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### The process of environmental innovation, a solution against the change? The case of European resilient flooring industries

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#### Abstract

Since the end of the 1970s, companies consider the concept of eco-design as a pragmatic solution for solving environmental controversies for sustainable development. The European resilient flooring industry, symbol of mass consumer society, with its PVC and Linoleum products, implements innovative projects based on voluntary participations and the support of European public policy. Nowadays, eco-design paradigm is based on a “Laisser-faire” approach in order to shift environmental constraints into opportunity of competitiveness. Yet, is this trend modifying the current socio-technical regime? This paper demonstrates the core of eco-design is a relevant tool for piloting the evolution of a controversial sector in order to reinforce and to protect the existing system in a context of radical uncertainty. Firstly we will discuss on methodological disputes of eco-design paradigm and the key role played by policy makers for a “social control of innovation”. Secondly, we will emphasize how resilient flooring manufacturers is taking over collectively eco-design paradigm for withstanding environmental controversies.

**Mots clés :** eco-design, resilient flooring, transition, public policy, sustainable development

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**THE PROCESS OF ENVIRONMENTAL INNOVATION, A SOLUTION AGAINST THE CHANGE? THE CASE OF EUROPEAN RESILIENT FLOORING INDUSTRIES**

**Working paper**

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Since the end of the 1970s, companies consider the concept of eco-design as a pragmatic solution for solving environmental controversies for sustainable development. The European resilient flooring industry, symbol of mass consumer society, with its PVC and Linoleum products, implements innovative projects based on voluntaries participations and the support of European public policy. Nowadays, eco-design paradigm is based on a “Laisser-faire” approach in order to shift environmental constraints into opportunity of competitiveness. Yet, is this trend modifying the current socio-technical regime?

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## INTRODUCTION

In the wake of the 1970s, Western countries questioned the mode of production and consumption (Meadows *et al.*, 1972 ; Johoda *et al.*, 1974). Designers and artists are the first able to propose alternatives in proposing new creative and original inspirations (Papanek, 1984). These initiatives move faster thanks to the publication of the Brundtland report and the participation of industries during the first United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. The resilient flooring industries is still concerned by these events since it produces chemical garbages and plastic goods. That is the reason why this sector had to propose alternatives for eco-design for sustainable development. At the same time, the same industries had to take into account a context of economic crisis of the 2000s (i.e. Subprime crisis and crude oil price rising). Thus, the resilient flooring industry is confronting to a systemic crisis and to a high level of uncertainties.

Basically, this period could be a good opportunity for innovating according economics, and, why not, for testing new methodologies for preserving the environment, such as eco-design. Yet, many projects in eco-design implement incremental solutions instead of calling for radical changes (Abrassard and Aggeri, 2002, Tyl, 2011, Gendron and Reveret, 2010). It means giving a priority to technical dimensions is not enough. Indeed, the main challenge is to know clearly if the transition towards sustainable development needs the intervention of policy makers, or rather the intervention of private initiatives on the behalf of the “Creativity”. In the case of the European resilient flooring industries, competitors recognizes the importance of the second option, but are implementing their own institutional devices of regulation. The goals is to resist to socio-economic pressure while following conventional rules for practicing eco-design methodologies.

Our demonstration will be divided as follows. Firstly we propose a critical analysis of the paradigm of eco-design from a political economic approach. Indeed we discuss on conceptual weaknesses and the formation of community of actor. Secondly we emphasize how concepts are taken over and applied by resilient flooring manufacturers. For this, our work will be based on around twenty qualitative interviews through Europe and heterogeneous secondary literature.

## I. ECO-DESIGN PARADIGM, THIS “MYSTERIOUS” GUEST OF THE SUSTAINABLE TECHNICAL CHANGE

### I.1. Eco-design, a topic for social sciences

Ecological disasters and economic crisis of the 1970s reveal a strong pessimism for our future. Yet, technical change was considered as solution for providing more acceptable mode of production and of consumption. Designers and artists are the first pioneers which are involved in this challenge by proposing a “*Sustainable design*” approach (McLennan, 2004, p. 23). Its goal is to modify the process of design by choosing a holistic point of view, including social behaviors and social representations (Papanek, 1984<sup>1</sup>, Abbrassart and Aggeri, 2002). This holistic approach is quickly facing an existential crisis between two points of views : those calling for radical ideas and those calling for more opportunists/pragmatic ideas (McLennan, 2004, p.29).

Despite these debates, manufacturers propose various solutions thanks to their engineers. Their missions is to avoid incremental solutions in favor of *innovative design* projects including the social dimension (Pahl and Beitz, 1988 ; Suh, 1990 ; Hatchuel *et al.*, 2002). At the same time, some economists focus on the making of “appropriated technologies” in order to implement a strategy of *Eco-development* for the future (Ceron and Baillon, 1979;<sup>2</sup> Vivien, 2005, p. 89). These authors argue the real challenge is not based on specification and technical life cycle of products, as it is supposed by the concept of *sustainable design*. It is rather based on the evolution of an “obsolescence rate” of products. This rate depends on the use and economic and social context (*Ibid*, p.11). That is why, according Baillon and Ceron (*Ibid*), the interactions between the technosphere and the biosphere should be managed by a “social control of innovation” thanks to social norms and international standards<sup>3</sup> (*Ibid*, p. 37). So, let’s see how these control is implement since the 1990s.

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<sup>1</sup> The second edition of this book

<sup>2</sup> These authors was members of the International center of research of environment and development (CIRED, France).

<sup>3</sup> This perspective feeds the theory of « participatory planification » proposed by Sachs (1978, p.19) from an eco-development perspective. These authors participated in expert discussions, such as the French association of Standards (AFNOR) which plays a key role in terms of environmental certifications.

## I.2. Towards an « opened » or a « closed » eco-design : a methodological dispute

Manufacturers are involving for sustainable development since the publication of Brundtland report, entitled “our common future”(1987), and the conference *World Business Council for Sustainable Development* which took place during the international conference of United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. Basically, manufacturers was invited to reduce by four, even by ten, their consumptions of natural resources and their emissions in the atmosphere. (McLennan, 2004, p. 29). In spite of the framework proposed by the paradigm of *sustainable design*, the social perspective has been substituted by the conservation of flow of energy and matters. (Fussler and James 1997, p.25 ; p. 78-79, p. 85, p. 137). In other words, an ecocentric approach based on pure calculation of stocks and flows is substituting an anthropocentric approach based on a social approach.

This new perspective is useful for manufacturers, because the commensurability of environmental impacts can be evaluating in terms of opportunity of competitiveness. In others words stocks and flows of matter and of energy can be translated into economic value. Moreover, Porter and Van der Linde (1995a ; 1995b) argue that regulations and norms are useful for modifying processes of production, but Ambec *et al.*, (2013) point out the fact that the level of normativity could shackle the process of creativity. That is the reason why various flexible standards based on voluntary participation is currently the mainstream for eco-design for transforming environmental constraints into economic profits.

Nowadays, the environmental management system, including ISO 14001 and EMAS standards, is sufficiently flexible for being recognized as a relevant solution for Anglo-Saxon countries in the 1990s (Aggeri and Abbasart, 2002, p. 42). Moreover, French initiators of theses international standards assume that each organizations are invited to make its own tools, because “no magic solutions” exist (Meyer, 1998). Consequently policy makers do not have to give orders to firms for being creative and companies are free to choose the level of constraints for implementing an eco-design strategy. Some exploratory tools are implemented, such as mono-criteria, multi-criteria and life-cycle analysis of product. Paradoxically, no radical changes are observable in the 2000s. Some authors assert that this result is due to the selections of hypothesis and the interpretations of results : both are a source of radical uncertainties that cannot modify deeply the process of decision-making (Abbrasart, 2011 ; Tyl, 2011).

### I.3. Making the environmental quality : All roads lead to Rome?

Since the emergence of these “opened” international standards in the 1990s, many methodological disputations exist between radical ideas and moderated ideas for practicing eco-design. (McLennan, 2004, p. 34). Firstly, the most moderated idea calls for the management of energy and matter as we mentioned below. Secondly, the radical ideas propose a guideline based on six principle : preserving natural eco-systems thanks to biomimicry<sup>4</sup> (1), preserving energy and natural resources (2), evaluating life-cycle of products (3), taking into account population health (4) and locations (5). These initiative have to be integrated from a holistic perspective (6) (*Ibid*, p.38). Thirdly, Ryan (2006) proposes four main solutions for practicing eco-design : recycling, rebuilding, remanufacturing (1), dematerialization and decarbonization of consumption (2), an sharing economy based on services and the improvement of functionality, and a system of distribution for a better allocation of resources. Fourthly, the French research team, called CIRED, include an economic perspective by including the role played by prices and incentives. Baillon and Ceron (1979) write a product which aims to preserve the environment “must be compatible with the brevity of use value”. That is the reason why these authors propose four principles for controlling the economic obsolescence : in establishing warranties, after-sales services, products that are easy to repair, slowing down fad phenomenon. Finally, the establishment of eco-design for a company could be based on various pathways.

Despite this diversity of solution, European policy-makers play a key role for modifying technological trajectories, such as packaging methods and household equipment and electronics device. Their role is also important for managing controversial sectors, like the sector of chemistry. Since 2008, European union implements the REACH<sup>5</sup> regulation in order to control some of thousands of chemical molecules (Schiesser, 2011). Policy-makers are also pragmatic in allowing industries to do the management their own end-of-life of products<sup>6</sup> : industries are becoming the best experts for solving environmental issues (Godard, 1993). This reversal power leads to the adoption of ISO 14 062 standard dealing with “all steps of life cycle of products” (ADEME<sup>7</sup>, 2013). Sometime, sectoral rules are made by “collective commitment” for the

<sup>4</sup> Many examples are available at: <http://www.asknature.org/> . We will keep in our mind the imitation of belted kingfisher cranium in order to design the *Shinkansen*.

<sup>5</sup> “Registration, Evaluation, Authorisation and Restriction of Chemicals” (REACH).

<sup>6</sup> For example, the integrated politic of products (PIP).

<sup>7</sup> The French agency for environment and the management of energy.

making of common declaration of products (Jacquot, 2012). Consequently industries institutionalized eco-design practices thanks to a common vision of the future. Thus, we observe eco-design practices are confined between demanding regulation to a paradigm based on pure freedom for innovating.

#### I.4. The life-cycle of product : a compass without map ?

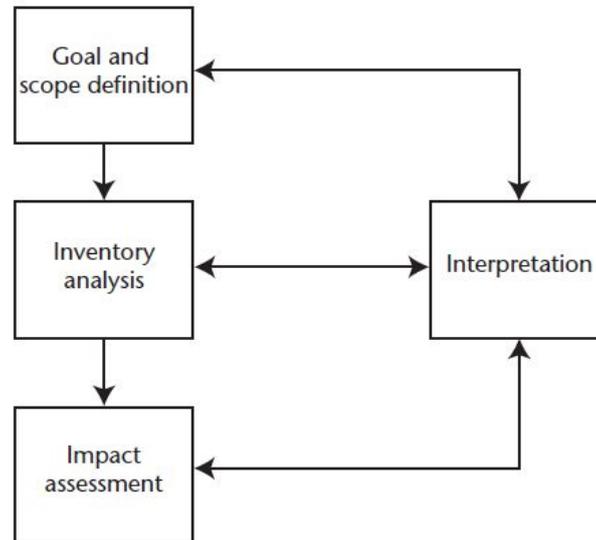
Nowadays, life-cycle analysis of products contributes directly to evaluate and to sort global impacts on environment (Grisel and Duranthon, 2001, p. 20-21). At the first sight, understanding all steps of process of production and distribution is consider as a relevant solution for finding solutions (*Ibid*, p. 68). Basically, around ten methodology/tools exist. In others words, there are as many assumptions and results as there are methodologies (Patingre and Vigneron, 2001 ; Gendron and Revéret, 2010 ; Knight and Jankins, 2009). Yet, on the one hand, Knight and Jenkins point out that a high diversity of tools is making more complex the environmental challenge and decision-making (2009, p. 557). On the other hand, some authors argue this large range of tools is providing a high level of freedom for making strategy (Grisel and Duranthon, 2001, p.22). Finally, these diversity of solutions question the relevancy of selected assumptions and of interpretations of results for decision-making.

The international standard ISO 14040, established in 1998<sup>8</sup> and dealing with life-cycle analysis of products, emerges in order to help distrustful companies (see Schematic below). This approach becomes more and more powerful as multi-criteria tool. It is due to the fact decision-makers are able to fix their own goals while drawing the borders of their analysis (Horne *et al.*, 2009, p. 17). It means that the efficiency of life-cycle analysis of product is based on social interpretation. This trend is transforming management methods in terms of “life-cycle management” although eco-design and LCA paradigms are still unclear as we mentioned above (Fullana i Palmer *et al.*, 2011). Then, even if the LCA seems to be robust, various scientific works point out the fact that it is hard to find the most efficient solutions. In the 1970s, Baillon and Ceron (1979) explain the impossibility to find the best trajectory for the sector of electronic devices, of automobile and of building. Later, the main drawback of LCA is due to the difficulty to get relevant data (Horne *et al.*, 2009, p.28). Unlike it, Tyl underlines that the more data are

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<sup>8</sup> This standards was based on Helias A. Udo de Haes *et al.*, 'contribution in 1996 (Udo de Haes *et al.*, 2002 ; p. xiv).

collecting, the more uncertainty is important because of the existing knowledge and the cost of productions into the organization (2011, p. 45). What are the consequences of these uncertainties in spite this tool?



**Schematic 1 : The main principle of LCA according ISO 1404xx standards**

Economic sciences show that institutional devices exist for managing a context of uncertainty. Clive Spash, mentioned by Munda, writes that a multi-criteria analysis is disputed by interest groups (Munda, 2004, p. 8). Moreover, Martinez-Alier, Munda and O'Neill (1998, p. 285) emphasize the main role played by political economics for managing multi-criteria analysis, like LCA (Horne *et al.*, 2009). These authors assert that getting information required the collaboration of actors and the organization of turntables<sup>9</sup>. They write that a LCA exist for assisting decision-makers, but the decision are based on “backcasting”, a common representation of future. We argue that a “backcasting” point of view aims to drive the society towards sustainable development around social group with more or less power. Finally, it reveals that, behind the porous concept of eco-design and its diversity of tools, an ideological/political dimension and an identity determine the basement of eco-design. We propose to analyze the consequence of it in the following chapter of this paper.

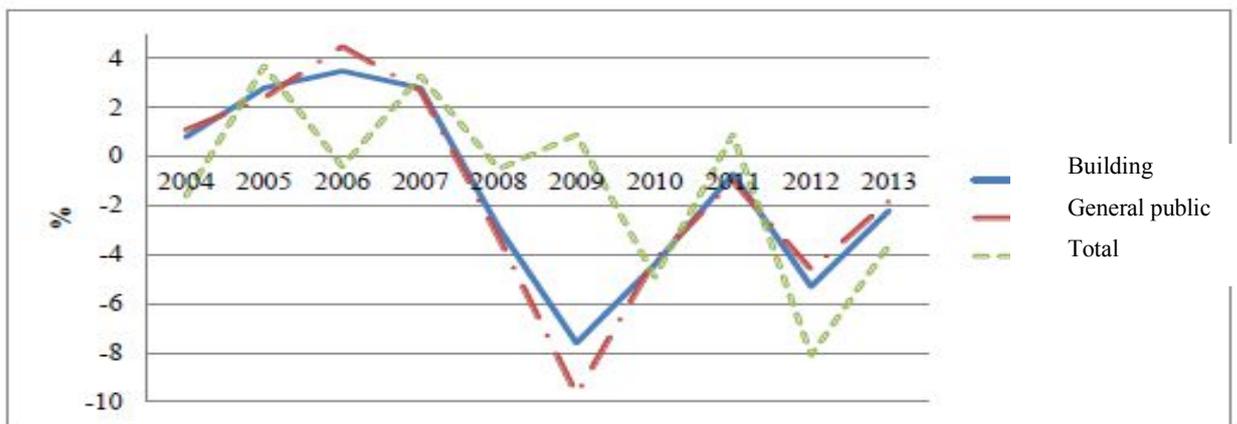
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<sup>9</sup> The European commission emphasizes the role played by the constitution of group studies involving stakeholders (European commission, 2001).

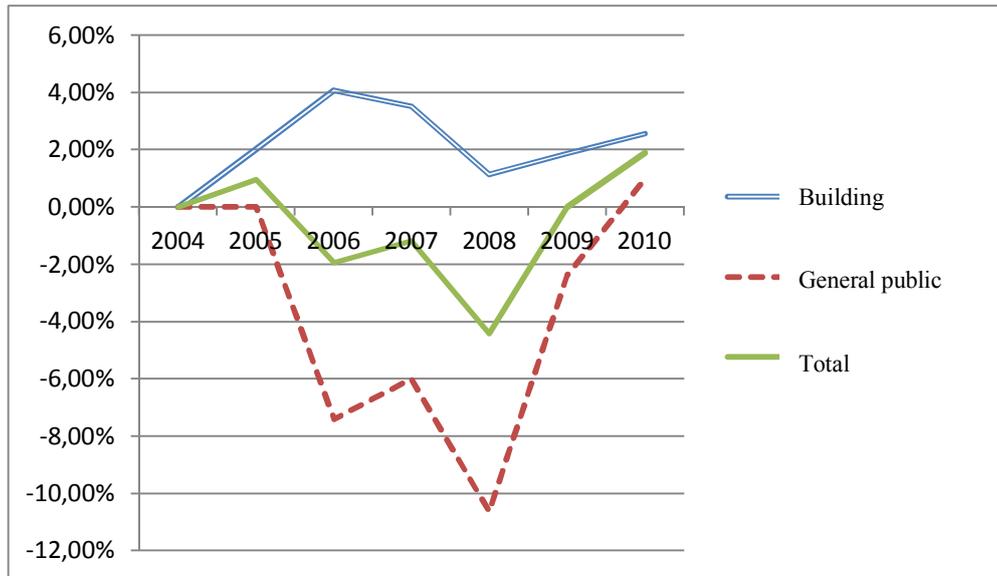
## II. APPLYING THE PARADIGM OF ECO-DESIGN TO THE EUROPEAN SECTOR OF RESILIENT FLOORING : AN EMPIRICAL EVIDENCE AT A SOCIAL CONSTRUCTION

### II.1 Economic crisis and environmental issues : a controversial sector looking for guideline

The European sector of resilient flooring makes final products and contributes directly to our life-style. These resilient floorings are commonly recognizable into house, hospitals, schools or sport halls. Most of them are PVC products and biobased products called “linoleum”. Nowadays, about ten multinational firms are in competition together all over the world. The leader are Tarkett, Armstrong, Gerflor and Forbo. They are confronted to economic and environmental issues since the 1970s. The first one was the crude oil crisis in 1973-1979 and during the 2000s. We can also add the subprime crisis that includes building markets and financial markets (2006). That is the reason why the production level in building industries was decreasing between 2007 and 2013 in European union (See the graphic below). This systemic economic crash can also be observed for French resilient flooring industries (See the graphic below).



Graphic 1 : Evolution of the production in building industries in European union (27 members, in volume; Eurostat, 2014; reference : sts\_coprgr\_a)



**Graphic 2 : Evolution of production in French resilient flooring industries (SFEC, our own data, 2015)**

The second one is the raise of Green Chemistry paradigm that drives the sector of chemistry, plastics and resilient flooring (Nieddu *et al.*, 2010). In spite of the popularity of those final products, this topic is unknown in social science literature, that is why our empirical study is based on around 20 interviews<sup>10</sup> (See the appendix, p.16-17). We aim to emphasize how actors are interpreting and practicing the concept of eco-design.

We observe that interviewees cannot clearly define what “environment” is. Some of them assert that it is a “complex topics” (interviews n°12-19). Yet, according to them, companies have a “moral obligation” towards environmental issues, that is why most of the firms had to implement strategy for the long term, such as water purification plants, waste management and the making of evaluation tools (interviews n° 2-3-12-16). We learn that practitioners are invited to preserve “future generations” and to respect eco-systems in various domains thanks to a pragmatic point of views (interview n°1-4-10). Consequently, we assume that actors from the sector of resilient flooring are aware about environmental issues.

These environmental issues are solved by a technocentric approach. It reveals that companies apply the core of the principles of eco-design explained previously. The most of interviewees call for the reduction of energy use (1), fighting against the planned obsolescence, for the use of clean matter (2), for the improvement of surface finishing (3) and of repairing (4), and for recycling (Interviews n°7-11-16-18).

<sup>10</sup> We chose the leader located in France, Sweden and Italy.

Yet, between 2006-2014, we observe that the interpretation of what eco-design is does not change radically. For instance, one environmental manager explain that eco-design aims to contribute to the competitiveness of systems of production while emphasizing the difficulty to get a holistic approach (interview n°1). Basically, all elements of eco-design previously presented in the paragraph above are setting up in order to increase the level of production thanks to commensurable tools (interviews n°1, n°3, n°6, n°7, n°8, n° 16, n°18, n°20). Finally, eco-design methodology aims to reinforce the productivity of firms. It that true?

## II.2 Implementing eco-design methodology for incremental change: « take collectively the shortest path »

Interviewees show the main role played by international standards (ISO 14001-9001) in order to question “every step of the process of production, even those that do not seem to need it , and even change the production process”. In spite of it, one plant manager admits that his team know exactly when evaluator will visit them and they have around 15 days for solving a challenge to succeed. Finally, adopting this standard might be a constraint *in situ*.

This classical situation hides one other reality. Basically Porter and van der Linde assert that preventive actions for preserving the environment is a relevant solution to the competitiveness for companies (1995a ; 1995b). Yet, we observe the existence of collective preventive actions in the sector of resilient flooring. Instead of managing their own resources, competitors are implementing various institutional devices for a European collective recycling system. These initiatives aim to provide an efficient system of resource distribution in a context of environmental controversies and of economic crisis : since the 2000s, all initiatives for eco-design is based on a “voluntary engagement” in European union and collective recycling systems exist in Europe (EPFLOOR project) and in France (SolPVCpro project). These innovative solutions aim to preserve no renewable resources (i.e crude oil) and reducing the price elasticity of crude oil demand while improving brand-building strategy. Institutional representatives manage these collective devices for eco-designing, such as the European Resilient Flooring Manufacturers’ Institute (ERFMI). Then, some companies can have schizophrenic responsibilities, since they could be a competitor while being a defender of the sector. Finally, we conclude that eco-design methodology are indeed followed by resilient flooring manufacturers, but all rules may be based on collective initiatives in order to preserving collective interests while increasing the level of production in a context of uncertainties.

### II.3 The life-cycle analysis of product, an useless compass?

Collective devices for life-cycle analysis of products are based on the ISO standard 14040 (Pluijmert *et al.*, 2008). Institutional representatives of resilient flooring manufacturers manage LCA by collecting shared information from European competitors. The goal is to provide an average of environmental impact assessment for saving money and improving environmental impact of resilient flooring (Nemuth *et al.*, 2006, p. 132; Pluijmert *et al.*, 2008). Basically, an average could hide individual environmental impact in order to avoid competition between companies while providing sufficient information for decision-making and getting a better legitimacy (Debref and Brulé-Gapihan, 2012 ; Debref, 2014). Even if collective declarations provide relevant information about the quality of products, our previous work emphasizes the fact that identifying the “best” product for a sustainable development required a systemic approach (Debref, 2014). Thus, LCA is unable to be clear for decision-making and to give a priority to the best technical pathway. In such a context of uncertainties companies keep their own strategies and protect the product identity. Indeed, on the one hand, manufacturers keep the identity of PVC product because its recycling and technical performance are good for the environment. On the other hand, Linoleum product, as biobased product, is considered as the most real green product which can be easily burned, based on renewable resources with good technical performance too. Since it is hard to compare, some interviewees are wondering if life-cycle analysis is useful, because no “one best way” exists (interview n°11), placing the cursor is hard (interview n°10) and there are free-riders being collective project. So, what are the relevancy of eco-design tools and collaborations? Moreover, as we show previously, there are misrepresentation of information (interview n°18). That is why a leader must make one other LCA with its own assumptions while using the European collective LCA. This inefficient situation contributes to the transition from original collaboration to classical competition. Thus, during the last four decades of environmental controversies and economic crisis, we observe that eco-design was useful for reinforcing historic companies of PVC while making a new legitimacy of environmental management.

### Conclusion

Nowadays, people considers eco-design such as a famous tools for driving a transition towards sustainable development. International standards (ISO), a high diversity of tools and of methodology help companies in order to promoting green innovation while reducing the

intervention of policy-maker in creativity process. That is why, we assumed that eco-design have to be analyze from a political economic perspective. We demonstrated that, behind a real stability of standards, a strong methodological dispute exists and eco-design is based on collective initiatives calling for the protection of social identities (groups, community).

Since the 2000s, the European sector of resilient flooring are more free for innovating then other sectors. This context is an opportunity for embedding environmental and economic crisis (i.e. rise of crude oil, subprime crisis). Mainstream economics assert that eco-design practices make new inventions in order to increasing the competition between companies. Yet our results show that collective strategies drive the process of transition towards sustainable development by gathered competitors under the single banner. Their initiatives are based on the management of collective recycling systems and life-cycle-analysis by representatives and competitors themselves. Nowadays, the uncertainties are less important than before, that is why the collective “spirit” is disappearing in favor of individualism.

Finally, we discover a paradox presented as follows. Instead of providing radical solution for sustainable development, creative freedom for eco-design was useful for protecting a controversial sector. This protection is due to the making of institutional device in order to drive eco-design practices based on historical identities. : eco-designing for no change exist.

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## APPENDIX

<b>Actor</b>	<b>Skills</b>	<b>#Interview</b>
<b>Chemical industry</b>		
Institutional representative	Chemist	5
Supplier	Chemist	7
Scientist	Chemist	6
<b>Resilient flooring industries</b>		
French institutional representative	Sector	8
Competitor and institutional representative	Environmental manager	9
	Institutional representative	
<b>Leader</b>		
R&D in top management	Research, market and environment	10
Eco-designer in top management	Research, chemistry and market	11
PVC product (Family 1) in various plants	Research in chemistry	12
	Environmental manager	13
	Plant-manager and market	14
	Engineer	15
PVC product (Family 2) in various plants	Plant-manager/market	2
	Environmental manager	1

<b>Actor</b>	<b>Skills</b>	<b>#Interview</b>
PVC product (Family 2) in various plants	Environmental manager	3
	Manager-plant/Market	4
Linoleum in various plants	Reasearch, chemistry	16
	Supply chain	17
	Plant-manager	18
Others		
PVC product (Family 1) and Linoleum in various plants	R&D Manager	19
	Environmental manager	20
	Environmental manager	21