies that it has been defined as "life blood of corporate survival and growth" (Zahra and Covin, 1994). As a result, new product development (NPD) has generated great interest among practitioners and researchers across different disciplines (Baregheh et al., 2009), focusing on how to make sure that the product innovation process is successful (Cooper and Kleinschmidt, 1987; D'Attoma and Ieva, 2020; Ernst, 2002; Frattini et al., 2012; Lins et al., 2019; Van der Panne et al., 2003).

Despite the large amount of research into successful product innovation (Cooper, 2019; Giesen et al., 2007; Griffin et al., 2009; Konietzko et al., 2020), the success rate of new products is still very low (Cooper, 2019; van Trijp and van Kleef, 2008). Despite all efforts and investments into the development and testing, it is estimated that around 40% of new products fail at launch (Cooper, 2019). Data between 2011 and 2013 showed that 76% of the innovations failed within one year after introduction (Dijksterhuis, 2016; Nielsen, 2016).

The success of new products largely derives from consumer adoption, based on the "recognized relevance", namely that consumers recognize the added value of the new product, in terms of distinctive positioning and relevance to their needs and demands (Amabile, 1983). Understanding consumers' needs and demands is essential to product innovation, often reflected in "incorporating the voice of consumers" into the NPD process (Busse and Siebert, 2018; Cooper, 2019; Horvat et al.,

* Corresponding author.
E-mail address: giulia.granato@wur.nl (G. Granato).

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2019; Morgan et al., 2018; Zhang and Xiao, 2020). Developing new products that fulfill existing consumers' needs, wants, and demands is at the heart of a reactive market orientated approach followed by many companies (Jaworski et al., 2000; Slater and Narver, 1998; Van Kleef et al., 2005). However, consumers' needs and demands are inherently dynamic, as recognized in the proactive market orientated approach according to which the NPD process must track and anticipate changes in market demand and structure (Brege and Kindström, 2020; Narver et al., 2004; Von Hippel, 1986). Companies' conservatism, namely their incapacity to proactively capture and anticipate emerging and future market needs, represents one of the key recognized factors for high innovation failure rates (Bessant, 2001; Datta and Jessup, 2013). Without foresight beyond the current market, companies may not be able to fully explore their innovation potential, running the risk of doing "too little, too late", instead of introducing new and relevant features-benefits combinations to the market (Dahlin and Behrens, 2005; Rice et al., 2001; van den Ende et al., 2008).

The conventional linear NPD methods and practices, based on the stage gate process (Cooper, 1990; Cooper and Edgett, 2006; Cooper and Kleinschmidt, 2001), reflect and contribute to this inability, as they tend to constrain and confine the company to the current market. Although these gate stage methodologies are still the most dominant and widely adopted NPD approaches by over 60% of companies worldwide (Cooper and Kleinschmidt, 2001; Griffin, 1997b; Grönlund et al., 2010; Kalluri and Kodali, 2014), they have been the subject of concern and criticism (Bers et al., 2014; Bianchi et al., 2020; Hutchins and Muller, 2012; Sommer et al., 2015). These conventional methods and practices are linear in nature, equipped for reactive rather than proactive NPD approaches. By strictly planning and explicitly setting the consumers' specifications and evaluation criteria up front (Antons et al., 2019; Cooper and Kleinschmidt, 2001; Kalluri and Kodali, 2014; Vinekar et al., 2006), these NPD methods bias and restrict the innovation space to the current market (whether mainstream or specific market segments). Only if the new product or concept complies and aligns with the up-front defined (current) consumers' demands, it will obtain a "go" decision and pass to the next "gate"; otherwise it will be discarded and considered a failure (Cooper and Kleinschmidt, 2001). This is clearly at the disadvantage of those options that misalign with the "status quo", but which could proactively anticipate emerging and future demands. As a result, conventional NPD methods are "by design" more likely biased towards "me-too" innovations, often late and a step behind the dynamic and fast changing market (Lee and Xia, 2010; Serrador and Pinto, 2015).

While the literature has emphasized the importance of a consumer orientation (Busse and Siebert, 2018; Cooper, 2001, 2019; Horvat et al., 2019; Morgan et al., 2018; Ulrich, 2003; Urban and Hauser, 1993; Zhang and Xiao, 2020), it has also warned against the risk inherent in a complete, almost slave-like, dedication to (current) consumers' needs (Brege and Kindström, 2020; Narver et al., 2004). Despite this warning, conventional NPD methods and practices remain often anchored in alignments, leading companies to constantly strive towards a better fit with the current market (e.g. Cooper, 2001; Ulrich, 2003; Urban and Hauser, 1993), rather than to proactively explore the innovation potential of misalignments, as informative, beneficial and inspirational to the NPD process.

This becomes even more problematic in today's fast changing and sometimes unstable market (Khajeheian et al., 2018), where "agility", flexibility and change are required as never before (Cooper, 2008). Gate-stage methodologies have been accused of being too rigid, too linear and too planned to deal with such a dynamic market (Cooper and Sommer, 2016a) and incapable of strategically handling deviations that might emerge (Munthe et al., 2014). As a result, they may fall short of proactively supporting companies' learning opportunities and strategic options (Cooper, 2014; Sethi and Iqbal, 2008).

To overcome some of these shortcomings of the linear stage-gate methods and to better reflect the speed, dynamism and volatility of the current business environments, more agile methods have been advocated (Bianchi et al., 2020; Cooper and Sommer, 2016b; Lee and Xia, 2010; Recker et al., 2017). Agile methods, such as customer development and lean practices (Ghezzi and Cavallo, 2020), are characterized by higher levels of iteration, prototyping and product releases as part of a continuous leaning process (as opposed to linear up-front planning) (De Meyer et al., 2002). Moreover, agile methods support a strategic identification of changes and deviations that are proactively considered as valuable opportunities for the NPD process (rather than as failure or undesirable results) (Bianchi et al., 2020; Lee and Xia, 2010). Although agile practices are widely documented in the digital industry (Beck et al., 2001; Boehm and Turner, 2003; Karlstrom and Runeson, 2005), they have not yet been thoroughly researched and adopted in other industries, such as in the physical product development, where their application is more challenging (Cooper, 2016). Cooper and Sommer (2016b) highlighted properties of physical product innovation that prevent the one-to-one application of agile methods. Tangible physical products (e.g. a new beer, new polymer, new pharmaceutical) are not easily divisible into sub-components, not easily adaptable after release and not easily releasable into the market in short time, due to their dependence on adjustments in production facilities and machineries (Cooper, 2016; Cooper and Sommer, 2016b). Except for innovations that have marginal impact on the manufacturing and production process (such as a new color of a car or a new flavor ingredient in a beer), a trial and error approach, with its constant experimentation and rapid product iteration and releases, is less feasible in the physical NPD (Cooper and Sommer, 2016b), as well as quite costly for mass production (although there might be more potential for customized physical product development, as in tailor-made fashion industry) (Goevert et al., 2018).

Therefore, with the aim of integrating characteristics of both stage gate and agile methods in a single approach, well equipped for the dynamism of the current market and applicable in a wider context, recent research has increasingly turned its attention on hybrid methods (Antons et al., 2019; Brock et al., 2020; Conforto and Amaral, 2016; Cooper and Sommer, 2016a; Salvato and Laplume, 2020; Sommer et al., 2015). As way of balancing between an highly structured process of clearly defined and sequential phases (stage gate) and an extremely iterative and agile approach, hybrid methods are rapidly gaining ground in the business world and hold potential to significantly change the way we think about new product development (Cooper and Sommer, 2016b). Despite this potential, academic research on hybrid methods for physical product development has been scarce and specifically, on how some of the characteristics of the stage gate methods and of the agile approaches can be integrated to each other to develop new forms of hybrid methods, specific for the physical product innovation (Cooper and Sommer, 2016b).

Responding to this recent call for hybrid approaches in the context of physical product development, the aim of this paper is to propose and validate a new method for the physical NPD process that is positioned as a hybrid approach. Our new method, that we call the *MUD method (misalignments users-designers)*, incorporates characteristics of both stage gate and agile approaches, such as the structured process, linearity, discipline and rigor of the former and the more proactive, iterative and leaning oriented perspective opened up by the latter. These characteristics have been recognized as essential for future NPD methods and practices (Boehm and Turner, 2003) and for the current dynamic and rapidly evolving market (Cooper & Sommer, 2016a, 2016b; Sommer et al., 2015).

To fulfill this aim, the current paper answers the following research questions: "How could an hybrid method look like in the context of

physical innovations?", "Analytically, how does this new method provide a deep insight into where and why (mis)alignments between companies decisions and consumers' demands might occur?, "At strategic level, how does this new method provide tools to proactively manage (mis)alignments between companies and consumers, at the advantage of the innovation process?"

In the next section, we discuss the literature dealing with the role of consumers in NPD (section 2.1) and present the theoretical foundations behind the conceptualization of our MUD method: the Goal determination theory (Ratneshwar et al., 2003) and the Means end chain theory (Olson and Reynolds, 2001; Reynolds and Gutman, 1988) (section 2.2). Afterwards, we discuss the existing NPD approaches from which the MUD method differs or draws inspiration (section 2.3 and 2.4). A description and visualization of our theory-based method follows (section 2.5). In the method section (section 3), we explain our qualitative data collection and we describe the context in which the MUD method has been validated: the European consortium, MYPACK, which involves leading food and packaging companies across Europe and aims at introducing a broad portfolio of packaging innovations.

2. Theoretical background

2.1. The role of consumers in the NPD process

Extensive NPD research has tried to pinpoint the factors that increase the success rate of product innovations (Cooper, 2019; Cooper and Kleinschmidt, 1987; Evanschitzky et al., 2012; Hauser et al., 2006; Henard and Szymanski, 2001). One of the key recognized factors is the integration of consumer inputs into the NPD process (Busse and Siebert, 2018; Cooper, 2019; Horvat et al., 2019; Morgan et al., 2018; Zhang and Xiao, 2020). Consumer inputs are considered valuable for revealing unexplored and unfulfilled user needs that could represent innovation opportunities (Cooper, 2001; Ulrich, 2003; Urban and Hauser, 1993), for identifying preliminary solutions to those needs that consumers might already have in mind (Von Hippel, 1986) and for gaining new and valuable ideas already at early stages of the innovation process (Blank, 2020). Consumer inputs can be integrated into NPD activities to different degrees (Janssen and Dankbaar, 2008; Kaulio, 1998): from a more passive role in NPD, where consumers are asked to express their opinion on existing products, to becoming more active partners or co-innovators, who take lead in the idea generation or design selection (Fuchs and Schreier, 2011; Von Hippel, 1978). Consumer inputs into the NPD process has been advocated in several research traditions. Open innovation literature argues that a greater company's opening towards external costumers and creative users can lead to new and promising ideas (Blohm et al., 2011; Cooper, 2019; Gassmann et al., 2006; Parmentier and Mangematin, 2014; Zhang and Xiao, 2020). Literature on front-end innovation and lean start-up emphasize the crucial role of consumers from the early stages of the NPD process (front-end) and even from the early stages of company's life (lean start-up) (Bortolini et al., 2018; Paternoster et al., 2014; Ries, 2011). Last, research on design thinking shows how thinking about consumers' needs benefits the overall design process, leading to superior ideas or products and facilitating innovation adoption (user-centered or human centric design thinking approach) (Brown, 2008; Chen and Venkatesh, 2013; Gruber et al., 2015; Veryzer and Borja de Mozota, 2005).

Although recognized as a crucial factor for the success of new products, the integration of consumer perspectives into NPD activities remains a challenging process (Grunert and van Trijp, 2014; Horvat et al., 2019), and how such integration should be implemented is still an ongoing debate. Research into innovation management has, for example, started to question the conditions under which the involvement of consumers in the idea-generation process is beneficial (Poetz and Schreier, 2012) and which characteristics or skills consumers need to have to be really valuable to the NPD (Amabile, 1996; Füller et al., 2012).

Doubts remain among researchers and practitioners about the absolute value of such practice: researchers have argued that being overly dependent on the consumer perspective can be undesirable, since consumers often do not know what they want, do not easily articulate their needs and desires, and express attitudes that are poor predictors of their behaviour (Klink and Athaide, 2006; Millett, 2006; Nijssen and Lieshout, 1995; Ulwick, 2002; Van Kleef et al., 2005). Furthermore, consumers often lack the imagination to envision innovative artefacts that fulfil their emerging needs (Goldenberg et al., 2003). Last, researchers have remarked on the challenges and controversies of an open and front-end innovation approach: excessive openness by companies might make them lose control of their innovation process (Gassmann et al., 2006; Lilien et al., 2002; Parmentier and Mangematin, 2014) and a strong focus on the consumer from the early stages might alienate designers from their core competences and restrict their creativity (Gassmann et al., 2006; Lilien et al., 2002). For the remainder of this paper, we will refer to "designers" as those actors in the NPD process, who develop and market the innovation, including developers and marketers.

Concluding, the NPD process is best served by balance. Grounded in the "recognized relevance", the innovation process aims to integrate the consumers' prospective to create an "artefact" that is recognized by users for its relevance. This requires creative design focused on meaningfulness (appropriate and useful innovation to the target user) and distinctiveness (new products and differentiated from existing ones) (Amabile, 1983).

2.2. The "recognized relevance" from the designers' and users' perspective

Means end chain theory, and its practical implementation in the laddering technique (Olson and Reynolds, 2001; Reynolds and Gutman, 1988), provides a useful conceptualization of the design process for "recognized relevance".

The Means end chain theory identifies how concrete features, developed during the design process, gain meaning and relevance for the desirable physiological and psychological consequences, called benefits, that product features are known or believed to signal (Gutman, 1982). These benefits, in turn, are instrumental to personal goals and values consumers want to achieve through the consumption or use of products. While consumer values are generally end states of being and concern the entire human existence (such as happiness or security) (Gutman, 1982), consumer goals are less abstract and more actionable, as they concern specific situations or actions (e.g., the goal of being healthy or relaxed) (Pieters et al., 1995).

The means end chain theory follows a hierarchical structure (from concrete to abstract), which is typically considered in a bottom-up manner, representing the process of inference making from concrete physical features (*cues*) to higher-order beliefs of what the innovation offers, in terms of the *benefits* delivery and *goal* achievement (Olson and Reynolds, 2001). In other words, in perceiving and evaluating an innovative product, users follow a bottom-up abstraction process: from concrete cues of the new product with which they are confronted (e.g. biodegradable material), users *abstract* and infer relevance in terms of benefits (e.g., naturalness), which gain priority and additional meaning based on the goals that users want to fulfil through their choice (e.g., sustainability) (Brunsø et al., 2002; Steenkamp, 1990). The understanding of this bottom-up abstraction process with its cues-benefits-goals links is important, since it is the key determinant of users' acceptance of the innovation (Grunert, 2010).

The Goal determination theory (Ratneshwar et al., 2003) broadens

this perspective beyond the bottom-up abstraction process, to also include a top down incorporation process that may be more representative for the designers' perspective. In their daily NPD practices, designers mainly follow a top-down incorporation process, since they *incorporate* and translate relevant goals that a new product needs to fulfil and that designers have in mind (e.g., convenience), into an offer of relevant benefits (e.g., easy to open packaging). These benefits are delivered through a set of concrete features in the physical product design (e.g., tear-off lid). The incorporation process is a top-down process, that starts from what an innovation should do for the user (the goals and benefits that the innovation should fulfil and offer), followed by the subsequent design of a concrete "artefact", a bundle of physical product cues associated with relevant benefits and goals (Ratneshwar et al., 2003).

2.3. Identifying alignments and misalignments between users' and designers' perspectives: existing approaches

The conceptualization of the design phase of the NPD process, as a simultaneous top down incorporation process (designer's perspective) and bottom-up abstraction process (users' perspective), provides an important analytical tool for the "recognized relevance". In developing new cues-benefits-goals combinations, the purpose is to align designers' and companies' NPD decisions with users' expectations (Costa and Jongen, 2006; Grunert and van Trijp, 2014). Conventional NPD methods assess this alignment through a linear gate-stage process, by evaluating whether the new product or concept fulfills consumers' requirements, at each stage of the process (Cooper, 1990; Cooper and Kleinschmidt, 2001).

The stage-gate methodology follows a plan-driven rationale. The essence is that by setting criteria up front (Antons et al., 2019; Cooper and Kleinschmidt, 2001; Kalluri and Kodali, 2014; Vinekar et al., 2006) and screening whether these criteria have been met from early stages of the NPD process, through a series of checkpoints for a go or no go decision, large investments can be delayed and optimized towards the most promising products (Cooper, 1990, 2008; Cooper and Kleinschmidt, 2001).

As widely adopted among companies worldwide (Cooper and Kleinschmidt, 2001; Griffin, 1997b; Grönlund et al., 2010; Markham and Lee, 2013), the traditional stage gate methods have been the subject of careful analysis, in terms of both advantages and shortcomings (Bers et al., 2014; Bianchi et al., 2020; Hutchins and Muller, 2012; Sommer et al., 2015). On the one hand, the structured process of clearly defined and sequential phases adds clarity and stability to the development process (Heirman and Clarysse, 2007). Moreover, discipline and rigor of the stage gate methodologies positively impact the NPD effectiveness (Mabert et al., 1992), the success in project execution (Tatikonda and Rosenthal, 2000) and the speed-to market (Griffin, 1997a). On the other hand, it has been noted that this same discipline and rigor, associated with a complete up front planning, may leave insufficient room for deviations from the plan, constraining the innovation process to the early market predictions that may already be or soon become obsolete (Bianchi et al., 2020; Lee and Xia, 2010; Serrador and Pinto, 2015).

While the traditional stage-gate methodologies help to understand *whether* the new idea or product aligns or deviates from current consumers' preferences at each stage of the process, they are less informative on *why* such alignments or deviations exist and what innovation potential can be derived from it. Insight into where, how and why the designers' incorporation and users' abstraction processes are not fully aligned can be a creative source of innovation to build "recognized relevance" through meaningfulness (of benefits) and distinctiveness (of features). The hierarchical structure of the Means end chain approach, applied to the top-down and bottom-up process simultaneously, offers analytical insight into "the process in between"; into how cues, benefits and goals are connected and linked with each other and so into why alignments or deviations might emerge between companies' decisions and consumers' demands (Olson and Reynolds, 2001).

2.4. Managing alignments and misalignments between users' and designers' perspectives: existing approaches

While the rigorous hierarchical structure of the means end chain approach provides a tool to systematically identify alignments and misalignments, offering an analytical insight and awareness, more flexible approaches have been advocated to manage such alignments and deviations, allowing for a more strategic insight (Beverland et al., 2015; Bianchi et al., 2020; Cooper and Sommer, 2016b; Lee and Xia, 2010; Recker et al., 2017).

Flexible methods, also referred to as "agile" or iterative methods, follow a learning-oriented rationale (De Meyer et al., 2002; Nakata, 2020). The principle is that, through iterative trial and error experiments, companies can quickly learn from their mistakes, gathering strategic insight for their NPD process (Bianchi et al., 2020; Nakata, 2020). This approach has proven to be particularly valuable in today's rapidly evolving scenario (Cooper and Sommer, 2016a; Lee and Xia, 2010; Smith, 2007), where speed, flexibility and change are increasingly required (Cooper, 2008). Agile methods support a proactive and strategic management of changes and deviations from the plan, that are embraced (rather than discarded) and framed as valuable learning opportunities (rather than as failures) (Bason and Austin, 2019; Bianchi et al., 2020; Cousins, 2018; Lee and Xia, 2010; Nakata, 2020; Zheng, 2018).

By applying this agile and iterative approach to the NPD process, companies are confronted with the identified deviations and use them to re-consider constraints (Kolko, 2010; Leavy, 2010), to challenge what already exists (Nakata, 2020) and to produce new creative solutions (Carlgren et al., 2014). By misaligning with the "status quo", new options, that did not surface before, may emerge and new valuable discoveries may be generated (Nakata, 2020). This is evident in some radical innovations, such as Steve Job's mobile phone without a physical keyboard (iPhone) or the automobile of Henry Ford. Both these innovations originated from a deviation and misalignment with the current market (at that time), as Henry Ford is often claimed to have said "if I had asked people what they wanted, they would have told me faster horses". While a complete alignment among parties (between the designer and the user) would have limited change and creativity (Colville and Pye, 2010; Corsaro and Snehota, 2011), these misalignments opened up innovation opportunities and led to proactively explore emerging and future demands (Van Kleef et al., 2005).

2.5. Towards the creation of a new method for the NPD process: our proposed MUD method

Responding to the call for new hybrid methods for physical product innovations (Cooper and Sommer, 2016b) and synthetizing insights from existing NPD literature, we propose and validate a new theory based method for the NPD process, that is positioned as an hybrid approach. On the one hand, our MUD method integrates the discipline, rigor and linearity of the traditional stage-gate methods with the hierarchical structure of the means end chain approach to gain analytical insights. Analytical insights are derived from the analysis, comparison and identification of (mis)alignments between the designers' top down incorporation and the users' bottom up abstraction process. On the other hand, MUD includes a proactive, reflection and learning-oriented perspective, typical of the agile methods, to gain a strategic insight; to strategically explore the identified misalignments between designers'

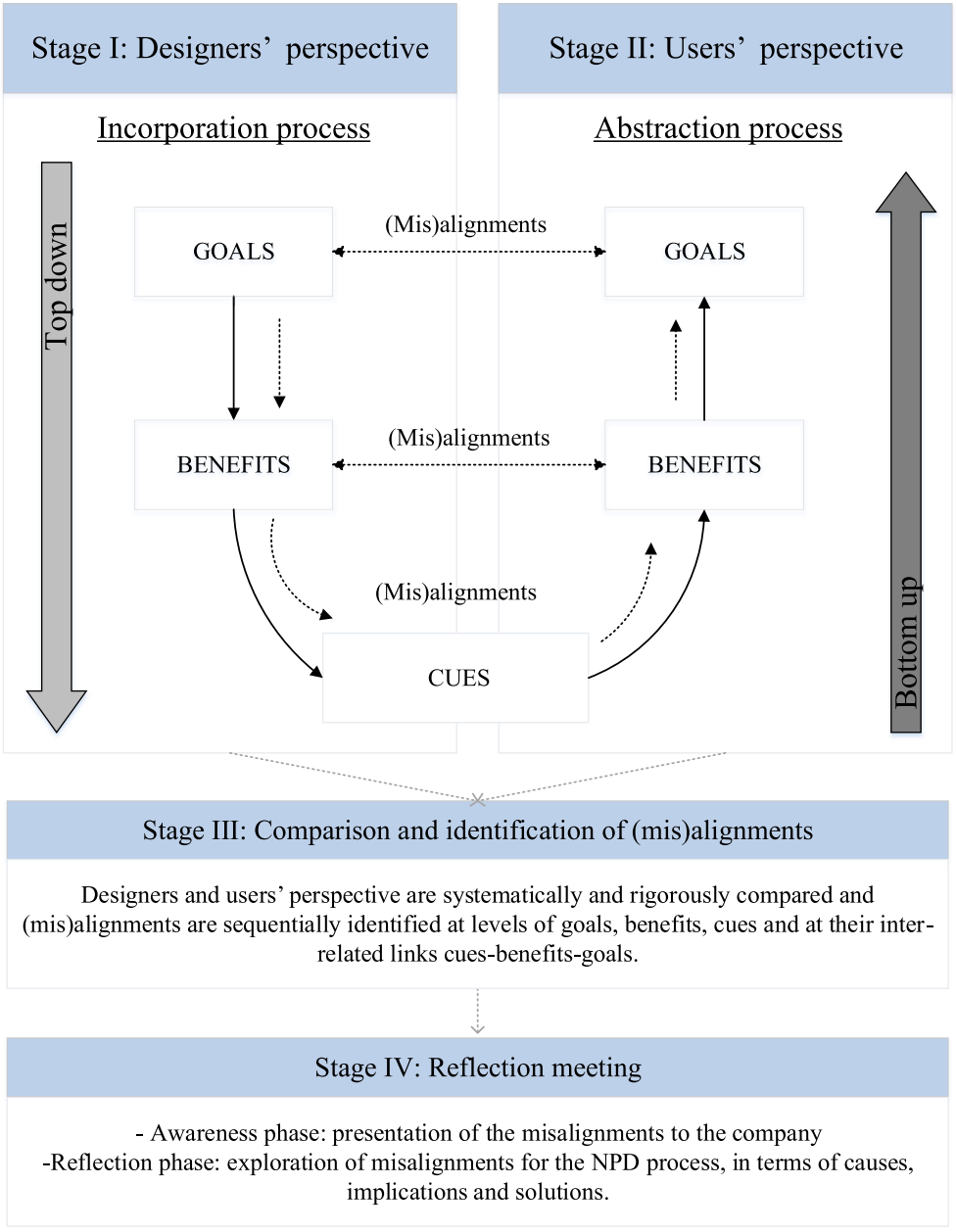

Fig. 1. Our proposed MUD method for the NPD process to identify misalignments between users and designers and explore their innovation potential.

users' perspectives.

The MUD method includes four stages: 1) designers' perspective, 2) users' perspective, 3) identification of (mis)alignments by comparing users' and designers' perspectives, 4) reflection meeting.

Stage I-designers' perspective: by integrating the rigor and discipline of the traditional linear methods with the detailed hierarchical structure of the means end chain approach, this first stage of the MUD method supports companies in the understanding of how their designers make decisions in their daily NPD activities. Building on the goal determination theory (Ratneshwar et al., 2003) and going beyond the typical (bottom-up) applications of the means end chain theory (Cooper, 2008; Olson and Reynolds, 2001; Reynolds and Gutman, 1988), we depict the designers' perspective as a top down incorporation process from abstract goals to benefits to more concrete cues (see stage I in Fig. 1). To operationalize this stage of the MUD method, data concerning how designers implement and incorporate goals and benefits into product cues during the NPD process are collected.

Stage II-users' perspective: this second stage of the MUD method supports companies in the understanding of how their users perceive and evaluate the developed innovation. Building on the Means end chain theory (Reynolds and Gutman, 1988), we analyze the users' perspective through the bottom-up cues–benefits–goals links of the abstraction process (see stage II in Fig. 1). To operationalize this stage, data regarding how users abstract and infer relevance in terms of benefits and goals from product cues are collected.

Stage III- identification of (mis)alignments by comparing perspectives: based on the idea that both users and designers connect goals through benefits to product cues in a hierarchical way, this stage of the MUD method compares the top down incorporation with the bottom up abstraction process. Specific (mis)alignments between users' and designers' perspectives at different (hierarchical) level of the NPD process (at level of goals, benefits, cues and at their inter-related links) are identified. In comparing designers' and users' perspectives, the MUD method comprises a rigorous and systematic approach, which draws inspiration from the rigor and discipline of the traditional linear NPD methods (stage gate). In identifying specific (mis)alignments between

the cues–benefits–goals links for users and those for designers, the MUD method builds on the hierarchical perspective of the means end chain approach (Olson and Reynolds, 2001). Through this perspective, our MUD method 1) provides companies with an analytical insight and awareness of the existence of (mis)alignments between their designers and users and 2) reveals the specific level of the NPD process (goals–benefits–cues links) at which the designers' and users' perspectives start to misalign. To operationalize this stage of the MUD method, the comparison and identification of misalignments are sequentially conducted at the goals, benefits and cues levels (Fig. 1):

- At the goals level, the comparison identifies whether users and designers have the same goals in mind and whether the goals that designers intend to offer with new product cues are recognized by users.
- At the benefits level, the comparison provides insights into whether the benefits that users want to receive are the same benefits that designers want to provide, and whether designers and users associate the same benefits with a common goal that they both share.
- At the cues level, the comparison enables the evaluation of whether the new product cues that are salient for users are the same cues that designers consider important to develop. Moreover, this comparison identifies whether the same goals and benefits for users and designers are associated with the same cues.

Stage IV- reflection meeting: by encouraging the internal communication, interaction and the learning-oriented approach derived from the agile and iterative NPD methods (Chan and Thong, 2009; Lee and Xia, 2010), this stage supports companies in the proactive reflection and learning process on how to manage the identified misalignments. This stage of the MUD method is operationalized through a "reflection meeting" that comprises an awareness phase and reflection phase (see stage IV of Fig. 1). In the awareness phase, the specific company or community of designers are confronted with the identified misalignments and become aware of them. During the reflection phase, the company has the opportunity to reflect on 1) the causes of the misalignments and the factors that might have influenced them (why the misalignments are there and from what they arise), 2) the implications that misalignments have for the company, 3) the strategic solutions that companies might consciously and deliberately implement to fully explore the value of misalignments for the NPD process.

3. Research method

In this section, we describe how the MUD method was validated. We first introduce the European MYPACK consortium and then we explain how each of the four stages was validated and how the qualitative data collection was conducted.

3.1. Validation of the MUD method: context and stimuli

The MUD method previously conceptualized, described and visualized (Fig. 1) was tested in the context of packaging innovations within the European consortium MYPACK. MYPACK is a consortium of packaging innovators, including developers and marketers, from innovative food and packaging companies across Europe. The aim of the MYPACK consortium, created in 2017, with the support of the European Union, is to identify and develop a portfolio of food packaging innovations targeting the sustainability of three distinct food product categories (baby food, fresh pre-cut salads, and organic biscuits). The diversity, in terms of countries (Germany, the Netherlands, Italy, France and Greece), disciplines and innovations that the consortium aims to develop, contributes to the realistic setting for testing and demonstrating the value of the proposed MUD method.

A large set of packaging innovations was selected to test the MUD method, and specifically, to collect data on the top-down incorporation process of designers and on the bottom-up abstraction process of users (stage I and II of the method). The packaging innovations were selected in collaboration with MYPACK project and, most of them, were part of the portfolio of packaging innovations that the MYPACK consortium was developing between 2017 and 2021. The stimuli varied in terms of structural elements, such as packaging material, shape, opening/closing mechanism, level of transparency, micro-insertion technology applied to the packaging to extend food shelf life, and logos for biodegradable and compostable materials, but did not contain any other verbal or visual elements, labels or brands. For each of the three MYPACK product categories (baby food, fresh cut salads and organic biscuits), visual representations of between 15 and 19 packaging prototypes were developed by three graphic designers using 3D modelling. The images were shown to respondents (designers and users) as printed A4-size images (examples of stimuli are shown in Fig. 2[1]).

A qualitative data collection was conducted to test the MUD method: the first two stages of the method were validated through individual face to face interviews with packaging designers and packaging users. Stage IV of the method was validated through a focus group interview with packaging designers. The overall data collection took place between February and July 2019.

3.2. Validation and data collection for stage I of the MUD method: interviews with packaging designers

To elicit the designers' top-down incorporation process, eleven designers (including developers and marketers) from Germany, France, Greece and Italy were recruited through the MYPACK project and interviewed in 1-h face-to-face in-depth interviews. More information on the recruited designers, including their function in the company, years of experience and background are provided in Appendix A (table A1).

During the interview, designers were invited to reflect on their packaging design process by imagining that they would have to develop (or choose, if they were marketers) new packaging for a food product (either salad, baby food, or biscuits). Following the goals–benefits–cues links approach as the rationale of the top-down incorporation process of designers, the interviews were mainly top-down structured, guided by the following sequential topics: 1) which activities, goals and requirements designers take into account; 2) why they take these goals into account/which benefits they want to offer to consumers; and 3) which cues they would consequently develop/choose. After completing this task, packaging designers were shown a subset of the total stimulus set[2] and asked to indicate whether the proposed product–packaging combinations represented a product–packaging fit or misfit. As a final task, designers were asked "to step into the users' shoes" and indicate their beliefs about 1) which cues would be noted by the user, 2) which benefits were offered by the cues, 3) which goals were served by those benefits and cues, and 4) which opinion they would expect users to have about the packaging innovations.

3.3. Validation and data collection for stage II of the MUD method: interviews with packaging users

To elicit the users' bottom-up abstraction process, thirty users of the

[1] The total set of stimuli is available from the corresponding author.

[2] The designers were confronted with the product category relevant to them. Five designers were confronted with packaging innovations associated with a biscuit product, four designers with packaging innovations for baby food, and two with packaging innovations for salad.

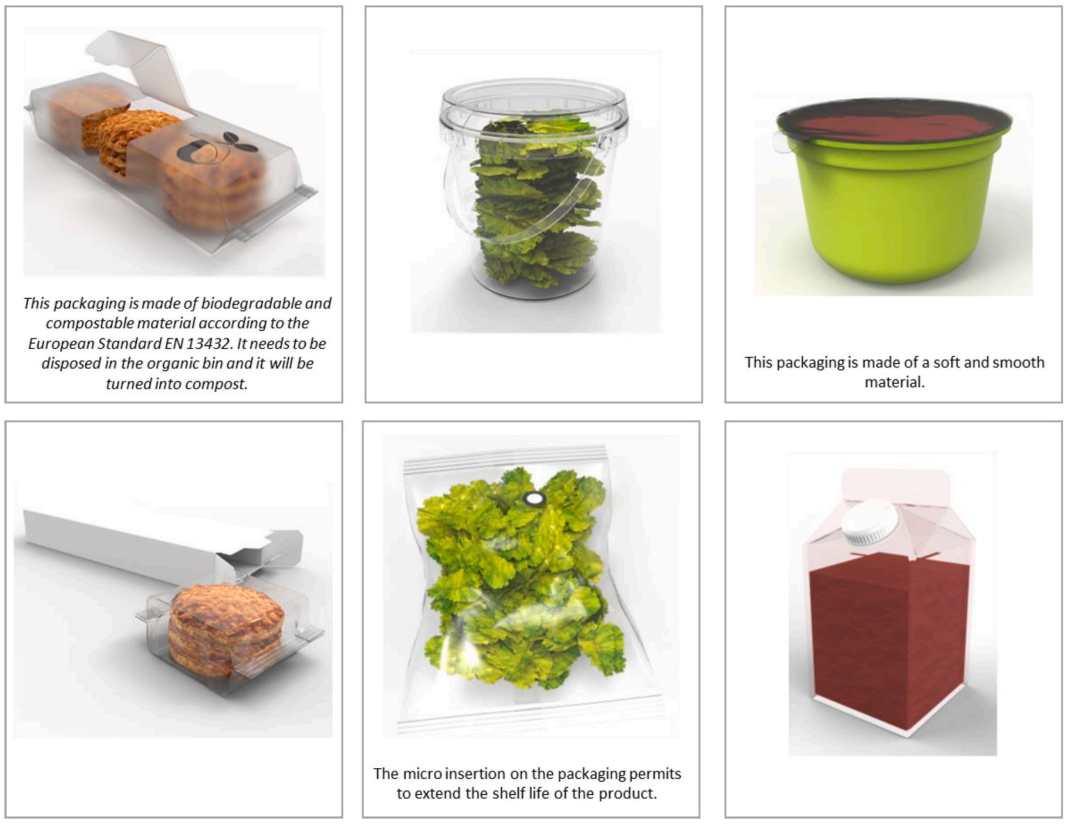

Fig. 2. Examples of packaging innovations, which were the stimuli of this research. Information below the image were reported when was necessary to clarify the innovation (e.g. explanation of logo, micro insertion technology etc.).

proposed packaged products (baby food, salad and biscuits) were interviewed through individual 1-h face-to-face in-depth interviews.[3] The respondents were recruited in the Netherlands through a professional agency and compensated for their participation with a €20 voucher.

The interviews used the *salient cue elicitation* (Kelly, 1955) and *laddering* techniques (Steenkamp and Van Trijp, 1997). First, respondents were shown a set of three stimuli (12 triads in total) in a random order and asked to indicate how two of the stimuli were alike and different from the third, until they could not notice any more differences/similarities in each set of stimuli. The respondents had to specify which of the end-poles of elicited cues they liked best. These questions were repeated for all 12 triads of stimuli. The elicited cues (salient cues) formed the inputs for the laddering procedure in which, using structured "why" questions, implicit knowledge is retrieved about the benefits and ultimate goals that consumers (un)consciously associate with the cues. At the end of the interview, users were shown a full set of product–packaging combinations and were asked to indicate the ones representing a product–packaging fit.

3.4. Analysis of the interviews

The interviews with packaging designers and users were recorded, transcribed verbatim and subjected to a content analysis. All perceptions of packaging cues and inferences in terms of benefits and goals were identified and coded as either: (a) cue, (b) cue immediate perception, (c) direct benefit, (d) indirect benefit or (e) goal (adjusted from Gutman, 1982).[4]

The analysis of the interviews with users was consolidated in *hierarchical value maps* that represented the bottom up abstraction process of users; the cues salient to users, the goals and benefits retrieved from the packaging cues, and the links between cues, benefits and goals. A cut-off value of five was used to graphically represent the cues–benefits–goals links in the hierarchical value maps[5] (similar to the methods used by Barrena and Sanchez, 2010; Nguyen et al., 2012). The analysis of the interviews with the designers was consolidated in *goal implementation maps* that represented the top down incorporation process of designers; the goals designers stated to have in mind, the benefits they wanted to communicate, the physical cues they would design and the links between them. These links are the focus of the comparison between the

[3] Ten users were interviewed about the packaging innovations for baby food, ten with biscuits and ten with salad. The recruited users had to be the regular consumers of the product in question (buying the packaged product at least once every two weeks).

[4] The codes "*cue*" and "*cue immediate perception*" represent the packaging cues (concrete and abstract) that the users recognized as salient from the stimuli and that the designers stated they developed for a certain product. The codes "*direct benefit*" and "*indirect benefit*" represent benefits that users inferred from the cues and that the innovators wanted to offer to users. The code "*goal*" represents the goals that users perceived as being served or hindered and that designers had in mind when developing packaging for a specific product.

[5] If a certain link between a cue and benefit or benefit and goal was mentioned five times or more, it was considered relevant to many users and was graphically displayed in the hierarchical value maps. This was done to make the maps interpretable.

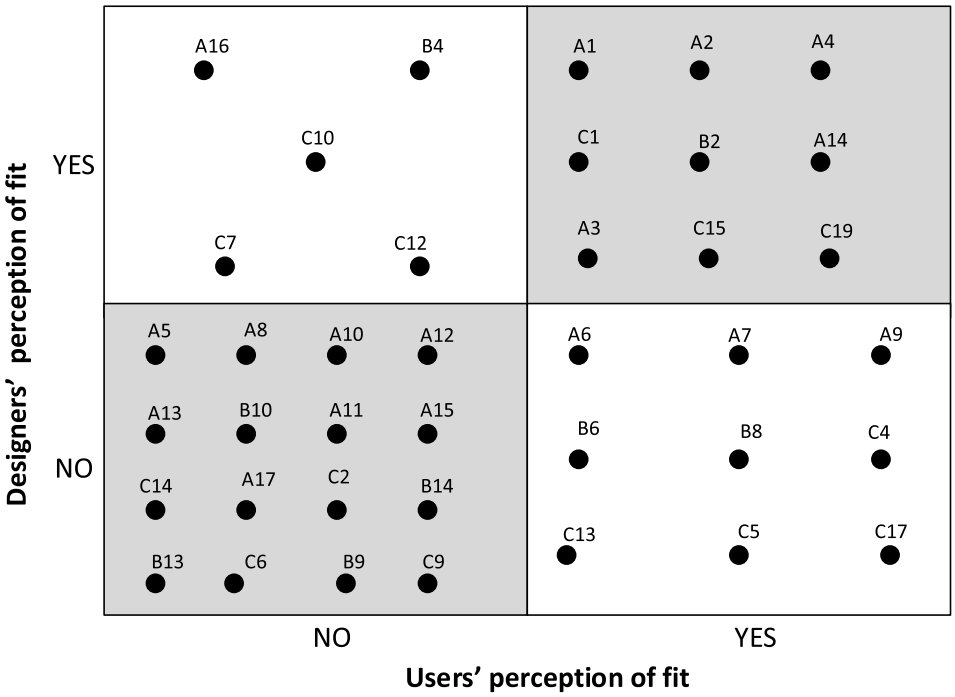

Fig. 3. Alignments and misalignments in the perception of product-packaging fit (yes/no) between designers and users. Numbers and letters on the dots represent the name of the stimuli: A (n = 17) refers to packaging associated with baby food, B (n = 15) refers to packaging associated with salad, and C (n = 19) refers to packaging associated with biscuits. The position of the dots in the quadrants is randomly assigned. The quadrants contain only those product–packaging combinations that were evaluated by both designers and users (where the comparison was possible).

designers' and users' perspectives (rather than the goals, benefits and cues *per se*). Three hierarchical value maps and three goal implementation maps resulted from the analysis of the interviews (one for each product category). The maps of each product were comparable in terms of their coding and hierarchical structures.

The data related on the product–packaging fit as perceived by the designers and users were analyzed using a frequency analysis. If fewer than 50% of users and designers evaluated the proposed packaging innovation as an example of fit, it was categorized as a misfit.[6]

3.5. Validation of stage III of the Mud method: systematic comparison and identification of misalignments between designers and users

Designers' and users' perspectives (stage I and II) were compared in three steps. First, they were compared through the measures of product–packaging (mis)fit, which provided insight into how well designers and users are aligned in their overall assessment of product–packaging (perceived) appropriateness. The perspectives were next compared through the confrontation of the hierarchical value map with goal implementation map for each product category for a general indication of alignments and misalignments at different hierarchical and inferential levels, especially at the goals level (top of the maps) and cues level (bottom of the maps). Finally, the perspectives were compared through the confrontation of specific ladders extrapolated from the hierarchical value maps and goal implementation maps, to provide detailed insight into misalignments between designers and users for the goals–benefits and benefits–cues links (middle part of the maps).

3.6. Validation and data collection of stage IV of the MUD method: reflection meeting with designers

The final step in the procedure (stage IV) was a reflection meeting where the misalignments, identified by comparing hierarchical value maps and goal implementation maps, were presented to and discussed with the designers. Twelve packaging designers took part in the reflection meeting, designed as a focus group interview, which was moderated by the first author and facilitated by the second author. Designers from Italy, France, Greece and the Netherlands, including developers and marketers from food and packaging companies, were recruited from MYPACK. Four of them also participated in stage I. More details on the designers' recruitment is available in Appendix A (table A1). During the reflection meeting, the designers were first asked to think of possible reasons why general misalignments occur between designers and users, then they were presented with the identified misalignments to reflect on their possible causes, implications and solutions. The meeting was audio-recorded, transcribed verbatim and analyzed using a coding and content analysis.

4. Results

The results of the stage I (designers' perspective) and stage II (users' perspective) of the MUD method were compared (stage III) to reveal 1) the alignments and misalignments between designers' and users' overall assessments of product–packaging (perceived) fit, and 2) specific misalignments at the hierarchical and inferential levels of the cues–benefits–goals links.

4.1. Alignments and misalignments between designers' and users' overall assessment of product–packaging perceived fit (stage III)

Perceptions of the product–packaging fit provide a first indication of the alignments and misalignments between designers and users. For one third of the proposed packaging innovations, the designers and users had a different perception of product–packaging fit and were thus misaligned with each other (white areas in Fig. 3).

4.2. Alignments and misalignments at the hierarchical and inferential levels of the cues–benefits–goals links between users and designers (stage III)

The confrontation of the goal implementation map (top down structure derived in stage I) and the hierarchical value map (bottom up structure derived in stage II) gives a first indication of the alignments

[6] The detailed protocols of the interview procedure and additional information on the data analysis plan are available from the corresponding author.

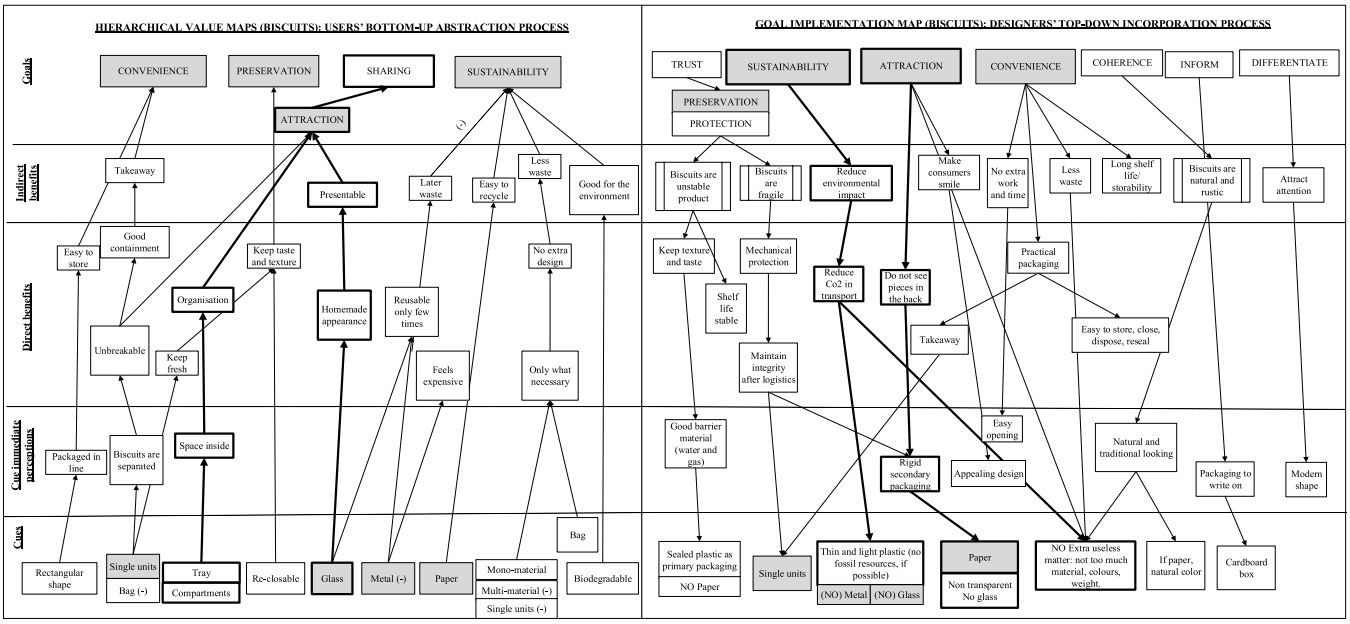

Fig. 4. Hierarchical value map and goal implementation map for biscuits to illustrate the goals, benefits and cues relevant for users and designers and the links between them. The hierarchical value map (on the left) represents the users' bottom up abstraction process, thus it needs to be read from the bottom to the top, as the direction of the arrows shows. The goal implementation map (on the right) represents the designers' top down incorporation process, thus it needs to be read from the top towards the bottom, as the direction of the arrows shows. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while white boxes show cases of misalignments. The highlighted arrows and boxes (in bold) represent the ladders selected for subsequent analysis.

and misalignments at different hierarchical and inferential levels, especially at the goals level (top of the maps) and cues level (bottom of the maps). Looking first at the goals level, the example presented in Fig. 4 (for the case of biscuits) shows that designers and users have a certain level of overlap, such as for the overarching goals of *convenience, attraction, preservation* and *sustainability*. Designers and users also have a certain degree of misalignment, since certain goals are relevant only for designers (e.g., *coherence*, *inform*, *differentiate*) or users (e.g., *sharing*). At the cues level, designers and users align on certain cues, such as for *single units*, *glass*, *metal*, and *paper*, and misalign on other cues mentioned only by designers or users.

The comparison between the hierarchical value map and goal implementation map for the product categories of salad and baby food are provided in Appendix B (figures B1 and B2).

As one of the added values of the MUD method lies in exploring misalignments, we focus on cases where designers and users misalign

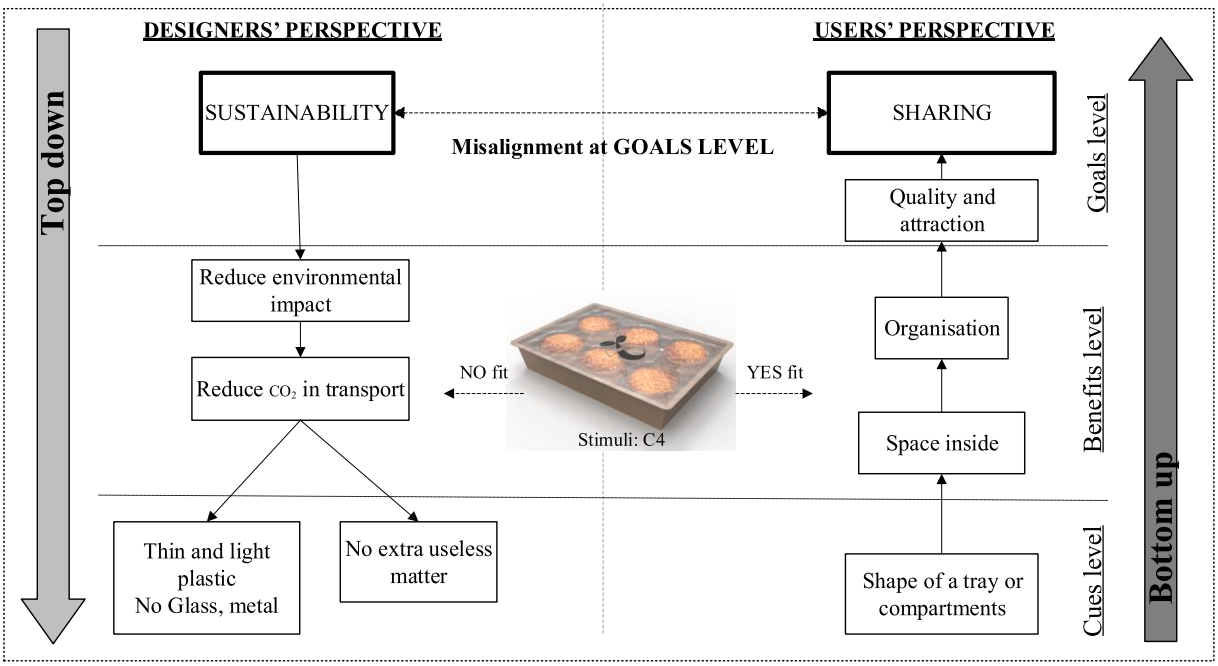

Fig. 5. Comparison of a ladder extrapolated from the goal implementation map for biscuits and one extrapolated from the hierarchical value maps for biscuits to illustrate an example of misalignment at the goals level, which might explain why designers and users differently perceive the same packaging innovation (C4).

(white areas in Fig. 3). The identification of a misalignment between users and designers at a specific level of the NPD might explain why the same packaging innovation was perceived differently by designers and users in terms of fit/misfit. The packaging of biscuits in a tray (C4 in Fig. 3), for example, represented a good example of product–packaging fit for users, but a bad fit for designers, as one of them stated: "*Not a good fit as [there] is too much plastic, even if it is bioplastic. You can make it half as heavy and provide the same protection. There is also lot of space between the biscuit stacks and too much material. Not a fit with these plain biscuits*". Another designer stated, "*Too much packaging; consumers would not like it*".

In this case, designers and users have different goals in mind: designers evaluate the innovation based on the goal of *sustainability*, while users do so based on the goal of *sharing*, not mentioned by any of the designers (marketers and developers) and indeed not included in the goal implementation map (Fig. 4). The hierarchical value map (for biscuits) shows that users positively perceive the *tray shape* of the proposed packaging innovation, since it *creates space inside the packaging* for the content and makes the packaging *organized*. Such *organization* is an indicator of *quality and attraction* for users and is related to the goal of *sharing* the product (life moments of sharing with family, visitors and friends) (Fig. 5).

By comparing the hierarchical value map with the goal implementation map (and specifically by considering specific ladders), the MUD method shows that designers and users do not recognize each other's important goals (in this case, sustainability vs. sharing), which might explain their disagreements in the perception and evaluation of the same innovation.

Placing the focus of the comparison on the center of the ladders (middle part of the maps) allows us to study how benefits are linked to goals and cues, and to what extent these connections are aligned between designers and users. The comparison revealed that even when designers and users have the same goal in mind, they link this goal to different benefits (goal–benefit link). Fig. 6 shows an example of misalignments at the benefits level, which might explain the different perceptions of designers and users of the same proposed biscuit packaging innovation. Glass packaging (C17 in Fig. 3), for example, was perceived by users as a good example of product–packaging fit, but a bad fit for designers: "… *Through transparent glass you can see little pieces of product that break off, which is not nice to see. In addition, the biscuits will leave a shadow on the glass and it will look dirty*", one designer stated. "*I think that consumers would believe that the shelf life is not good because it looks homemade, not a safe commercial product*", another designer said. For the same reasons why designers evaluated this packaging as a bad fit with the product (the packaging is transparent and looks homemade), users evaluated it as a good fit.

Although both designers and users had the same goal in mind (attraction and aesthetic appeal), they associated it with different benefits, which led to completely different and contradictory perceptions and evaluations of the same packaging cues. Specifically, users associated *attraction* (goal) with *homemade looking* and *presentable packaging* (benefits) and, in turn, they positively evaluated the *transparent design* of the *glass packaging* (cues) (Fig. 6). On the contrary, designers associated *attraction* with a *non-transparent packaging*, which prevents people from observing dislodged pieces of product in the back of the packaging. Moreover, contrary to the users, designers negatively evaluated the *homemade looking* aspect of the packaging, which they felt would harm the consumers' perception of the safety and shelf life of the product.

By comparing how goals are linked to benefits for designers and users, the MUD method enabled us to reveal that, although designers intend to target the same goals that users want to fulfil, in this case they offered benefits that differed from the ones users want to receive with the innovation. Consequently, designers might develop innovation cues (rigid secondary packaging, non-transparent, non-glass) that are not accurately recognized by the users or adequately designed based on user inputs.

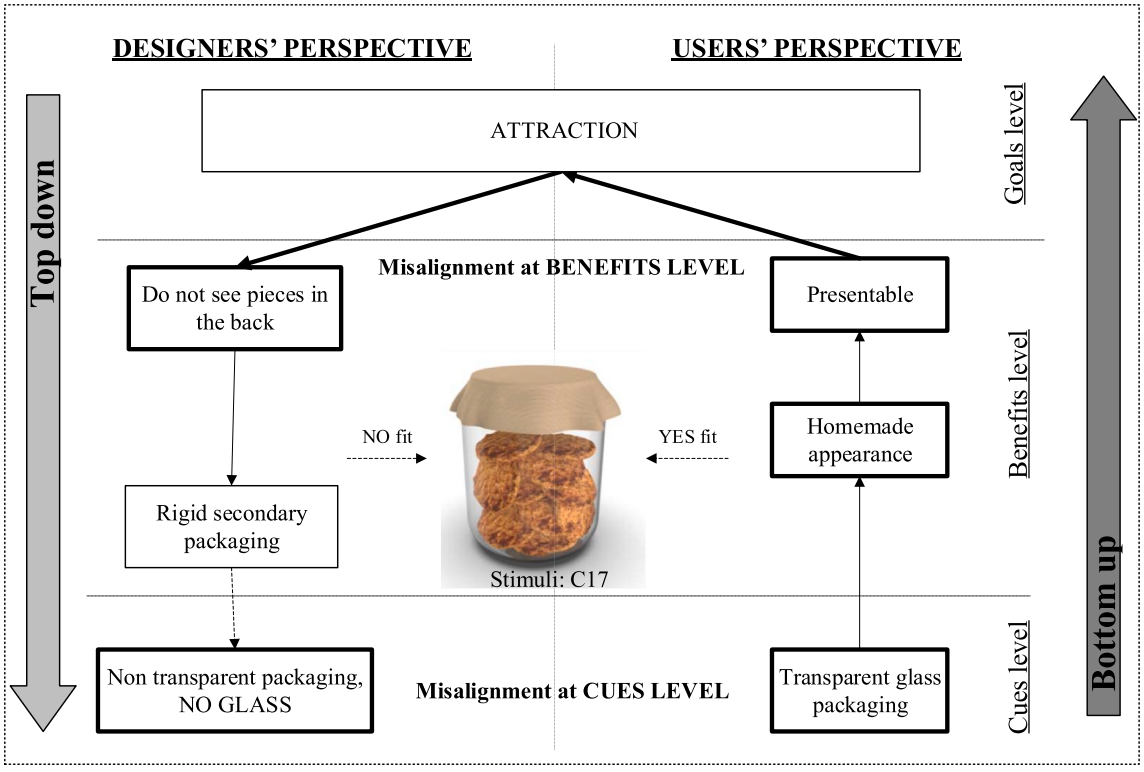

Fig. 6. Comparison of a ladder extrapolated from the goal implementation map for biscuits and one extrapolated from the hierarchical value maps for biscuits to illustrate an example of misalignment at the benefits and cues levels, which might explain why designers and users differently perceive the same packaging innovation (C17).

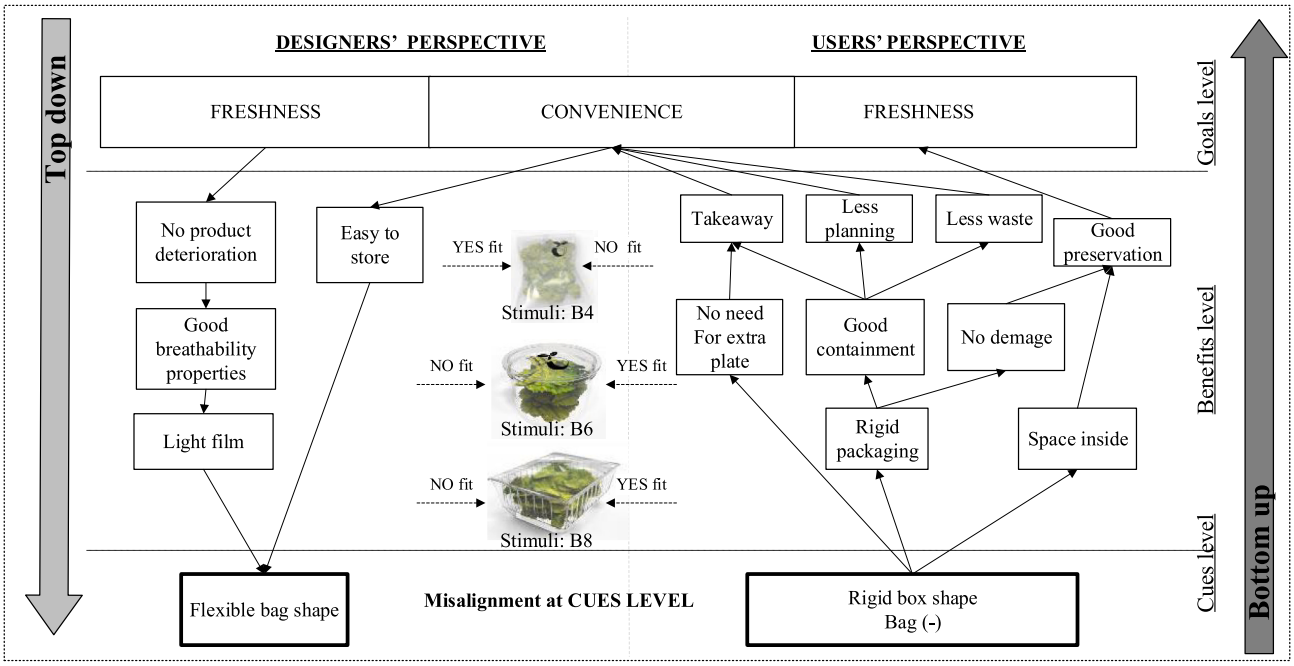

Fig. 7. Comparison of a ladder extrapolated from the goal implementation map for salad and one extrapolated from the hierarchical value maps for salad to illustrate an example of misalignment at the cues level, which might explain why designers and users differently perceive the same packaging innovations (B8, B6, B4).

By focusing on how goals and benefits are linked to cues (goals/benefits–cues links), the MUD method revealed the cases in which the same goals for users and designers were translated into different cues. Fig. 7 shows an example of misalignment at the cues level, which might explain why the same packaging innovations are perceived and evaluated differently by users and designers. The box shape packaging for fresh cut salad (B8 and B6 in Fig. 3), for example, was perceived as a good example of product–packaging fit by users, but a bad fit by designers: "*This sector requires bags, not trays or boxes. If you travel to twenty countries and go to the supermarket, concerning the product of salad you will realize that eight out of ten solutions are bags*", one designer stated.

Therefore, in this case, the different perception of product–packaging fit between users and designers is attributable to a different way of conveying the same goal (convenience and freshness) into packaging cues: users associate freshness and convenience with *rigid box shape packaging*, while, to convey the same goal (*convenience and freshness*), designers develop a *flexible bag shape packaging* (for the product of salad). This finding also suggests that designers carefully design freshness into technical aspects (bag shape packaging made of light film, with good breathability properties) that users do not recognize.

4.3. Learning from misalignments: the reflection meeting (stage IV)

During the reflection meeting, designers explored the misalignments by reflecting on their causes, implications and solutions. Three main solutions that might be implemented to exploit the value of misalignments for NPD were voiced during the meeting: 1) reduction of the misalignment and restoration of an alignment, where the misalignment represents a barrier to market success; 2) maintenance of the misalignment where it is essential for the product functioning; or 3) maintenance of the misalignment and the further exploration of where it might open new market opportunities.

The solution to reduce a misalignment was, for example, discussed in relation to a misalignment identified at the goals level (case of biscuits), where users and designers did not recognize each other's goals: designers were unaware of the relevant user goal of sharing (users evaluate the packaging based on its social and sharing aspect), while users did not recognize the designers' efforts to convey sustainability through the packaging cues. Confronted with this misalignment, designers first reflected on the possible causes that might have influenced this misalignment and on its implications for NPD. One of the possible causes that emerged from the discussion centered on the idea that designers and users have different ways of thinking: designers considered themselves objective and rational, in contrast to the emotional consumer: "*The average consumer often has inputs at the emotional level*", a designer stated. "*Experts and industries are objective. Our answers are generally recognized. Our process and procedure are documented, and when we take a decision, it has enough scientific evidence of being a good one. In contrast, consumers have subjective knowledge; what they think is not documented and so they raise objections*", another designer said. This might explain why designers, who, in their rational behaviour, give priority to the sustainability of the packaging, do not value the emotional, social and sharing aspects of the packaging (goal of sharing) as users do. If they are not aware of the users' goals, designers might risk missing marketing opportunities and fail to incorporate (in this case) emotional, social and sharing aspects into packaging cues that users may value. Moreover, this misalignment may indicate that sustainability is not as salient to users as it is for designers, so users might not recognize innovation efforts and creativity deliberately implemented in the product design.

Considering the causes and implications of this misalignment, designers reflected on the necessity of reducing it, either by making consumers "more rational" or themselves becoming "more emotional" (as the designers intended this terminology). The designers perceived difficulties in adjusting to the users' more emotional perspectives: "*Consumers need to become more rational. For us experts, it is much more difficult the other way around [for experts to change]; we cannot become more emotional with what we do*". To make consumers more rational, designers reflected on the necessity of educating consumers and communicating in a more transparent and homogenous way. The sustainability aspect of

Table 1
Causes, implications and solutions for the misalignments discussed during the reflection meeting to help the company extract the deepest value of misalignments for the NPD process.

Causes of misalignments	Implications for the company	Solutions
Different way of thinking between designers and users: rational vs. emotional	Barrier to market success Missed market opportunities	Repair an alignment: by making consumers more rational (role of communication), or designers more emotional
Consumers lack a comprehensive view of the supply chain Education and training of designers Prejudices by designers	Natural misalignments, essential for product functioning	Maintain the misalignment but be aware
Lack of consumer-oriented approach Innovation requirements/boundaries Gap marketing-developers	Market/innovation potential	Maintenance and further exploration of misalignments

the packaging could indeed become more salient and visible to consumers if, as one designer proposed, "*we create a unique logo, recognized across Europe, which is modern and minimal, and which should reflect the environmental parameters of the film instead of having different logos for different countries [as now]*".

The solution of maintaining certain misalignments was also voiced, where misalignments might be natural and essential for the product functioning, such as in the case of packaging aspects salient to designers but less so for users (e.g., the breathability of the packaging that prevents product deterioration, or long shelf lives). The designers discussed the different potential causes of these misalignments: 1) consumers have limited knowledge and lack a comprehensive view of the entire supply chain and its requirements (e.g., safety and freshness requirements), as one designers stated: "*Consumers do not know the constraints, the logistics, what happened before. For the customers, the story of the packaging only starts when the product is bought*". 2) The designers have been trained to make certain aspects of the packaging invisible to consumers: "*We are trained to design a packaging in such a way that consumers do not even notice it. I was trained for four years to make packaging so easy to open that you don't even notice*". 3) The designers and packaging experts have some prejudices towards consumers, which influence how they communicate technical aspects (e.g., safety): "*It is generally agreed that consumers will not understand complex things and are considered to not be very intelligent. Members of the packaging industries think that it is not possible to engage deeply in complex communication with consumers*".

Important implications were noted by designers in relation to the identified misalignment: safety and shelf-life requirements are probably considered a bare minimum by consumers; they can lead to product rejection if they are absent but are not noticed if present. If the company opts for restoring an alignment with consumers, lower investments in the baseline requirements (shelf life, breathable material, safety and freshness requirements) would likely create a product not accepted by consumers. In this case, it is advisable to maintain such a misalignment, since it is essential for proper product functioning and considered natural by the designers: "*These differences [between designers and users] are natural. We just need to understand that this difference exists. Why should we imagine that this bridge will be crossed?*". Aware of this misalignment and of its implications, the company might opt for an alternative communication with consumers, which would make certain requirements more visible and salient to consumers: "*Consumers think that if you extend the shelf life of the product [to make it safer for longer] you do something (strange) to the product*", therefore "*We, experts, should start telling a story that consumers can see and not the one we have in our minds*". In this case, designers started to "step into their users' shoes", indicating an opening and learning process.

The solution of maintaining and further exploring a misalignment was proposed in relation to misalignments that might open innovation opportunities, such as in the case of the misalignment identified at the cue level, where designers develop cues (bag shape packaging for salad) not always in line with consumers' demands (box shape packaging). The designers identified three main reasons that might explain the existence of this misalignment: 1) Designers' daily practices are not sufficiently consumer oriented: "*We in companies feel that we are very consumer driven but maybe we are not [consumer driven] enough. We are price driven. We immediately discard the consumers' requirements that are too expensive or that we consider to be too expensive*". 2) There are gaps within the companies between the development and marketing phase "*Marketers and developers are often not aligned; the same question can be answered in two different ways between technology and marketing, and I think that can create mismatches*". 3) Designers' intentions and creativity are constrained by different boundaries, such as the scale of production needed to be innovative: "*Generally the big companies like Danone or Nestle can express specifications and everybody follows them. Apart from these big companies, there is no possibility [for others] to ask for big innovations in packaging*".

Maintaining and further exploring this misalignment (the one identified at cue level) might be advisable and beneficial for the company, since it might open to new design opportunities. For example, by providing salad in rigid box shape packaging, making it easier to take away and eat on the go, companies could go beyond the mainstream market of salad in the typical bag packaging.

Table 1 summarizes the main results of the reflection meeting in terms of causes, implications and solutions that designers mentioned for the misalignments identified.

5. Discussion and research implications

This paper had three main research ambitions: 1) to propose and test a new hybrid method for the physical product innovation, in response to a recent call in this regard (Cooper and Sommer, 2016b), 2) to increase companies' analytical insight into the NPD process 3) to offer a strategic approach in exploring the value of misalignments. These ambitions were realized by conceptualizing and testing the MUD method. The application of the MUD method has provided a pivotal analytical insight into users' and designers' perspectives and into how, where and why differences exist between designers' and users' perception of the same innovation. This was achieved by integrating the discipline, rigor and linearity of the stage gate methods with the hierarchical structure of the means end chain perspective. In addition, moving beyond the reactiveness of the traditional stage gate approaches, the MUD method integrates a more proactive, iterative, reflection and learning oriented perspective, typical of the agile methods, to gain an additional strategic insight. The MUD encourages designers to reflect together on misalignments, not from the perspective of "failure" but rather as business potential. During the reflection meeting, designers went through all the identified misalignments as a check list and reflected on their causes, implications for the NPD process, as well as on how to strategically

handle each of them: they reflected on the necessity of reducing the misalignments in cases where they represented a barrier to market success or missed marketing opportunities, to maintain them when they were essential for the product functioning, and to further explore them when they might represent innovation opportunities. Through this process of internal communication and interaction, derived from the agile approaches, the MUD method has proven to be a useful learning tool, even in a packaging context, which tends to be a highly technology, rather than consumer, driven domain. The stage IV of MUD method allowed packaging designers to detach from their more conservative perspective, opening up towards a more progressive and consumer-oriented approach, closer to design thinking.

5.1. Theoretical and managerial implications

The current research has several theoretical and managerial implications. First, this paper adds to the nascent and growing research on agile-stage-gate hybrid methods in the context of physical product innovation (Cooper and Sommer, 2016b). This research opens new possibilities of balancing between a highly structured process of clearly defined and sequential phases (stage gate) and an extremely iterative and pure agile approach. Improving the traditional stage gate approaches, enriched with agile components to better fit the dynamism of the current market, the MUD method offers an original contribution to both NPD approaches (stage gate and agile) for physical product development.

Second, at a theoretical level, our focus on the diversity that exists between the designers' (as top down incorporation) and users' perspective (as bottom up abstraction) and on the opportunities that misalignments might open for the NPD process, substantially contributes to the existing NPD research, that, until now, has been biased towards alignments, as the key to market success (e.g. Cooper, 2001; Ulrich, 2003; Urban and Hauser, 1993).

Third, this research identifies a new domain for the Means end chain theory (Olson and Reynolds, 2001; Reynolds and Gutman, 1988) and the Goal determination theory (Ratneshwar et al., 2003), namely that of the hybrid methods for the NPD process. These theories have proven useful to simultaneously look at top down incorporation process and bottom-up abstraction process "as two sides of the same NPD coin". This paper advances the understanding of designers' daily practices in the NPD process, that would not have been possible without going beyond the typical application of the means end chain approach and, thus, applying an alternative way (top-down) of looking at the cues–benefits–goals links.

At the managerial level, this research enriches the "NPD toolbox" with a new method that can be combined with other NPD methods. One could, for example, imagine the application of MUD within the design thinking approach (DT) to structure and detail the coherence between the first four stages of DT: empathize, define, ideate and prototype (Dam and Siang, 2018; Plattner, 2016). The "goal level" of the MUD method, in which designers aim to align with consumers' goals relates to the "empathize" stage of the design thinking approach. The "benefits level" of the MUD structures the "define stage" of the DT, where products benefits are defined and need to be translated into a bundle of product cues in the "cues level" of the MUD and in the "ideate and prototype phase" of the DT. The MUD method can contribute to the DT as it does not only compare designers' and users' perspectives at these levels but also provides a tool to connect these levels, ensuring consistency in the design process.

Using the realistic setting of the large European packaging consortium MYPACK, this research offers a robust and validated method that is ready to use. Moreover, by identifying specific misalignments at the levels of goals, benefits and cues, the MUD method provided companies with specific insights (e.g., at which goal–benefit link designers and users start to disagree), which are informative and useful for the implementation of precise and relevant strategies on how to handle the misalignments.

While the identified misalignments and the insights that can be obtained from them are specific to, in our case, packaging innovations, and may differ from company to company, the method's procedure is general and applicable to different contexts, both within and beyond the packaging field.

6. Limitations and avenues for further research

As a first study on the new MUD method, there are limitations to be mentioned and several avenues for further research can be identified. The MUD method shares some of the limitations of the means end chain and laddering methodologies, which assume the existence of a hierarchical cognitive structure in consumers' mind, retrieved through the laddering interviews (Cohen and Warlop, 1995). It might be that such hierarchical structure is an artefact of the data collection technique used, which might "push" respondents to create, instead of retrieve, hierarchically linked concepts up to abstract values (Cohen and Warlop, 1995; Van Rekom and Wierenga, 2007). To mitigate this potential effect, we terminated the laddering procedure at the level of users' goals (rather than continuing up to the abstract values associated to these goals).

We also envisage broader applications for the MUD method in other contexts beyond packaging (such as in the car industry, holidays, robotics, fashion, design, software etc.), but some adjustments might be necessary. While for many fast moving consumer goods, terminating ladders at the goal level may suffice, for those companies developing products that express consumers' identity, values and life principles, the MUD method (stage I and II) might need to be extended to capture and retrieve cognitive linkages up to values.

In addition, the long procedure and intensive data collection of the MUD method might represent a practical limitation in those industries (such as software industry) that base their NPD process on a trial and error approach, with fast iteration and testing. In order to make the MUD method more suitable in such industries, and in general more manageable and less labor intensive for its practical application, companies could decide to delegate the interview's procedure to a marketing research agency, or reduce the sample size by interviewing only certain relevant members of the company (instead of designers from different departments, countries and backgrounds [marketers and developers], as we did) or only the habitual consumers of the company's product or lead users. In turn, the analysis procedure would be simplified and would flow into more concise maps, increasing the "agility" of the overall method.

Furthermore, the MUD method is mainly intended for the experimental phases of the NPD process, such as concept testing, prototyping, product testing, design, which are timely moments to identify misalignments between users and designers so they can still be used as valuable insights. The MUD method is indeed a "pre-market" method, particularly relevant once a product idea has reached specification as a bundle of features. We expect its contribution to the NPD process to be less evident with existing products, as a "post-market" approach.

While the MUD method explored the innovation potential of misalignments in terms of analytical insights (increased companies' awareness) and strategic insights (as a reflection and learning tool), the consolidation of this innovation potential in actual innovations remained beyond the scope of this research. Further studies need to be conducted to investigate the effect of hybrid methods (such as ours) on

company's performance.

Last, while the method was primarily developed to investigate designers' and users' perceptions (through their cues–benefits–goals links), it rather overlooks their preferences and choices. By investigating users' and designers' perceptions rather than preferences, which change faster and require larger samples to be assessed, our method was developed to rely on a modest sample size, as was used in this research.

Despite these limitations, the MUD method supports companies in the identification of possible misalignments between designers and users of innovations and suggests how the awareness of these misalignments can be strategically used for the product development process.

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Declaration of competing interest

None.

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Appendix A

Table A1
Information on the designers recruited for the validation of stage I and IV of the MUD methods

Designers	Companies where the designers are working in	Background of the designer	Current function of the designer	Years of experience in that function	Recruited to validate which stage of the MUD method
Designer #1	French company developing food and packaging innovations	Technical-food engineer	technological innovation director and R&D manager	10 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #2	French company developing food and packaging innovations	Technical-packaging engineer	Packaging engineer in R&D	4 years	Stage I (face to face individual interview)
Designer #3	French company developing food and packaging innovations	Marketing	Marketing manager	10 years	Stage I (face to face individual interview)
Designer #4	French company developing food and packaging innovations	In marketing and R&D	Sensory panel	18 years	Stage I (face to face individual interview)
Designer #5	German company developing food and packaging innovations	Technical-food and packaging scientist	Food scientist	8 years	Stage I (face to face individual interview)
Designer #6	German company developing food and packaging innovations	Marketing and business economics	Marketing manager	23 years	Stage I (face to face individual interview)
Designer #7	Greek company developing food and packaging innovations	Technical-packaging engineer and analytical chemistry	R&D manager	20 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #8	Greek company developing food and packaging innovations	Marketing	Marketing director and deputy CEO	12 years	Stage I (face to face individual interview)
Designer #10	Italian company developing packaging materials	Technical-environment science and agriculture	Agricultural Public Affairs specialist	5 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #10	Italian company developing packaging materials	Technical-materials' engineer	Technical and development team	12 years	Stage I (face to face individual interview)
Designer #11	French technical center developing packaging	Technical-materials' engineer	Packaging expert	20 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #12	Dutch institute of sustainable packaging	Packaging design and development	Packaging expert	2 years	Stage IV (focus group interview)
Designer #13	Dutch institute of sustainable packaging	Packaging design and development	Packaging expert	8 years	Stage IV (focus group interview)
Designer #14	Italian company on environmental (packaging) assessment	Marketing and communication, eco-design	CEO of the company	9 years	Stage IV (focus group interview)
Designer #15	Greek company developing food and packaging innovations	Technical- food and packaging engineer	Packaging expert	9 years	Stage IV (focus group interview)
Designer #16	Italian company developing packaging materials	Material engineer	R&D packaging researcher	6 years	Stage IV (focus group interview)
Designer #17	French company developing food and packaging innovations	Packaging engineer	Senior packaging engineer and innovation coordinator	20 years	Stage IV (focus group interview)
Designer #18	French packaging institute	Technical-packaging engineer	R&D manager	5 years	Stage IV (focus group interview)
Designer #19	Italian research and innovation company	Food engineer	Food and packaging expert and CEO	7 years	Stage IV (focus group interview)

Appendix B

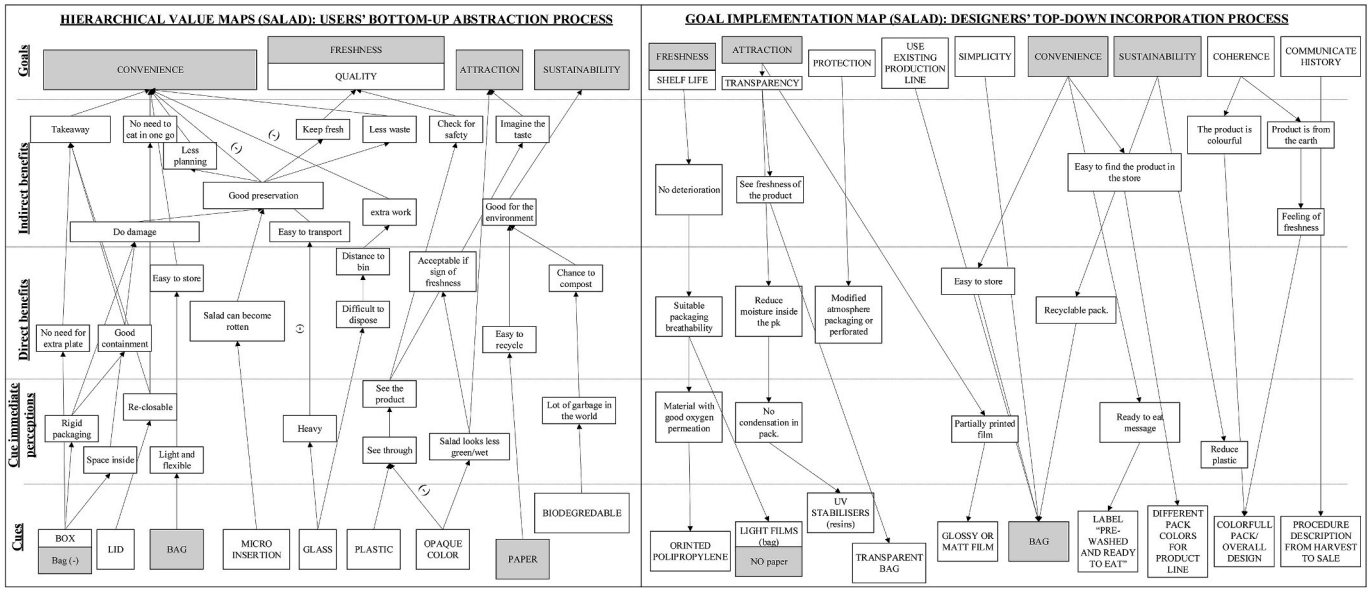

Fig. B1. Comparison of the hierarchical value map and goal implementation map for salad to illustrate the goals, benefits and cues relevant for users and designers and the links between them. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while those in white indicate misalignments.

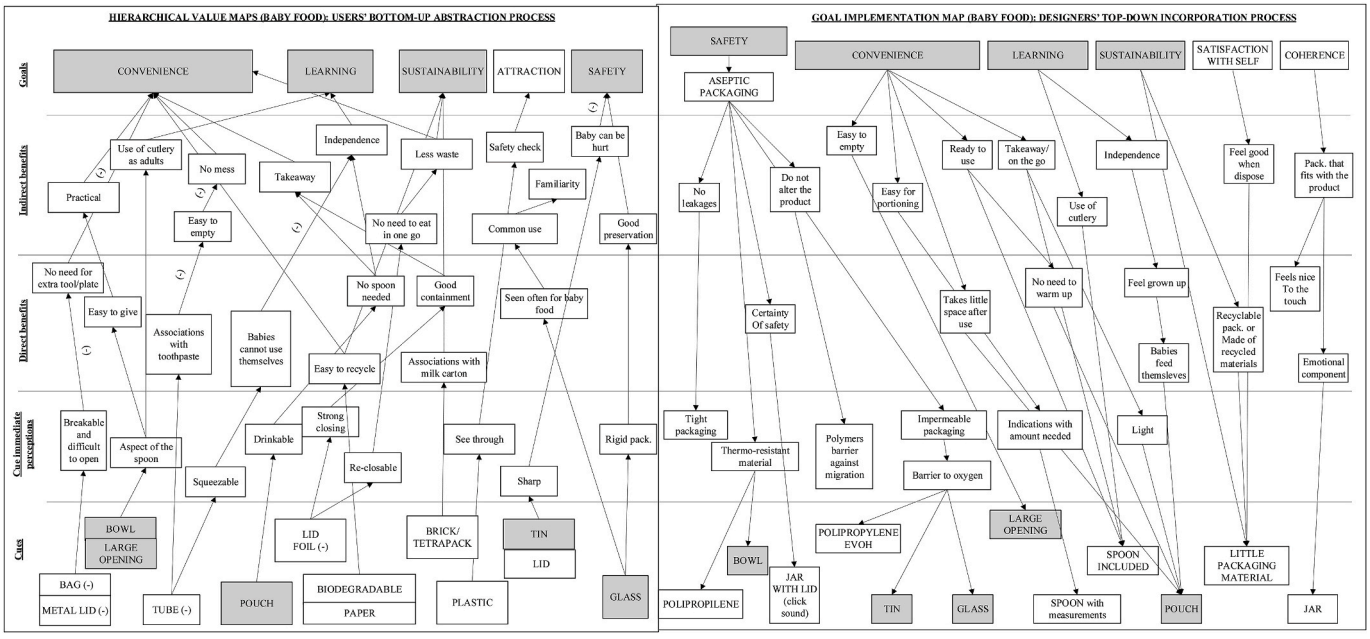

Fig. B2. Comparison of the hierarchical value map and goal implementation map for baby food to illustrate the goals, benefits and cues relevant for users and designers and the links between them. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while those in white indicate misalignments.

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G. Granato: Giulia Granato is a PhD researcher at Wageningen University, in the group of Marketing and Consumer Behaviour. In her PhD, Giulia studies consumers' acceptance of new technologies, such as sustainable packaging. Her work is part of the European consortium "MYPACK" on sustainable packaging innovations and food waste. She collaborates with food and packaging companies and research institutes across Europe. She is the corresponding author of this paper and can be contacted at giulia.granato@wur.nl.

A.R.H. Fischer: Arnout Fischer is associate professor in the Marketing and Consumer Behaviour group at Wageningen University. His research focusses on consumer response to innovative products and production technologies in food and agricultural production. Using insights from consumer psychology he studies how consumers perceive and evaluate innovative products and technologies; with these insights he aims to support technology developers to build in acceptability by design.

H.C.M. Van Trijp: Hans van Trijp is full professor and chair of the Marketing and Consumer Behaviour Group at Wageningen University. With 15 years of (part-time) experience in the R&D organization of a multinational company, he currently leads a research program on how science in marketing and consumer behaviour can contribute to the key challenges within the domains of agribusiness, food industry, food-related (governmental and NGO) institutions, and consumers.