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Building an Ecodesign Transition Framework toward Sustainable Product Innovation

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Abstract

In order to effectively integrate environmental aspects into product development processes, companies have to significantly change some of the practices and habits of all involved stakeholders and organisation. To complement earlier research and the (technical) “hard side of ecodesign”, this article explores the promising “soft side” that considers company culture and human factors, through a multiple steps literature review. Whereas a consistent prescriptive change model is still lacking in ecodesign literature, a strong convergence and synergy is shown with the emerging Transition Management approach designed for sustainability issues facing organisations. The principles of an “ecodesign transition framework” are proposed, combining a three-level systemic approach, complementary top-down planning and bottom-up innovation, through new types of interaction and cycles of action and learning, with a deeper stakeholder management. This new combination could be capable to address change management issues and help companies evolve toward a more effective sustainable product innovation process, in the context of evolving business management practices.

Keywords: *ecodesign, integration, change management, transition, sustainability*

1. Introduction

Along the last decades corporate sustainability has become more global and fundamental to the success for most companies (Kiron et al., 2015). Such “megatrend”, directly affecting the competitiveness and even the survival of their organisations, entails companies to update traditional business tools to consider the specialised requirements of environmental sustainability (Lubin and Esty, 2010).

Defined as the integration of environmental aspects into product development, with the aim of reducing environmental impacts of products throughout their life cycle, ecodesign has emerged in the 1990s (Charter and Tischner, 2001). But most companies still face substantial challenges for dealing with the effective implementation of ecodesign principles and tools into their product development and related processes, as confirmed by recent studies and surveys (Brones et al., 2013; Wolf, 2013).

To explain this situation, researchers have suggested that a potentially excessive emphasis was given to the (technical) “hard side of ecodesign”. Commonly recommended approaches have been questioned as mainly dealing with technical aspects, poorly relating environmental activities with other business aspects, and lacking a more systemic perspective, which often leads to little “change in

practice” (Boks, 2006). Thus, a gap has been pointed out in the literature on how to deal with this “soft side of ecodesign” (Boks, 2006, Verhulst and Boks, 2012).

This article presents new insights and propositions developed within the context of a research on how to incorporate environmental sustainability more effectively into the product innovation process of a company. Particularly, it intends to address recurrent challenges observed in previous studies. This paper links knowledge from operations and environmental management with recent social theories, which have been confronted with experiences acquired in a long term in-company study. The ultimate goal is to formulate a prescriptive framework capable to help companies evolve toward more sustainable product innovation process.

This article is composed of four parts. Section 2 summarizes the methodology that was followed. Then, the central section (3) presents the results of bibliographic reviews conducted in several perspectives and leading to the proposition of the concept of “ecodesign transition”. The following section (4) discusses the propositions in light of parallel field experience, finishing with concluding remarks and perspectives.

2. Methods

This paper explores the “change management side” of ecodesign integration building on previous researches. To do this, the methodology used reviews of existing literature on ecodesign management, change management and sustainability transition, as represented in Fig. 1. These theories were confronted with the experience of a longitudinal study conducted in parallel in a consumer goods company, following action research methodology, as will be discussed in the last section. Such approach follows “the theory-building process [that] occurs via recursive cycling among the case data, emerging theory, and later, extant literature” (Eisenhardt and Graebner, 2007, p.25).

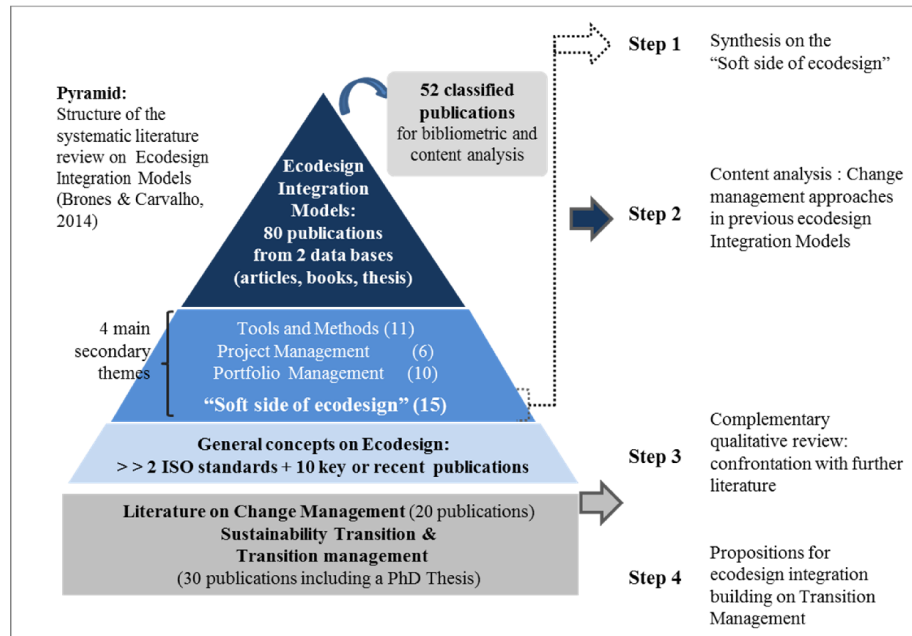


Fig. 1. Representation of the four-step methodology followed in the article, deepening previous systematic literature review on ecodesign integration.

The starting point was the challenges associated with the “soft side” of ecodesign management (step 1). Step 2 deepened a previous systematic review within this dimension, following Webster and Watson’s (2002) recommendation, in search of a thorough understanding of the literature considered. This previous review had given an overview of the state of the scientific art of ecodesign integration, focusing on previously published models (Brones and Carvalho, 2014) and led to the proposition of a systemic ecodesign integration model. Additional bibliometry techniques and content analysis were used in this complementary study, including simple statistical treatments and graphs to analyse the content of internal information, after encoding with the main constructs from step 1.

To further progress in exploring human aspects for ecodesign implementation (step 3), complementary qualitative reviews were conducted on change management approaches, including a search on the new concept of Transition Management. This process led to synthesize and analyse conclusions from previous researches, and identify new propositions and recommendations for ecodesign integration (step 4), seen both as a business objective and research object.

3. Results

Ecodesign research and literature predominantly derived from the engineering field, originally focusing on “the hard side” of ecodesign, i.e. the technical aspects, with a majority of publications on tools and based on theoretical or pilot projects (Charter and Tischner 2001; Stevels, 2007).

3.1 Learning from the “soft side of ecodesign”

The concept of “Soft Side of EcoDesign” has been formalized by Boks at Delft University of Technology, referring to a variety of sociological, psychological and even intangible factors that ecodesign research should address (Stevels, 2007). Stevels narrated how this innovation has been presented at the Electronics Goes Green Conference in Berlin in 2004, with the provoking title “EcoDesign in Industry is not an Environmental Issue”: *“It shocked part of the audience but it has been an eye-opener for some participants as well”* (Stevels, 2007, p.176).

Going back to the origins, ecodesign management and organisation principles have emerged as secondary insights in parallel to the (technical) principles of ecodesign consolidated during the late 1990s. For example, Lenox and Ehrenfeld (1997) explored the “environmental design capabilities”, based on the capabilities literature and four case studies.

In an exploratory study on implementing eco-design principles in several companies, McAlloone and Evans (1999) introduced the overall concept of an observed sequence of change facing change management issues. Charter and Tischner (2001) featured that it is “important to consider ‘soft factors’ such as organisational structure, systems, communications and corporate culture”, and that ‘soft issues’, aimed at gaining involvement from business functions are essential to address.

Nevertheless, this trend has further progressed relatively slowly, even after Boks’ initial studies. For example, Kerga et al. (2011) argued that companies should develop capabilities and resources to face these observed challenges. Such view is also found for the “greening of companies” more broadly, recognising that technical changes related to environmental management require human and organizational commitment (Jabbour et al, 2013).

Ecodesign integration can follow Top-down approaches driven by management leadership or alternatively Bottom-up initiatives - technical projects emerging from the field (Charter and Tischner, 2001; Stevels, 2007). Complementary knowledge should be brought from social sciences on wider change management perspectives to give rise to a novel and more effective approaches on ecodesign integration, strongly connected to industrial contexts. Such new trends will be explored hereafter, identifying the main constructs and bringing theoretical references from other disciplines.

3.2 Change management approaches in previous ecodesign integration literature

The content referring to change management has been analysed in the corpus of 52 integration models and associated publications from our systematic literature review (Brones and Carvalho, 2014). Table 1 presents the compilation of these approaches encoded following the main types of integration approaches as commonly discussed within literature (Top-down, Bottom up, or mixed). The references were also classified according to their level of relevance for the purpose of this research, i.e. if they introduced instructive integration principles in one or several of the considered dimensions (systemic levels, consideration of innovation management principles and detailed change management approaches).

The analysis reveals that 44% of the models do not consider change management issues at all, which confirms the general priority given to technical aspects. Then, the most common approaches recommend Top-Down ecodesign implementation or mixed approaches (23 % each), more frequently than Bottom-up integration (10%).

Additionally, Fig. 2 represents the evolution over time of the change management approaches considered in the 52 models. This distribution does not show an increase of a particular type of approaches along time. The first mixed approaches have been mentioned since 2000, but have not increased in more recent publications.

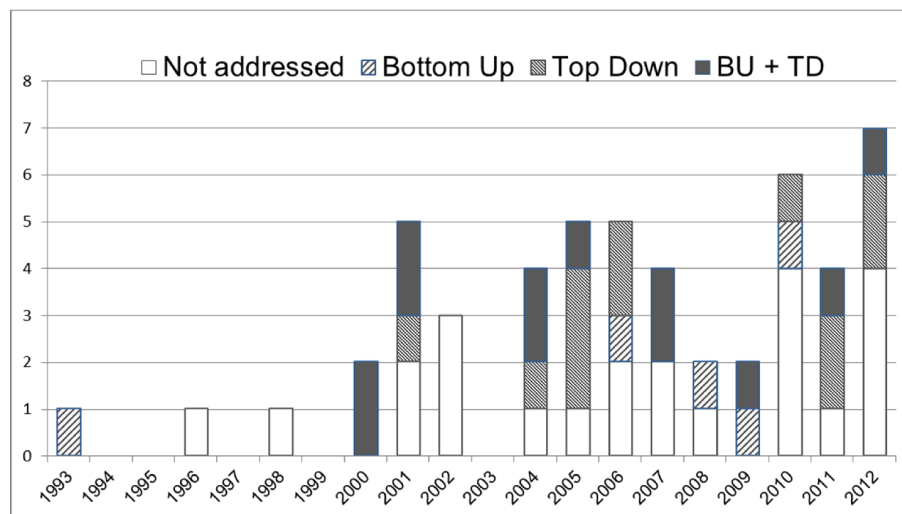
The qualitative content of these publications was also analysed. It was concluded that the change management perspective is a secondary content for most of these models, except for Verhulst and Boks (2012), which represents the recent expression of the “soft side” research trend, but the only model specifically built toward this dimension of the ecodesign integration challenges.

These models mention several aspects of change management principles, both from Top-down strategies (risks of inter-functional conflicts; multifunctional implementation team with top management support; goal setting) and from Bottom-up initiatives (awareness raising and training; pilot or demonstration project; new behaviours needed combining creativity and motivation; multi-stakeholders networking; action learning). Even if some sensible general advices are provided (e.g: “need for systemic transition with technological, social and cultural changes; importance of inter-disciplinarity”, by Vezzoli and Manzini, 2008), the models and associated publications provide almost no indication on how to conduct and follow up such change management processes, and do not report detailed application example of such field experience.

The model with most detailed propositions from the collection of 52 models (Verhulst and Boks, 2012) is a circular framework primarily based on Lewin’s three-stage change process (unfreezing, changing and refreezing). The authors presented it as a descriptive model, with limited prescriptive function, as confirmed in Verhulst’s PhD thesis (Verhulst, 2012), recommending further research in this direction. Hence this overview confirmed that the field of change management for ecodesign integration is still a challenging issue where other knowledge and experiences could be more deeply explored from social sciences.

Table 1: Classification of change management approaches in the 52 ecodesign Models (all references available in Brones and Carvalho, 2014).

Change management approach	Not addressed	Bottom Up	Top Down	Bottom Up + Top Down	Total	
# of Models (1993-2012)	23	5	12	12	52	
% of Models	44%	10%	23%	23%	100%	
References						
Higher relevance	Van Hemel, 1998;	Hassi et al., 2009;	Dewulf and Duflou, 2004; Goffin, 2012; Hermenau et al., 2005; Ölundh, 2006; Pigosso, 2012;	ABNT, 2004; Crul et al., 2009; Handfield et al., 2001; Kara et al., 2005; Ritzén, 2000; Stevels, 2001; Verhulst and Boks, 2012;		
Medium relevance	Alakeson and Sherwin, 2004; Baumann et al., 2002; Berchicci and Bodewes, 2005; Robert et al., 2002; Van Hemel and Cramer, 2002;	Fiksel, 1993; Vezzoli and Manzini, 2008;	Ammenberg and Sundinb, 2005; Donnelly et al., 2006; Hallstedt et al., 2010; International Standard, 2011; Jeganova, 2005;	Le Pochat et al., 2007; Tingström, 2007; Bhamra, 2004; Simon et al., 2000;		
Lower relevance	Bovea and Perez-Belis, 2012; Bucci et al., 2012; Dusch et al., 2010; Ferrer et al., 2012; Ghazilla et al., 2008; Keskin et al., 2012; Howarth and Hadfield, 2006; Jones et al., 2001; Lewandowska and Kurczew, 2010; Neal and Heintz, 2001; Nowosielski et al., 2007; Poyner and Simon, 1996; Ramani et al., 2010; Spangenberg et al., 2010; Trappey et al., 2011; Waage, 2007; Yang and Song, 2006;		Carrillo-Hermosilla et al., 2010; Lofthouse, 2006;	Arana-Landin and Heras-S, 2011; Sherwin and Bhamra, 2001;	Kengpol and Boonkanit, 2011;	

**Fig. 2.** Evolution of change management approaches in ecodesign models (1993-2012)

3.3 *Bringing complementary knowledge from change management literature*

In order to consolidate and complement previous findings, a wider qualitative review of literature on change management brought additional knowledge from social science theories to give rise to novel insights applicable at firm level.

Promoting change in organisations is recognised as complex as seen through failure rates of change projects estimated between 50 and 80% (Ford and Ford, 2010; Verhulst, 2012; Vladimirova, 2012). According to Boks (2006), change management has mainly to face individual and organisational resistance to change processes. As a key concept from organisational studies, the “status quo bias” states that people are reluctant to change because the disadvantages of leaving the current situation appear larger than the advantages of the change. More recently, social scientists have brought new insights on behaviours to overcome such barrier seen as a key challenge and opportunity to evolve to a successful change (Ford and Ford, 2010).

Several authors tried to bring organisational change management approaches to sustainability programmes, using the Change Wheel Model (Kanter), including nine drivers, or the Morgan Model, based on three essential steps: change intentions and attitudes; define and shape target behaviours; structure means to obtain the behaviours. In her review, Vladimirova (2012) compared different models addressing the process of change (How). The original model from Lewin is still the major reference but should not be seen separately from the other three elements which comprise his “Planned approach to change”, i.e. Field Theory, Group Dynamics and Action Research (Burnes, 2004).

Verhulst’s (2012) study of the human side of sustainable design implementation from the perspective of change management approached change at an organisational level, though she recognised that such evolution would also require changes in behaviour on a personal level. Organisational change management intends to take an organisation through the transition from today to a new future state. A successful enterprise transformation requires a holistic and systematic approach that crosses organisational boundaries and integrates viewpoints of multiple stakeholders, methods, and tools (Vladimirova, 2012). If sustainability perspectives call for such strategic transformative change, to fully address the complexities of such evolution it is necessary to consider several dimensions, including content, context, and process. Vladimirova (2012) proposed three models to address the content (What): second-order change (Levy, 1986); the change cube (Mintzberg, 1998). More recently, the business transformation model (Bititci, 2007) comprehends eight necessary business components: value streams, strategy, organization, people, processes, systems and resources, leadership and performance measurement.

From this overview, three main implications can be proposed. Firstly, though some convergence in general principles can be seen (transformative process, necessity of a systemic/multilevel approach involving organisational and individual dimensions), there is still a lack of consensus on how to plan and implement such change process at firm level for sustainability integration. Secondly, the behavioural dimension (e.g. expectations, intuition and judgment, individual decision-making processes, biases, power conflicts) has scarcely been studied for ecodesign integration (Szeler & Melberg, 2014) as confirmed by the content analysis presented in section 3.2. Recent works have highlighted opportunities of using behavioural theory, in order to encourage lifestyle change considering sustainability requirements, referred to as “nudging”, which could be further explored. Thirdly, there is still a lack of prescriptive methods applicable for organisations, which could guide the introduction of sustainability concerns. Recent social theories coming from wider sustainability studies can help fill these gaps.

The concepts of transitions have initially been developed for large-scale socio-technical systems like energy supply, transport, etc., motivated by public policies toward sustainability in Europe. A comprehensive review on transition studies showed such development within the last 15 years, with a new field of “sustainability transitions” represented by up to 100 scientific papers per year, and Transition Management (TM) as one of the main strand (Markard et al., 2012).

The Dutch TM concept was rooted in the complex systems theory and recent social models, and originated operational principles both descriptive and prescriptive. TM was designed to deal with key

problems observed in sustainability transitions (complexity and distributed control; short/long term; danger of lock-in; political myopia) in an integrated way. TM is based on complementary elements: 1) development of long-term sustainability visions and overarching joint strategies, 2) organisation and mobilisation of a multi-actor network, execution of projects/ experiments, and finally 3) monitoring and evaluation as inputs to the collective learning process (Kemp et al., 2007).

Few pioneering companies have reported to move beyond traditional Corporate Social Responsibility to transform their value chains and markets along with their internal organisation. Such a systemic perspective on transformative business strategies is so far lacking in the literature (Loorbach and Wijsman, 2013). It is proposed here as a useful and original source toward a more effective ecodesign integration. The intended synthesis of different knowledge areas is represented in Fig. 3, with the necessity to determine how TM approaches could address ecodesign integration challenges.

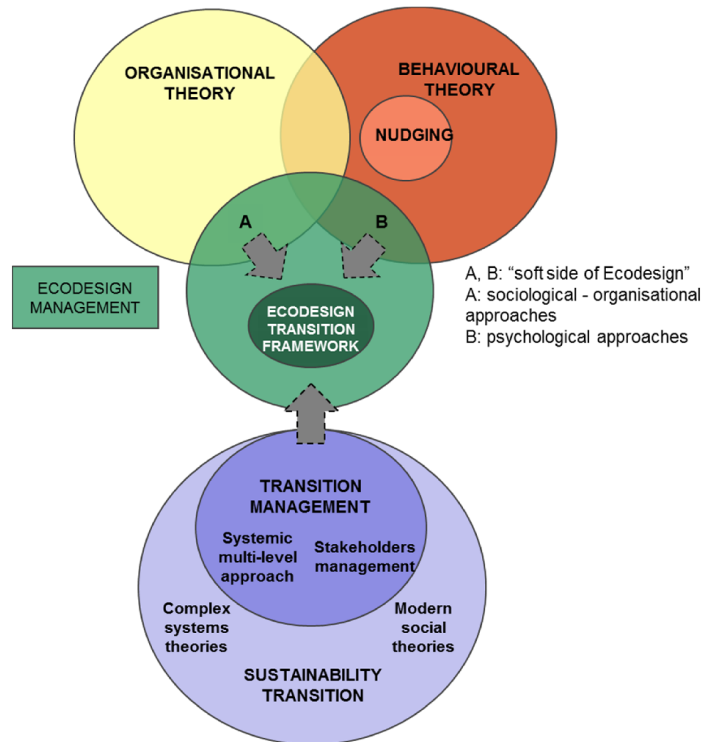


Fig. 3. Joining several change management approaches for ecodesign integration

3.4 Transition Management for ecodesign integration

A deeper understanding of sustainability transition gave rise to TM as a governance approach including a framework for experimental implementation. TM is based on a central multi-level concept that describes the dynamics of a transition as the interactions between strategic, tactical and operational levels. One of the claimed advantages of TM is the possibility to bridge the gap between Top-down planning and Bottom-up incrementalism, through new types of interaction and cycles of action and learning, with a deeper stakeholder management (Loorbach and Wijsman, 2013).

Interestingly, the principles of TM present high convergences with the ecodesign integration model previously elaborated (Brones and Carvalho, 2014), based on a synthesis of ecodesign literature and previous field experiences, as represented in Fig. 4. This framework associates the same three systemic levels (macro/strategic, meso/tactical and micro/operational), calling for complementary top-down senior management supported activities and bottom up initiatives conducted by field teams, and a complementary transversal axis focusing on change management and the "soft side" of ecodesign.

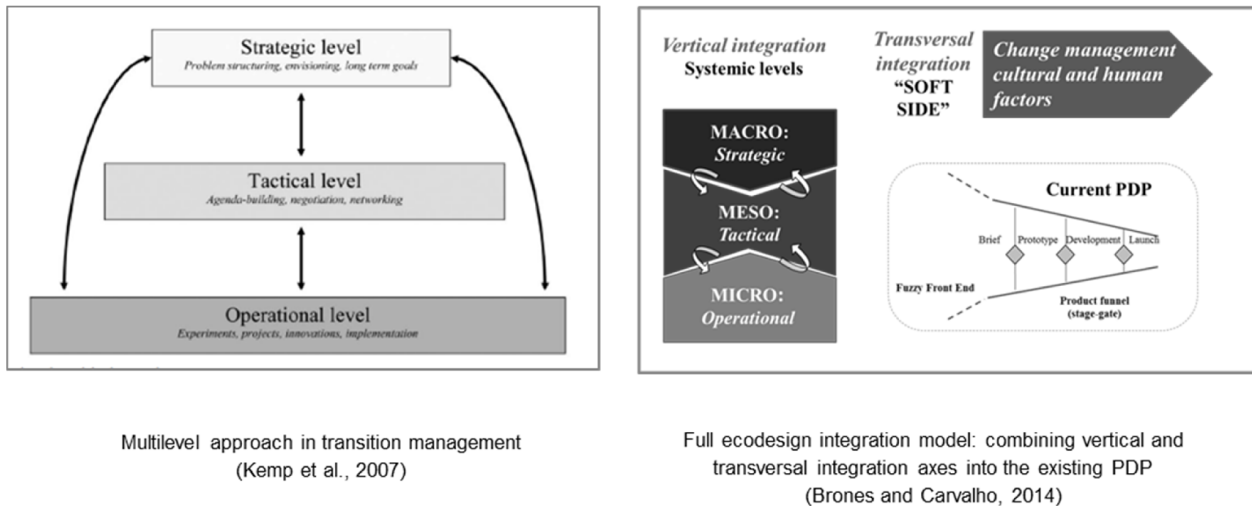


Fig. 4. Systemic multi-level approaches from transition management and ecodesign integration

Thus both models share the multi-level principle, same three levels definitions (strategic, tactical and operational) applicable in company context, and the complementarity of top-down and bottom up transformation dynamics. Another strong similarity is that both approaches were developed through action research.

These observations show that TM is quite coherent and synergetic with the conclusions from previous studies on ecodesign integration, and it is proposed as a promising framework that can help fill the gaps found on earlier attempts to bring change management notions to the challenges of ecodesign implementation.

4. Discussion and final considerations

The main contribution of this exploratory research is the proposition to combine TM principles with the systemic ecodesign integration model to compose a promising “ecodesign transition framework”. Such proposition was not reported in previous literature, which was confirmed by a search in Scopus database, where no article was found combining TM and ecodesign or synonymous expressions. This research has led to a new synthesis of diverse sources from the engineering literature and social sciences, building propositions on similarities and complementarities. TM methods are expected to permit analysing and influencing the evolution of innovation practices considering sustainability requirements in a more effective way than former change management attempts, as observed in the review of the literature and published models.

TM approach was cited in a recent review within a PhD thesis, but was considered as unsuitable to a company context (Verhulst, 2012). Based on a deeper and more recent exploration into the field of TM, which has extended over the initial application to larger societal systems (like cities or region), a different conclusion can be stated, that TM principles can also be applied at company level. TM brings a new management approach, with a framework for ‘guided evolution’, seeking to balance emergent changes, bottom-up innovation, guiding visions and collective agenda-building processes (Loorbach, 2013). Also, TM presents remarkable convergence with our previous company oriented systemic synthesis on ecodesign best practices and principles.

Moreover, TM recommendations can be related to broader business management tendencies. Groysberg and Slind (2012) concluded a recent research project that focused on the state of organisational communication in the 21st century, that the command-and-control approach to management is no more viable and that lateral and bottom-up communication has become as important as the top-down one. Such view strongly echoes a trend that emerged the 1990s, with the 5th Discipline based on systems thinking and organisational learning. Senge and co-authors have identified the development of new modes of organisation, more flexible and less hierarchical and

authoritarian, giving increasing space to individual decision-making and innovation (Senge and Sterman, 1992). Managers were advised to become 'systems thinkers' as well as better learners, forming collaborative action research partnerships to develop new tools to accelerate learning. Applying those tools embedded in systems thinking in real organisations would convert companies into learning organisations (Senge and Sterman, 1992).

In the new context of businesses facing the Sustainable Transition challenges, where management practices nowadays give more space to individual and team autonomy versus directive processes, the application of TM principles for ecodesign integration could permit fostering even more effectively sustainable changes, considering individuals' engagement, including behavioural aspects, interaction with project teams and higher level business organisations in a multi-level approach.

Transition cycles should be translated into flexible and polyvalent planning and application principles, in order to adapt to diverse specific organisational contexts, in different companies, sectors and countries, considering cultural aspects. Such adaptation will be necessary to overcome the limitations of this research, based on qualitative exploration and preliminary in-company observations. On-going action research will develop, formalize and operationalize the "ecodesign transition framework" in order to further contribute to more sustainability integrated product innovation processes.

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