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# Driving behavioural change towards ecodesign integration: Nudging experiment in industry

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## **Abstract**

This paper describes a research study conducted at Natura, a large Brazilian cosmetic company, in order to stimulate more systematic sustainable innovation practices by means of behavioural change. Within the “soft side” of ecodesign implementation, “nudging” is a novel approach brought from social sciences and policy making. An empirical experiment identified and tested employee motivations in combination with behavioural influences, in order to positively affect employees’ intention to practice ecodesign. This original experience of green nudging in a private company context supported the diffusion of the current ecodesign programme, which may contribute to turn change strategies more effectively in complex business and human organisational situations, where management styles evolve and rely on more autonomous individuals and teams. Further research and application on sustainable changes should systemically consider individuals’ engagement, including behavioural aspects, interaction with project teams and higher level business organisations.

## **1. Introduction: new explorations into ecodesign integration**

Although the evolution to more environmentally sustainable business operations has gained increased recognition in corporations and academia (Sterman, 2012, Lubin and Esty, 2010), companies still face various challenges when dealing with the effective implementation of ecodesign into their product development and related processes, towards an increased environmental performance, from an organisational to a personal perspective (Brones & Carvalho, 2014; Pigosso et al, 2013).

Despite the existence of relatively consolidated research on the technical and management aspects, the incorporation of ecodesign at the individual level is still in its early stages. The “soft side of ecodesign” has emerged as a research stream dealing with human aspects of integrating ecodesign (Boks 2006, Stevels 2007, Verhust & Boks 2012). Within this stream, besides organisational approaches, detailed individual and behavioural aspects that have not yet been fully developed (Szeler & Melberg, 2014).

The research presented in this paper is embedded in a Research and Development programme conducted since 2011 by Natura, one of the largest cosmetics manufacturers in Brazil. In collaboration with external specialists, this programme aims at a broader integration of ecodesign within the product development process (PDP), following a “bottom-up approach”, stimulating voluntary adoption. This paper details a research study to experimentally use new principles in order to leverage individual change, and in particular a wider adoption of new ecodesign tools and practices (Brones et al, 2013).

Section 2 presents the methodology used in the project, based on insights from a literature review. Section 3 exposes a summary of the main results of a field study, evaluating attitudes inside the company, related to ecodesign practice. The results of the experiments are discussed in Section 4, including final considerations for broader applications and future research.

## **2. From literature review to experimental methodologies**

The methodological approach was developed within the Action-Research (AR) perspective, within the second cycle of an ecodesign programme, held by Natura in collaboration with the University of São Paulo and the Technical University of Denmark. The general AR framework (Brones et al., 2013), is based on Lewin’s principles (1946), as a way of learning about organisations through trying to change them.

This article exposes a set of social experiments, conducted to explore the potential drivers of behavioural change associated with ecodesign integration into product development. The experimental work was preceded and based on a review of existing literature on change management issues and behavioural theory associated with ecodesign implementation.

### **Emergence and need for the “soft side of ecodesign”**

Whereas the (technical) principles of ecodesign were consolidated in the late 1990s, new insights on ecodesign management and organisation emerged in the same period.

Lenox & Ehrenfeld (1997) explored the “environmental design capabilities”, based on the capabilities literature and four case studies. Also from the US, in a pioneer “walk on the human side of industrial ecology”, Cohen-Rosenthal (2000) discussed “the centrality of human decision, imagination, skill, and process in effective industrial ecology applications”.

In an exploratory study on implementing eco-design principles in companies, McAlloone & Evans (1999) introduced the overall concept of an observed sequence of change and change management issues. Lofthouse (2003) proposed the Information-Inspiration source and process to promote ecodesign tools for industrial designers.

Charter & 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.

However, according to Stevels (2007), the concept of “Soft Side of EcoDesign” has been introduced more consistently by Boks (2006):

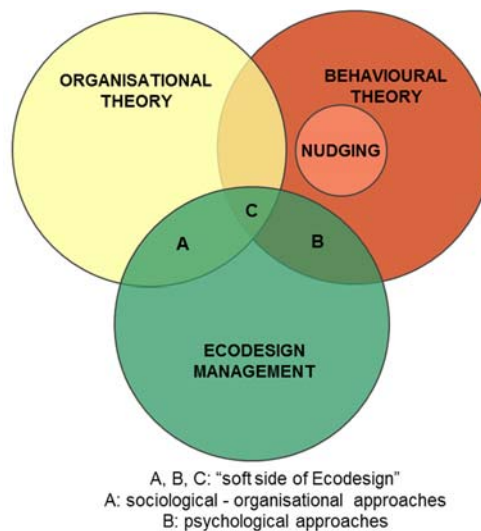
“The emergence of these relatively new topics in the ecodesign community is by some, in particular those with an engineering attitude and/or background, addressed as the soft side of ecodesign, referring to a variety of sociological, psychological and perhaps intangible factors that research should address as well” (Stevels, 2007, p.161).

Nevertheless, this trend has progressed relatively slowly. According to Zahari & Thurasamy (2012), firms are still ambiguous to embark on green product innovation, because they lack technical and human resources capabilities. Kerga et al. (2011) observed similar challenges. More broadly, human and organisational commitment is also decisive for the “greening of companies” (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; Fiksel, 2001; May et al., 2012; Stevels, 2007; Zhang et al., 2013). Complementary knowledge could be brought from social sciences on wider change management perspectives to give rise to a novel approach on ecodesign integration.

### Knowledge from change management and behavioural theories

A review of previous literature explored knowledge from social science, linking organisational and behavioural theories to ecodesign management, as represented in Figure 3.



**Figure 1:** Overview of change management approaches for ecodesign (adapted from Szeler & Melberg, 2014)

The review showed that the behavioural dimension (e.g. expectations, intuition and judgment, individual decision-making processes, biases, power conflicts) has been only scarcely studied for ecodesign integration, since the “soft side” stream has more focused on organisational issues (Szeler & Melberg, 2014).

Recent works have highlighted opportunities of using behavioural theory for policy-making, in order to encourage lifestyle change considering sustainability requirements. A new approach named “green nudges” has emerged.

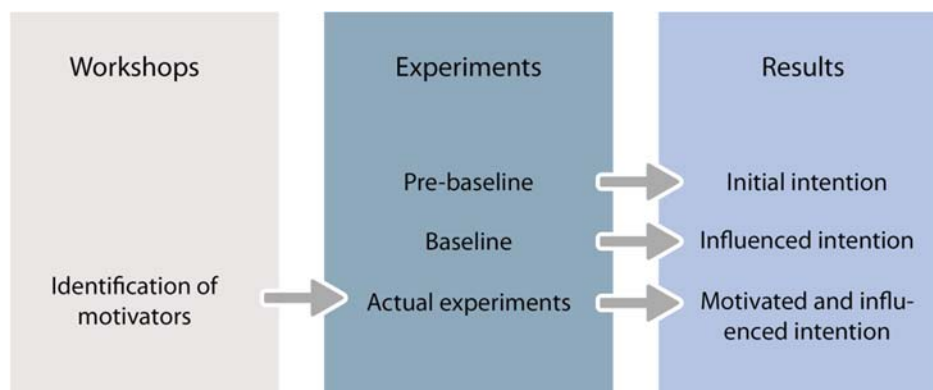
Nudging refers to new types of incentive strategies, capable of leading individuals to make choices in the collective interest, without being prescriptive or guilt-inducing (Thaler & Sunstein, 2008; Selinger & Whyte; 2010; Oullier et al., 2011). This approach makes use of shortcomings or “biases” in human decision-making or non-rational choices. A wide range of influences can affect decision-making and guide behaviour, but there is no formal guide on how to apply the influences and the execution.

No previous study has been found using nudging techniques to influence professional attitudes and choices in the direction of sustainable innovation. Such an approach of using behavioural knowledge, including green nudges, could be an original experience towards encouraging ecodesign integration at individual level.

### Experimental methodologies

The experimental motivational study was conceived to experiment new scientific inspiration to foster ecodesign integration within Natura Product Development teams.

In this work, the methodological approach was rooted in Design Research Methodology (Blessing & Chakrabarti, 2009). Figure 2 summarises the practical aspects of the empirical research phase. The field work was conducted at Natura’s headquarters in Cajamar, Brazil, in November 2013.



**Figure 2:** Nudging empirical research overview

In order to identify the most significant motivators for employees involved in the PDP at Natura, two workshops were facilitated, involving employees from different areas and completed with individual interviews.

Based on literature on behavioural change theory, experiments were designed, aimed at exploring the combined effect of behavioural influences and motivation on behavioural intention, to achieve a desired behaviour: “Practicing ecodesign, including the use of ecodesign tools”.

Two sets of experimental sessions were conducted, both initiated by a pre-baseline question, to establish a point of reference, as seen in figure 2. The baseline experimental session tested the isolated effect of four behavioural influences, while the actual experimental session tested the combined effect of behavioural influences and selected motivators.

The experimental sessions involved 27 employees (11 from product development and 16 from marketing) through individual interviews, including quantitative questions, where the intention to practice ecodesign was measured using a five-level Likert-scale, plus open-end questions. The data analysis comprehends qualitative and quantitative approaches.

### 3. Experimental results

#### Identified motivations

The workshops identified the motivating factors for practicing ecodesign at Natura, as indicated in Table 1.

**Table 1:** Summary of main motivations identified and ranked in the workshop sessions and interviews (by overall perceived importance)

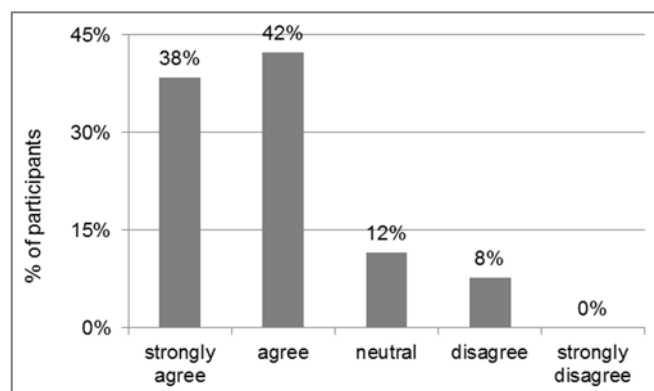
Identified motivations	Rank	Type
Add innovative quality to the products	1	Extrinsic
Visualization of the results of using Ecodesign	2	Extrinsic
I learned something new and increased my knowledge and skills	3	Intrinsic
Could increase brand value and image	4	Extrinsic
Natura had ambitious and clear goals within sustainability	5	Extrinsic
It adds a competitive advantage (like innovation, brand value etc.) to the end-product	6	Extrinsic
It will provide experience that will improve my CV	7	Extrinsic
It is aligned with Natura's business objectives	7	Extrinsic

Behavioural motivation can be extrinsic (engaging in a behaviour in order to obtain some goal that is apart from the behaviour itself) or intrinsic (engaging in a behaviour because of personal satisfaction and inherent interest in the activity itself). All but one of the identified motivations to practice ecodesign were extrinsically motivating, meaning that a personal interest in practicing ecodesign is not expected. More than half of the identified motivations related to the associated company benefits. The identified motivations and their origin give an important insight into what drives the employees in doing their work.

#### Results of the nudging experiments

The experimental interviews intended to test the effect of various behavioural influences and motivators on the behavioural intention to engage in the target behaviour (to practice ecodesign).

A first interesting result was the very high declared intention to practice ecodesign that was obtained in the pre-baseline phase, with 80% of the interviewed people, as can be seen in figure 3.



**Figure 3:** Distribution of pre-baseline scores on the five steps of the Likert scale (26 answers from Marketing and Product Development).

As for the experimental sessions, the design of the questionnaire and number of respondents led to very small cells for each combination of influences and motivators to be tested (two to five participants), which led to non-statistically conclusive results. For this reason, the results from the experimental sessions can only be used as an indication of tendencies for the behavioural change effect of the influences and identified motivators.

While the results are not statistically conclusive, in most instances the measured intention remains either unchanged or increased. Only a few individuals expressed a decrease in intention. Hence the potentially negative effects of conducting the experimental sessions in terms of employees' behavioural intention can be considered as relatively faint.

Four behavioural influences were tested during the experimental sessions: Messenger influence, Norm influence, Priming influence and Commitment influence. Table 2 summarises the observed tendencies.

**Table 2:** Summary of collective tendencies of the nudging experiments

Influences	Tendencies
<p><b>Messenger</b> 3 potential sponsors for the ecodesign tools from the top management were proposed for each public (director, innovation VP or business VP).</p>	<ul style="list-style-type: none"> <li>• Highest influences among the four tested influences.</li> <li>• A strong connection between employees and their directors is crucial.</li> <li>• Combining the messenger influence with motivation had only limited effect.</li> <li>• Adding motivation had the greatest effect on employees from marketing.</li> </ul>
<p><b>Norm</b> The participants were informed that a survey had been performed at Natura, showing that 86% of development teams intended to practice ecodesign.</p>	<ul style="list-style-type: none"> <li>• Limited effect.</li> <li>• Combining the norm influence with motivation double the effect compared to using the influence on its own.</li> <li>• Adding motivation had the greatest effect on employees from marketing.</li> </ul>
<p><b>Priming</b> Several potential motivating arguments were proposed (selected from the previous workshops, for both publics).</p>	<ul style="list-style-type: none"> <li>• Limited effect.</li> <li>• The only motivation that was successfully primed, and showed an increased connection to the practice of ecodesign was: "Adds competitive advantage to the end-product".</li> </ul>
<p><b>Commitment</b> Participants were told that information about ecodesign would be sent to them by e-mail as a follow-up on the interview. Their intention, if positive, was then captured by having them tick a box on their hand-out material.</p>	<ul style="list-style-type: none"> <li>• No effect on its own.</li> <li>• Combining the commitment influence with priming increased the effect, for product developers.</li> <li>• The motivation with the strongest effect was: "adds innovative quality to the end-product".</li> </ul>

Also, it was observed that the participants' comprehension of ecodesign was fair and they also stated the relevance of ecodesign for Natura: "It is very important, it fits with Natura's strategy to lower CO<sub>2</sub> emissions and water footprint" and "Environment and Natura fit together. Ecodesign is a good tool." (Product developers). Participants from marketing stated: "Natura wants better products with less CO<sub>2</sub> emissions, more eco-friendly products" and "It is very important to Natura. The business unit directors and the product committee value sustainable products."

However, the overall knowledge about ecodesign and the new ecodesign tools proved to be partial, as illustrated by the following statements: "I would like more knowledge on ecodesign. I intend to practice ecodesign, but cannot really tell as I do not know how it will affect my work" and "I need a better understanding and knowledge of the ecodesign tools". One of the participants from Marketing provided the following elaboration on the pre-baseline question: "It is very easy for marketing people to agree with the intention to practice ecodesign and use the tools as it won't affect our work". Several interviewees from marketing presumed that ecodesign tools would be mainly used by product developers, just as the Carbon Calculator is. This comment confirms a lack of knowledge about the new tools to be used in the early stages of the PDP by multifunctional teams.

The interviewees' true intention for practicing ecodesign is difficult to assume. Most participants expressed that practicing ecodesign was important for Natura, both in regard to competitive advantage and the environment, which might suggest that the intention they stated related more to the importance for Natura, rather than their actual individual intention.

## 4. Discussion and conclusions

The experiences described highlighted new kinds of challenges for implementing ecodesign in a real life organisational context and brought additional insights. This is one of the first reported experiences of green nudging in a professional company context to promote more sustainable innovation practices, as a promising change strategy.

The nudging experiments revealed a somehow paradoxical situation, where a large majority of people involved in product development declared a very high intention to practice ecodesign but seemed to have a relatively superficial knowledge of the concept and not to be connected with the new tools developed within the last years.

This situation, coupled with challenges faced in the application of a complex questionnaire design, led to non-statistically conclusive results. Such risk was assumed by the research team, knowing that this experience on nudging was quite new, with high uncertainty on the applicability of experience patterns, particularly in a company context.

Another limitation was the use of the declared intention (to practice ecodesign) as a “behaviour” in the experiments, due to the difficulty to observe such a complex behaviour more effectively.

In future research, the questionnaire design should be improved, considering the sample size and number of factors to be tested, as well as the definition of observed behaviour.

Nevertheless, such exploratory research brought a series of new insights that have been applied to reinforce ecodesign dissemination at Natura.

The observed paradox led to Natura question the chosen bottom-up approach for integrating ecodesign, and to consider the necessity of a more directive top-down support, as commonly recommended (ISO 14062, 2002; ISO 14006, 2011). It was also noticed that Marketing leaders, who have a key role in the current innovation projects, particularly in the early phases, are being evaluated based on many parameters, but the use of ecodesign is not one of them.

Hence, one of the actions that emerged stands in seeking for stronger endorsement from top management, both in the Innovation Department and in the Business Units (marketing teams). The results of the nudging experiments have been used in such debate with innovation management teams.

Besides the continuation of collective motivation and initiations to ecodesign principles, it appeared as necessary to more clearly formalise the recommended use of ecodesign tools in the formal PDP guidelines. However, in continuity with the previous strategy, the new practices and tools are still presented as recommended and not compulsory.

This relatively indulgent form of promoting the evolution of the working process may be surprising, depending on the cultural company context. In the case of Natura, it sounds adequate since the proliferation of formal procedures and norms tends to produce more rejection than adhesion.

It is worth relating this perception to observations from new business change management strategies, as proposed by Groysberg & Slind (2012):

“The command-and-control approach to management has in recent years become less and less viable. Globalisation, new technologies, and changes in how companies create value and interact with customers have sharply reduced the efficacy of a purely directive, top-down model of leadership.”

“As companies have become flatter and less hierarchical, and frontline employees more pivotally involved in value creating work, lateral and bottom-up communication has achieved the importance of top-down communication.”

Another potential effective concept that emerged from the nudging experiment and behavioural background was to look at the company organisation from a different perspective, considering each target group (marketing leaders, product development, internal and external designers groups etc.) with the following question: through whom and how could this group be positively *influenced* to adopt new ecodesign practices?

A new action plan was designed with this new mind-set, acknowledging the way Groysberg & Slind, (2012) observed how leaders now tend to relate to working communities: “*Employees engage in a bottom-up exchange of ideas*”. This plan includes several channels to reach and engage the target groups of marketing and product development, involving intermediary management and giving priority to direct contacts and participative flexible interactions, which must be compatible with each group’s priorities and busy agendas. It includes different media such as e-learning, diffusion of video material, face to face and group meetings.

Such research, bringing knowledge from social science, tries to consider the real complexity of business and human organisations, and evolving management styles that nowadays give more space



to individual and team autonomy, versus directive processes. Nudges and associated strategies can be a response to modern society's shift towards a focus on individuals, who are no longer passive to central authority.

The diverse specific organisational contexts will certainly modulate how such observations and strategies may apply to different companies, sectors and countries, considering their own cultures. In this sense, this study is limited by the single company context, acknowledging that it is the condition to access a business organisation from inside and to have the possibility to really experiment new solutions.

However, a tendency toward "softer" change management approaches seems to be a strong trend, that can adapt to different contexts and that appears quite meaningful for the purpose of more sustainable organisations. As Ehrenfeld argued (2008), the sustainability challenge for business is to adopt a new set of values and beliefs, which has to face inherent firms' conservative cultural system.

Future research should further explore the possibilities of including behavioural aspects during an organisational change process, considering the involvement of the individual and its complex and systemic interaction with the projects teams and higher level business organisations.

## References

- Blessing, L. & Chakrabarti, A., 2009. DRM, a design research methodology. n.p.: Springer
- Boks, C., 2006. The soft side of ecodesign. *Journal of Cleaner Production*, v.14, (15-16), pp.1346-1356.
- Brones, F.A.; Carvalho, M.M.; Guelere Filho, A., 2013. Bringing Ecodesign to the front stage of innovation: linking action and research at Natura Brazil. *Proceedings of Sustainable Innovation 2013, 18th International conference, University for the Creative Arts, Epsom, UK. November 4 - 5.*
- Brones, F. & Carvalho, M.M., 2014. From 50 to 1: Integrating literature toward a systemic ecodesign model. *Journal of Cleaner Production*, Available online 8 August 2014. DOI: 10.1016/j.jclepro.2014.07.036
- Charter, M. & Tischner, U. *Sustainable Solutions: Developing Products and Services for the Future.* Sheffield, UK: Greenleaf Publishing, 2001.
- Cohen-Rosenthal, E., 2000. A walk on the human side of industrial ecology. *American Behavior Scientist*, v.44, (2), pp.245-264.
- Ehrenfeld, J. 2008. *Sustainability by Design: A Subversive Strategy for Transforming our Consumer Culture.* New Haven: Yale University Press.
- Fiksel, J., 2001. Measuring Sustainability in ecodesign. In: Charter, M., Tischner, U., 2001. *Sustainable solutions, developing products and services for the future*, Greenleaf Publishing, Sheffield.
- Groysberg, B. & Slind, M., 2012. Leadership is a conversation, *Harvard Business Review* v. 90 (6), pp. 76-84.
- ISO 14006, 2011. *Environmental management systems - Guidelines for incorporating ecodesign*, Geneva.
- ISO/TR 14062, 2002. *Environmental management - integrating environmental aspects into product design and development.*
- Jabbour, C.J.C.; Santos, F.C.A.; Fonseca, S.A.; Nagano, M.S., 2013. Green teams: understanding their roles in the environmental management of companies located in Brazil. *Journal of Cleaner Production*, v.46, pp.58-66.
- Kerga, E., Taisch, M., May, G., Terzi, S., 2011. Integration of Sustainability in NPD Process: Italian Experiences. In: *The IFIP WG5.18th International Conference on Product Lifecycle Management*, Eindhoven, Netherlands, pp.117-126.
- Lenox, M. & Ehrenfeld, J., 1997. Organizing for effective environmental design, business strategy and the environment, v. 6, (4), pp.187–196.
- Lofthouse, V., 2003. Designing for designers-ecodesign tools to inform and inspire. *Electronics and the Environment, IEEE International Symposium*, pp.377-382.
- Lewin, K. 1946, "Action Research and Minority Problems", *Journal of Social Issues* 2(4), pp. 34–46.
- Lubin, D.A. & Esty, D.C, 2010. The sustainability imperative. *Harvard Business Review*, v.88, (5), pp.42–50.

- May, G.; Taisch, M.; Kerga, E. 2012 Assessment of Sustainable Practices in New Product Development, *Advances in Production Management Systems*. IFIP Advances in Information and Communication Technology, vol. 384, pp.437-447.
- McAloone, T.C. & Evans, S. Using empirical data to build an advisory tool for eco-design Environmentally Conscious Design and Inverse Manufacturing, 1999. Proceedings. EcoDesign '99, 1999.
- Oullier, O.; Sauneron, S., 2011.Green nudges: new incentives for ecological behaviour. Department of Social affairs, Centre d'analyse stratégique, Note d'analyse n°216, pp.1-11.
- Pigosso, D.C. A.; Rozenfeld, H.; McAloone, T. C., 2013. Ecodesign maturity model: a management framework to support ecodesign implementation into manufacturing companies. *Journal of Cleaner Production*, v.59, pp.160-173.
- Selinger, E. & Whyte, K. P. 2010. "Competence and Trust in Choice Architecture." *Knowledge, Technology and Policy*, vol. 23, no. 3, pp.461-482
- Sterman, J. D., 2012. Sustaining sustainability: creating a systems science in a fragmented academy and polarized world. In m. Weinstein and R.E. Turner (eds), *sustainability science: the emerging paradigm and the urban environment*. Springer, pp.21-58.
- Stevens, A. L. N., 2007. *Adventures in ecodesign of electronic products - 1993-2007*. Delft university of technology, the Netherlands.
- Szeler, A.C. & Melberg, M. G., 2014. Encouraging voluntary practice of ecodesign in product development at natura. Master thesis, Technical University of Denmark, Department of Mechanical Engineering.
- Thaler, H. R. & Sunstein, C.R., 2008. 2nd ed. *Nudge: Improving decisions about health, wealth and happiness*. New York: Penguin Group.
- Verhulst, E. & Boks, C., 2012. Bringing about Sustainable Change in Product Development: Theory versus Practice. *Advances in Production Management Systems*. Value Networks: Innovation, Technologies, and Management, IFIP Advances in Information and Communication Technology, v.384, pp.448-457.
- Zahari, F. & Thurasamy, R., 2012. Linking green product innovation, technological and human resource capabilities: A conceptual model. *Innovation Management and Technology Research (ICIMTR, 2012)*, International Conference on, 21-22 May, 2012.
- Zhang, F.; Rio, M.; Allais, R.; Zwolinski P.; Reyes Carrillo T.; Roucoules L.; Mercier-Laurent E. ; Buclet N., 2013. Toward an systemic navigation framework to integrate sustainable development into the company. *Journal of Cleaner Production*, v. 54 (1), pp.199–214.

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