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Knowledge engineering and management applied to sustainability and innovation

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Editorial

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The sustainability of humanity is a challenging topic due to climate change, biodiversity reduction, and resources depletion. How to manage these environmental constraints, how to learn from experience to change the way to develop, and how to learn how to design technology in a different way? What is the place of knowledge on environmental impacts, on knowledge reuse or learning processes, and even cultural change?

In this global framework, this special issue of AI EDAM is devoted to papers concerned with the engineering and the management of knowledge applied to sustainability and innovation. Its goal is to examine how knowledge-based methodologies and tools can contribute to design innovative sustainable systems and how do they generate changes that could participate to transition toward sustainability in industries and societies.

In order to understand the fundamental issues of sustainability and its consequences on knowledge engineering and management, it is first fundamental to identify the current environmental trends, connected definitions, and postulates. Climate change, the reduction of biodiversity, a decrease of natural resources, and an increase of environmental risks are some of the consequences of human activities. Scientists argue that the accelerations of these trends are proofs of our responsibilities from the 50s (the Anthropocene concept) (Crutzen, 2002; Lewis and Maslin, 2015). The mitigation of the consequences and therefore acceleration requires effective responses in terms of transition, and it is necessary to rethink our economic and social models in depth as described by Lang and Marsden (2018). Extreme constraints should enhance creativity and innovation to generate sustainable solutions (Brown and Katz, 2011; Bocken *et al.*, 2014). Consequently, new knowledge-based approaches, methodologies, and tools must be developed and shared to face worldwide environmental issues, using sociotechnical scenarios as in Geels et al. (2020).

In this context, some definitions are given to guide the readers of this special issue. The fundamental debate regarding sustainable development is whether we choose to adopt a weak or a strong conception of sustainability (Ayres *et al.*, 1998; Neumayer, 2003). Weak sustainability states that human capital can substitute natural capital as initiated by Solow (1993). Conversely, strong sustainability postulates that natural capital is intimately linked to human capital and substitutability should be severely limited as underlined by Traeger (2011). Strong sustainability is lauded by researchers (Helne and Hirvilammi, 2015; Barbier and Burgess, 2017). In this specific framework, the stakes are changing, it is no longer a question of developing new tools or methods, but to question the knowledge engineering and management to help the transition from weak sustainability to strong sustainability. Figure 1 illustrates the way Design for Sustainability (DfS) should evolve to come from weak sustainability where the ecodesign approach can be placed toward strong sustainability that should consider a more social approach, wider than the technical one. It requires to change the scale of consideration to come to DfS, as underlined by Ceschin and Gaziulusoy (2016) or Arnsperger and Bourg (2017).

To support this transition, the special issue gathers contributions from both researchers and practitioners to discuss methodological, technical, organizational, and educational aspects, feedback from the application of knowledge engineering and management techniques to sustainability and successful innovation. Figure 2 illustrates the enlargement of considerations in DfS evolution toward transitions. It is coming from a quite focused approach of technical considerations on methods and tools for ecodesign toward knowledge transfer and the diffusion process in society.

The special issue starts with a proposal on a method for choosing adapted Life Cycle Assessment (LCA) indicators as a driver of environmental learning. The paper is entitled "A method for choosing adapted LCA indicators as a driver of environmental learning: French textile case study". Based on a case study approach, it experiments the use of environmental impact indicators' choice to enhance environmental impact understanding and ecodesign learning. It addresses a change of practice and consciousness at the technical and individual scale. The second paper, entitled "The relationship between the knowledge mapping and open innovation process: the case of education system", proposes a new approach based on knowledge management to integrate internal and external knowledge to enlarge the scale of information considered in decision-making along the innovation process. It still enables to

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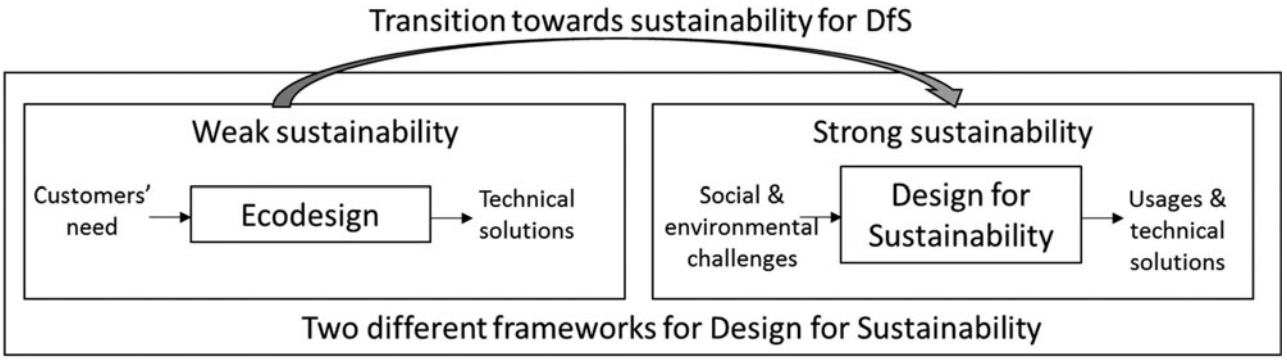

Fig. 1. Two different frameworks for DfS and the required trajectory to address DfS in a social transition approach.

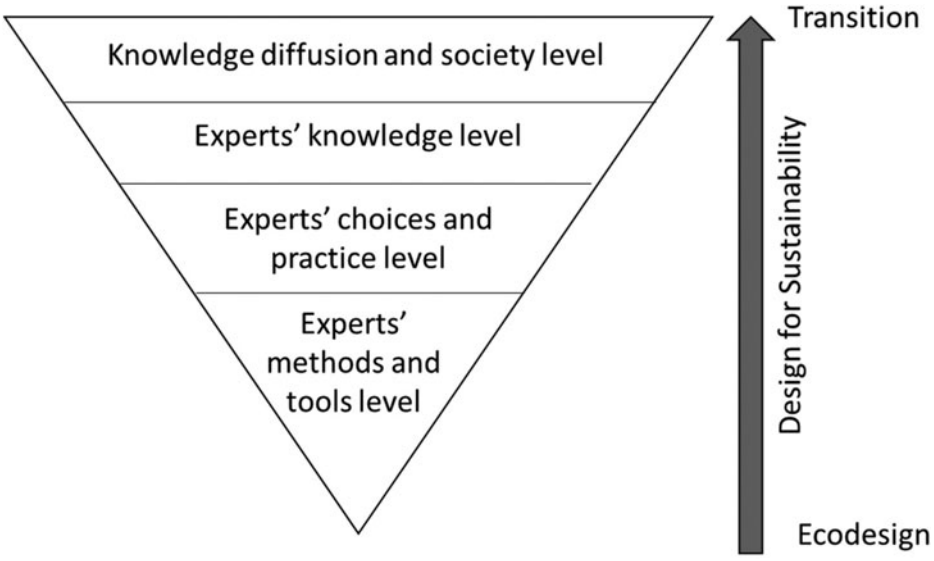

Fig. 2. The required levels of research questions to come from ecodesign toward transition in DfS.

understand how to integrate individual expertise in a collective innovation process. These two papers analyze the impact of technical solutions on environment (at a technical level).

The third paper, "Conceptual tool for environmentally-benign design supporting decision-making", proposes a framework to compare and choose among several design solutions considering environmental impact assessment using LCA and domain-specific mapping between LCA and design skills. The fourth one, "InDeaTe – A knowledge-based design process guidance tool", proposes a holistic, knowledge-driven platform for DfS. These two papers focus on the understanding of the decision-making process and the way to integrate environmental impacts in the ecodesign process (at the organizational level). In a more strong sustainability perspective, the fifth paper, "A personalized requirement identifying model for design improvement based on user profiling", deals with usages and the link and adaptation between the user and the product. It underlines the diversity of users and the necessity to adapt the product to personalized requirements. The question of changing the way of thinking product is addressed in order to deal with sustainability at a more social level.

The final paper in the issue is "Identification of contribution and lacks of the ecodesign education to the achievement of sustainability issues by analyzing French education system", by C. Perpignan *et al.* It deals with how to learn ecodesign. Based on a case study analysis of the French education system curriculum compared with the state of the art, a critical analysis is provided. From this critical analysis, new curricula are proposed. Even if it does not directly deal with artificial intelligence, the analysis can however influence the way to build intelligence of ecodesign and sustainability. In those terms, it can change the way to address sustainability. From this perspective, opportunities and limits for artificial intelligence are underlying and it invites to think sustainable design in a global cultural and political scale.

In conclusion, the special issue illustrates different scales to consider for reaching design for strong sustainability, coming from technical and environmental assessment to wider social and cultural considerations.

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