# How to lead a sustainability transition at the company level? An approach based on management tools performativity

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**Abstract**

Research on sustainability transitions has generally focused on socio-technical systems, but less on organizations and firms. However, the decisions of actors within companies are based on performance indicators, roadmaps, dashboards, etc., all sorts of management tools that embody their decision-making routines and contribute to maintaining the regimes in place. Our research links the literature on sustainability transitions with that of management instrument approaches in management science, by analyzing the conditions under which management instruments can contribute to impulse a sustainability transition at a company level. We use the concept of performativity to describe the ability of these artifacts to change the reality they point to. Indeed, through the design of a simplified LCA tool and an internal carbon pricing tool within a car manufacturer in the frame of a research-intervention, we have found that these conditions require the construction of the tools legitimacy with their users, but also the mobilization of windows of opportunity in a storytelling and sensemaking process. Finally, we propose a typical organization-wide model of sustainability transition inspired by the multilevel perspective framework. Our work thus contributes to the Sub-theme 54 of the 36th EGOS colloquium: Bridging Systems and Organizational Perspectives to Tackle Grand Challenges.

**Keywords:** management instruments, performativity, sustainability transition, multi-level perspective

## Introduction

Today, the link between human activities and climate change is becoming increasingly clear. Human-induced warming reached approximately 1°C above preindustrial levels in 2017, and is increasing by 0.2 °C per decade (ICCP, 2018). According to the International Climate Change Panel, a global warming exceeding 1.5°C − which could be achieved between 2030 and 2050 if no changes are made − will greatly and durably increase the risks for natural and human systems, through a series of irreversible consequences, such as the loss of entire ecosystems. Besides, these experts say that in order not to exceed the remaining "carbon budget", CO2 emissions must become carbon neutral in about 30 years.

This objective has been put on the European political agenda through the Green New Deal: a roadmap for making Europe carbon neutral by 2050 (European Commission, 2019). It includes targets in terms of clean energy, circular economy, sustainable mobility, biodiversity preservation, and equity. This illustrates the willingness to go through fundamental changes in several sectors. Indeed, achieving the Green New Deal objectives requires profound, systemic and long-term changes, which is the subject of increasing attention in the academic world and is referred to as a sustainability transition (Geels, 2010).

One of the purposes of transition studies is analyzing transition processes, in big socio-technical systems such as transport, building or energy, to more sustainable modes of production and consumption. They point out the existence of strong path-dependences and lock-in mechanisms that reinforce the systems in place and make these transformations difficult. Moreover, they highlight the multidimensional nature of these locks (technical, political, cultural, social, etc.), which leads incumbent actors to innovate incrementally rather than radically (Markard and al., 2012). However, because these studies have often focused on mesoscale systemic phenomena, they have only recently begun to look at organizations. Indeed, the latter are most often represented as homogeneous black boxes, and analyzed in terms of the struggle between incumbents and newcomers at a sector level, but also in terms of capacity for technological innovation, and contribution to facilitating institutional change (Köhler and al., 2019). Yet, companies are composed of groups of actors with different motivations, backgrounds and frames of reference, whose behaviors are governed by routines that amplify their cognitive biases, particularly in large established companies. Some of these routines are embodied in decision-making tools − also called management tools or management instruments−, which refers to a large literature in management science (Chiapello & Gilbert, 2019; Hatchuel & Weil, 1995; Labatut and al., 2012).

In fact, many scholars in management science consider management tools to be a relevant entry point for studying organized action. Some of them define management tools as all the knowledge and artefacts that participate in the three management acts: plan, decide, and control (Aggeri & Labatut,

2011). The interest of scholars for management tools stems from the diffusion of a multitude of instruments within organizations from the 1960s onwards, and the finding that these often lead to unintended results (Chiapello & Gilbert, 2019; Labatut and al., 2012; Miller & O'Leary, 2007). In the field of environmental management, the role of instruments is central because of the importance of impact assessment in this area. However, these environmental management instruments are most often studied as calculation and measurement methodologies, rather than supports for collective action. Indeed, few studies address the appropriateness of these tools in organizations. They are rather analyzed from an engineering perspective, with an underlying assumption of instrumental rationality according to which an instrument is inherently performative because of its scientific validity (Frankl & Rubik, 1999). Though many companies are developing tools related to the environment, without this having an impact on their decision-making. Faced with this observation, one can question the conditions under which environmental management tools act as transformation instruments towards a more sustainable decision paradigm in an organization. Hence the following research question: how can the design and the deployment of a management instrumentation can contribute to impulse a sustainability transition in a company? To address this question, we mobilize the concept of performativity, which is define as the ability of an utterance to change the social reality it is describing (Austin, 1962). This well-known social science concept has been used − among other things − as a framework for language analysis. More recently, Callon has proposed the concept of performation to capture the process by which theories change the reality they are supposed to describe by means of socio-technical agencements (Callon, 2006). This analysis of performation processes has been recently extended and used in organizational contexts to capture how managerial or theoretical discourses transform practices (Aggeri, 2017; Garud and al., 2017; Gond and al., 2016). In our study, we put special emphasis on management instruments which play a key role in these performation processes. More precisely, we will analyze through which processes and experiments, environmental tools are transformed into managerial mediating instruments that are aimed at performing a sustainability transition in a company.

For that purpose, we analyzed the case of an established automobile manufacturer in which we conducted research for more than two years. Indeed, road transport is responsible for almost 72 % of the total GHG emissions of the transport sector in Europe (EEA, 2019). These emissions come mainly from the combustion of fuel for internal combustion vehicles. For this reason, emissions from on-road vehicles are subject to numerous regulations in Europe, which has led car manufacturers to focus on reducing CO2 emissions during the use phase of vehicles (at least in theory). This induces a transfer of pollution to the upstream phases of the life cycle of vehicles, particularly the materials production phase. This is notably the case of the electric vehicle, as shown by the Figure 1.

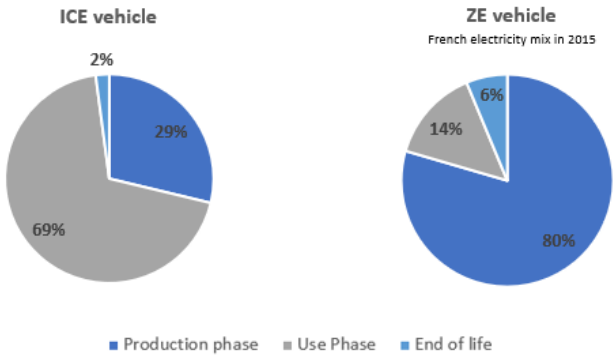



*Figure 1: typical distribution of a vehicle's GHG emissions over its life cycle stages. Source: company-internal Life Cycle Assessment calculations*

Therefore, the subject of our work in the field is the integration of environmental criteria with a life cycle perspective into a French car manufacturer's decision process, using management instruments. Based on the design and the deployment of a simplified Life Cycle Assessment (LCA) tool and an internal carbon pricing tool in the Engineering Department and the Purchasing Department of the company respectively, we analyze the conditions in which these instruments may become performative and how they may contribute to transform management practices. We assume that changing decision tools can transform routines, and potentially help drive a sustainability transition, under certain conditions. Furthermore, we also interviewed a set of companies (9 organizations) about the conditions under which a sustainability transition occurs in a company, particularly in regard to management instruments.

This paper is organized as follows. In the first section, we discuss in more detail the fields of literature we have invoked as well as the theoretical framework we have mobilized to address the research question. We then describe our research methodology and the fields settings in the third section, which is followed by the results section. To conclude, we discuss the outcomes of our study by putting them into perspective with transition studies − in particular the multilevel perspective (Geels, 2011) −, and present some research perspectives.

## 1. Theoretical orientation

### 1.1. Sustainability transitions and the multilevel perspective

Emerging in the 2000s, research on sustainability transitions aims to conceptualize and model transition processes in large sociotechnical systems. This emerging field of research is characterized by several features, notably the recognition that transitions are non-linear processes that involve several actors at several levels. One of the most important conceptual frameworks that helped better understand the dynamics of sociotechnical transitions is that of the Multilevel perspective or MLP (Geels, 2004). This theoretical framework highlights the importance of three levels of analysis (Figure 2):

(i) niches, which are protected spaces where actors work on experimental and demonstration projects that deviate from existing regimes.

(ii) sociotechnical regimes, which are the structural rules that coordinate and guide actors' perceptions and decisions and that tend to be maintained and reproduced.

(iii) landscape, which is the wider context that influence regimes and niches that includes political ideologies, social values, infrastructures, etc.

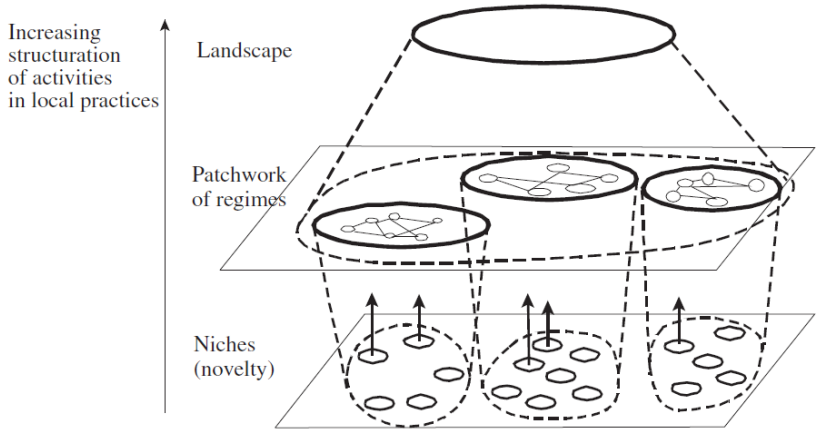



*Figure 2: multilevel perspective. Source: Geels, 2004*

These different levels are then mobilized to build a representation of an ideal-typical sustainability transition, the first step of which is the development of niche innovations that build up internal momentum (Geels, 2004). It is then through changes at the landscape level that pressure is exerted on the regime in place, which has the effect of destabilizing it and creating windows of opportunity for these niche innovations to develop (Figure 3).

Moreover, because it emphasizes the systemic nature of socio-technical transitions at the system level, the MLP has been criticized for its weak conceptualization of actors and agency (Farla and al., 2012). More generally, because transition studies take a system perspective, they often focus on a meso level of analysis (Köhler and al., 2019). Indeed, the main debates are neither at the macro level, where more global issues such as the capitalist system are discussed, nor at the micro level, where analyses at the individual level are carried out. In fact, assuming that a transition occurs in a socio-technical system means that transformations have taken place at different levels, especially at the level of businesses that are major components of production systems. Yet little attention has been paid to what is taking place in businesses from an organizational point of view, when it comes to contributing to the momentum for a sustainability transition. Hence the interest in creating bridges between sustainability transitions researches and organizational studies.

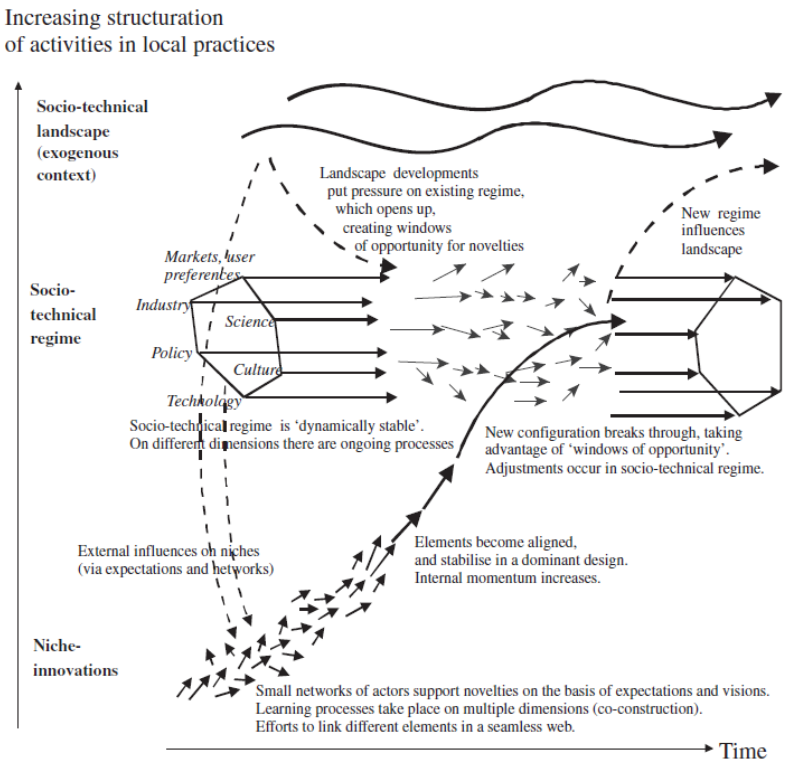



*Figure 3: Multi-level perspective on transitions. Source: Geels, 2004*

### 1.2. Management instrument approaches and the environment

Instrument-based approaches in management science suggest studying organized action through the prism of management instruments designed to this end (Chiapello & Gilbert, 2019; Hatchuel & Weil, 1995; Labatut and al., 2012). This focus on instruments rather than discourses and intentions is motivated by a critical approach to instrumental rationality. Indeed, in a paradigm of instrumental rationality, management instruments are perceived as reflecting the intention of the actors, having intrinsic effectiveness, the aim would therefore be to design optimal tools to achieve the desired effects. Instrument-based approaches take the opposite view, demonstrating that these tools are not axiologically neutral, but have often unexpected effects on collective action (Berry, 1983; Chiapello & Gilbert, 2019). Indeed, the first studies about management tools initially focused on analyzing the stability of organizational behaviors to explain these unintended effects. But the way management tools are analyzed evolved progressively from the 1980s, moving from tools for conformation to tools for the exploration of reality (Moisdon & Hatchuel, 1997), then to tools to drive change (Bouyssou and al., 2012).

In the field of environmental management, although there has been a massive deployment of environmental assessment tools within organizations, these have generally been analyzed from an engineering perspective that deals with the technical substrate of tools (Reap and al., 2008; Scipioni and al., 2012), or environmental accounting perspective that provides a descriptive classification of

these tools (Ness and al., 2007; Singh and al., 2009). In both cases, the users of the tools, the way they interact with and through these tools, but also the knowledge at stake, are blind spots.

In addition to environmental assessment tools, whose results are generally expressed in physical units, there are also tools for monetary valuation of environmental impacts. The idea of assigning a monetary value to externalities stems from the neoclassical ideology that externalities are due to market failures, which can be corrected by "internalizing" these externalities. This practice is criticized by ecological economists because it is founded on neoclassical economic concepts based on the rationality of actors, the substitutability of goods, the reversibility of environmental consequences, within the framework of a weak sustainability (Hediger, 2006). But for the proponents of what Spash called the "new environmental pragmatism" (Spash, 2009), the ecological crisis brings such urgency that it is no longer time to question the founding concepts and tools of economics, but rather to mobilize them in order to facilitate the understanding of decision-makers thanks to the language they are familiar with: the language of money. This theory of action based on the comprehension of environmental impacts through the financial language is today promoted and diffused in the private sector by many institutions such as the Natural Capital Coalition or the World Bank, but also consulting firms and associations. Few studies focus on the design and deployment of these tools within companies, as well as their impact on decision-making processes.

### 1.3. Performativity and organizational studies

Introduced by the philosopher and linguist John Austin in 1962 in his book *How to do things with Words*, the concept of performativity has been interpreted and mobilized by the social sciences in various ways. This concept points to the fact that certain deliberate statements can change reality and the practices they refer to (Austin, 1962).

Originally, Austin's work focused on linguistics and language acts, but his ideas have been expanded from their original scope and applied to new contexts and objects such as philosophy of science, gender studies and sociology (Gond and al., 2016). The influence of the philosopher's work is such that it led social science scholars to adopt a more pragmatic orientation, by analyzing the situated micro-practices that shape reality, rather than prioritizing the coherence of their work from an epistemological and theoretical point of view (Aggeri, 2017). This turning point was therefore accompanied by a specific analysis of situated practices, where performation processes succeed or fail through the intervention of actors.

While the performativity of language acts is the subject of numerous researches, this is less the case for other elementary acts such as writing acts and calculation acts (Aggeri, 2017) . Indeed, if the link with the study of organizations is to be made, it becomes clear that the elementary acts that occur within organizations are indeed not limited to acts of language. The study of these acts in a management situation allows to highlight the conditions of performativity of these acts, and how a

management strategy can succeed or fail. Moreover, discussions in a management situation are mediated by multiple kinds of instruments (Miller & O'Leary, 2007). Indeed, the latter create a bridge between acts of language, acts of calculation and acts of writing (Martineau, 2017). In Austin's work, conditions of performativity are not to be constructed but are considered as given. However, it is precisely the production of the conditions of performativity of management instruments in organizations that is of interest in management sciences.

Knowing the background briefly described in this section, our study contributes to these different fields of literature in the following way. Through field research, we analyze the conditions under which intentional interventions of actors in an established firm are performative. The intentions in question are focused on improving the integration of the environment into the company's decision-making processes. Moreover, they are mediated by management instruments designed for this purpose (in this case simplified LCA and internal carbon pricing). We also use the MLP theoretical framework to analyze this process of transformation of decision-making tools and thus contribute to clarify the transition mechanisms at the enterprise level.

## 2. Research design

Because of our theoretical orientation, the research methodology we adopted is that of comprehensive research (Dumez, 2016). Indeed, it is part of a constructivist epistemological framework in which reality doesn't preexist but is a social construction. In this paradigm, the distance between the researcher and his or her object of study for the sake of objectivity is not a criterion of scientific validity. The researcher rather seeks to analyze the production of meaning by the different actors that takes place in the field. This requires proximity to the organization being studied. Indeed, the way in which a management tool acts as a support for collective action during its design and deployment cannot be analyzed solely based on elements that are visible in the company's external reports or communications. On the contrary, this requires the immersion of the researcher in the firm, its teams and their micro practices. From a methodological point of view, this approach is in line with the intervention-research methodology (David & Hatchuel, 2014), which aims to help design adequate management instruments based on a concrete project of transformation.

Our research is thus based on qualitative data collected through participant observation in working meetings conducted from December 2019 to June 2020 (more than 56 meetings in total, see Appendix p.27 ), but also the analysis of secondary sources such as presentation materials and internal emails. For confidentiality issues, recordings were not possible during internal company meetings, the conclusions are therefore based on notes taken during these discussions. Our study also has a quantitative dimension, due to our participation in the design of the technical substrate of tools. Indeed, our work as researchers consisted both in constructing management tools, but also in having a reflexive vision on our discussions with different actors regarding the conditions that seem necessary

for these tools to be considered in the decision-making process. The Figure 4 illustrates the general structure of the research.

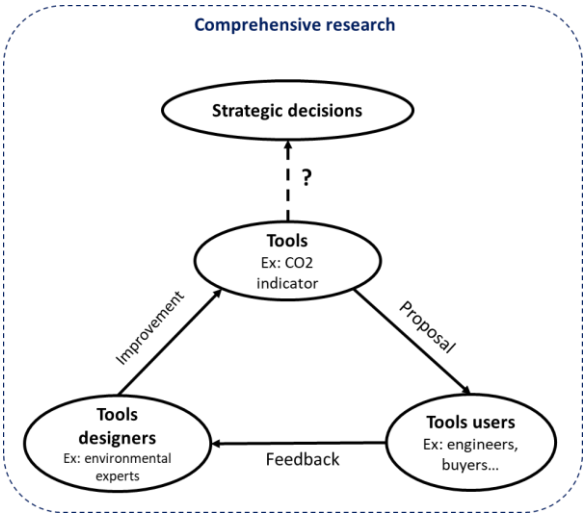



*Figure 4: organization of the research-intervention*

Furthermore, we supplemented this research material with semi-structured interviews conducted with 12 organizations between June 2018 and February 2019: among them 8 large multinational companies, 3 consultancy firms and the Natural Capital Coalition. Discussions included the conditions under which a sustainability transition can be steered in a company, and the role of management tools in this process (see Appendix p.28).

### 3. Fields settings

Our work is part of a transformation plan that aimed at better integrating the environmental and social impact of materials into a car manufacturer's technical choices. Indeed, only indicators related to CO2 emissions during the use phase of vehicles are translated into KPIs during vehicle development projects in the company. The calculation of the environmental footprint over the entire life cycle of a vehicle (which is done through LCA methodology) is used as a retrospective tool to make an assessment once the vehicle is produced, but that does not influence neither upstream technical choices, nor procurement decisions.

To support this transformation, an action plan has been proposed in the company, one of the axes of which is the improvement of the company's tooling regarding materials sustainability, but also its articulation with the procedures in place. To ensure that this tooling is deployed at relevant levels, we first analyzed the decision-making processes affecting the use of materials and the key players in the company. Indeed, the technical specifications (and thus the material content) of parts that are implemented in vehicles depend on the input of several actors. These contributions can be summarized as follows: (i) product managers translate customers' expectations in terms of functional specificities, (ii) vehicle parts experts determine the technical characteristics of these parts in order to

comply with the proposed specifications, (iii) innovation project managers propose some innovative technologies that may be implemented in vehicles in addition to innovations proposed by suppliers, and (iv) buyers select final suppliers. As shown by the Figure 5, too far upstream in this process (at the innovation phase), the material content of the parts is not yet known. Too far downstream, the technical choices have already been made. Based on this observation, we have determined the following priority areas of work. Indeed, we have identified the actors for whom the design and deployment of an instrumentation for a purpose of performativity would have *a priori* the greatest impact on the use of materials and the final environmental footprint of products. The first category of actors is that of vehicle part experts, who are part of the company's engineering department, and with whom we worked on the simplified LCA tool described in section 3.1. The second category of actors is that of buyers in the company's purchasing department, through internal carbon pricing (section 3.2). In what follows, we describe and analyze these two different experiments in order to derive elements of answers to the research question mentioned above.

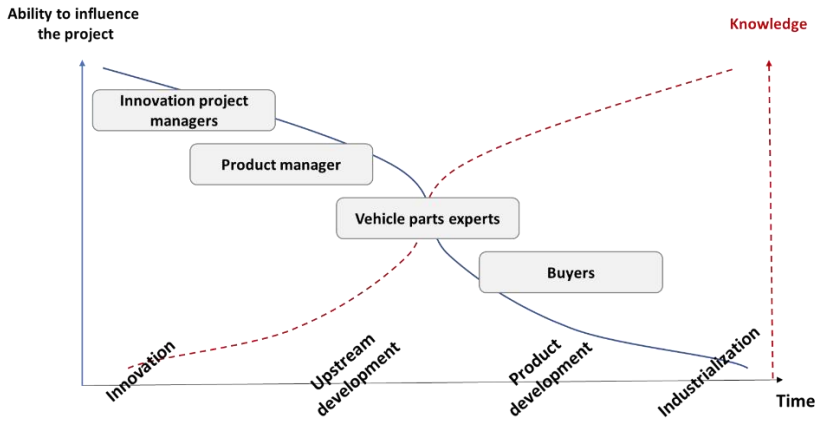



*Figure 5: stages of the vehicle projects and contribution of different actors. Adapted from (Midler, 1995)*

### 3.1. How can an impact assessment tool act as a business transformation tool? Case of simplified LCA as a decision criterion in vehicle projects

Life cycle assessment (LCA) is an approach to estimate the environmental impacts of a product, a process or a service throughout its whole life cycle: from the extraction of raw materials to the end of life. Although there are still debates about the subjective nature of certain methodological choices, this approach is among the most widespread and consensual in the field of environmental assessment (Finnveden and al., 2009). Moreover, it is framed by the standards ISO 14040 and ISO 14044. Indeed, this method provides a global, quantitative and as exhaustive as possible view of the object of the analysis, through a multitude of indicators related to pollution as well as resource consumption. Depending on the method used, an LCA can produce several dozen indicators corresponding to several categories of environmental impacts (water acidification, global warming, water eutrophication, etc.).

However, this exhaustiveness has a price. In addition to requiring a large amount of primary data − that often needs to be supplemented by secondary data − these analyses are time-consuming. In companies, this difference in time between LCA calculations and operational decisions, in addition to the expertise required to use the tool and understand its outcomes, makes it difficult for the field actors to appropriate LCA results and take them into account in decisions. This is what we have observed in the company in which we are conducting our research. We therefore chose to develop a simplified LCA tool for vehicle parts experts in order to improve the integration of the environmental footprint in upstream phases of vehicle development projects.

***Simplification as a means of improving appropriateness of LCA***

Based on the resources offered by the company's LCA software in terms of data, but also our knowledge about material content of an average vehicle, our approach has been to build a simple model to calculate the CO2 emissions of a vehicle part, with little input data. To obtain a result using this tool, the user only needs to enter the type and mass of the materials that compose the part in question, as well as a few other parameters such as the country of production. It allows then to compare between different alternatives for a given part (see Figure 6).

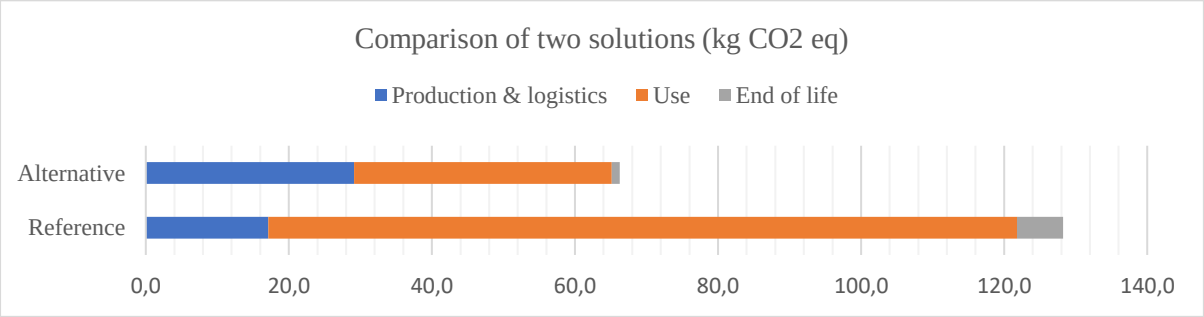



*Figure 6: example of simplified LCA results*

The simplification compared to traditional LCA takes place at different levels: (i) the calculation medium is more accessible than LCA software, (ii) the initial assumptions are fixed, (iii) the number of indicators into results is reduced, and (iv) the materials-processes list is reduced.

After the design phase, 3 series of trainings with about 15 participants were organized. The first part of trainings consisted in a presentation of the simplified LCA tool, its methodology and settings, and an illustration through an example to show how it works. The second part of the trainings aimed to collect parts experts' feedbacks and proposals regarding the tool.

### *3.1.1. Confrontation between designers' and users' visions*

Our exchanges allowed us to compare our vision (the designers of the tool) with that of the experts (the users of the tool). We collected their feedback on the simplified model, its representativeness of

the technical reality in their respective perimeters, as well as on the data used. This allowed us to identify important parameters according to them, both on a technical and operational level.

As illustrated by the Table 1, it appeared that there was a divergence between the environmental assessment (in particular the simplified LCA tool) and the technical and managerial requirements of the vehicle parts experts. The latter seem to expect the tool to fully reflect the technical reality in all its complexity, whereas environmental assessment involves a process of prioritization according to available resources. For example, the tool does not capture subtleties such as steel grades or coating types. As its aim is to compare – among others – several possible materials for a vehicle part, it also assumes a certain degree of material substitutability, whereas experts know that a change of material can induce a whole series of changes.

Moreover, these discussions also enabled us to identify certain cognitive biases among experts, particularly in relation to the importance of the impact of logistics on CO2 emissions of parts. Indeed, according the them, a long transport distance implies high CO2 emissions. LCA calculations show that this impact is often low, because a large number of vehicle parts are transported at the same time. Furthermore, there is also a kind of *a priori* incompatibility between what the tool proposes and the experts' operational decisions. Indeed, an important part of their mission consist of suppliers' preselection. If they want to include CO2 emissions as a decision criterion, they must be able to differentiate between suppliers on the basis of this parameter. However, the tool uses average market data, which does not provide a specific value for each supplier.

*Table 1: results of discussions with experts on the simplified LCA tool*

| **User vision** | **Designer vision (the parameters of the simplified model)** |
|---|---|
| In search for completeness and technical validity (grades? coatings? processes?) | A reduced list of groups of materials, each material is associated with a single process<br>Application of the Pareto principle |
| The majority of the parts are multi-material and multi-process | A part is represented by its most important materials in mass |
| A part is made up of several functional assemblies | A part is a set of materials weighted by masses |
| Changing the material sometimes changes other parameters of the part | Perfect substitution of one material for another in a part (only the mass changes) |
| Logistics phase: the filling rates are not optimal and depend on the volume of the parts | Logistics phase: optimal filling assumption for trucks |
| The CO2 impact of logistics must be rigorously calculated because suppliers' selection is an important part of the job | The CO2 impact of logistics is low compared to the other stages of the life cycle, regardless of the hypotheses |
| Need for differentiating data to select suppliers | Use of market average data |

### *3.1.2. Towards the construction of conventions to establish the legitimacy of the tool*

By exchanging on the parameters of the model, the realistic nature of certain calculation assumptions, and ways to improve it, we have turned to a process of negotiation with the experts. Indeed, to obtain a tool that is both simple and with enough technical inking, a compromise must be reached between completeness and feasibility of the tool. Finding this compromise through this process of negotiation requires the involvement of experts (tool users) in the tool design process. Indeed, there is a kind of translation that must be made between the designers' theoretical resources and the users' practical considerations, through a process of reciprocal prescription. For example, it was necessary to work together to match certain input parameters in the LCA software (such as specific materials denomination) with technical parameters as defined by the experts.

In this case, we observe that working with the vehicle parts experts to build the technical validity of the tool and its correspondence to their operational reality is essential to establish its legitimacy, which corresponds to a scientific and instrumental perspective on legitimacy (Tost, 2011). Indeed, it is essential to build conventions on assessment methodology together, so that they can trust the outcomes of these calculations and use them as a basis for certain technical decisions.

In the next section, we explore the conditions of this legitimacy in another context: through the design of another management tool (internal carbon pricing) and another category of actors (parts and materials buyers).

## 3.2. What the process of constructing an internal carbon price reveals about the organization: case of carbon pricing for procurement decisions

Carbon pricing is now a pillar of climate change policies. It is rooted in the "polluter pays" principle from neoclassical environmental economics, which is supported by the majority of OECD and European Union countries. Whether in the form of taxes, emissions trading systems or other mechanisms, there are currently 61 carbon pricing initiatives implemented or scheduled for implementation worldwide, covering 46 national jurisdictions (The World Bank, 2020). However, the carbon prices emanating from them are very disparate and don't commensurate with the issues at stake according to economists (OECD, 2018). Indeed, they vary from less than US1$/tCO2e (Poland carbon tax) to 129US$/tCO2e (Sweden carbon tax), with 51% of emissions priced less than 10 US$/tCO2e.

While some governments have long considered shadow costs in their decision-making − this is the case of the French government, which considers a carbon shadow cost in its investment decisions (France Stratégie, 2019) −, this practice has recently become widespread in the private sector. Indeed, in parallel with these regulatory carbon pricing schemes, some companies are proactively adopting non-regulatory, so-called internal carbon prices. More than 1,300 companies were adopting or

considering the adoption of an ICP[1] in 2017 (CDP, 2017). On this subject, there are a few reports in the grey literature promoting the importance of this tool in the ecological transition, showing the example of some pioneering companies, or proposing methodologies to businesses to implement this tool (CDP, 2016; I4CE, 2016). On the other hand, no study presents an analysis done at the level of an organization while it was constructing an internal carbon price.

However, the issue at stake here is not so much the supposed methodological outlines, but rather the sensemaking process by which actors understand the rationale of the tool, its potential usage and identify conditions of appropriateness. Through what process does an internal carbon price − that does not stem from regulation and goes beyond the framework of economic rationality − emerge and is performed in a company? This is what we discuss in this section, through the case of the purchasing department of a car manufacturer.

### *3.2.1. The idea of a decision-support tool based on the price of carbon*

As part of a more global transformation plan for the company's purchasing policy, we have been involved in the construction of a lifecycle-based CO2 indicator with a group of buyers, in order to integrate it into the supplier selection process of the company. One of the proposed paths was that of carbon pricing. We decided to explore the extent to which it was possible to build an internal carbon price and deploy it to accelerate the transition.

To structure our discussion, we based on a framework proposed by the Carbon Pricing Unlocked partnership (Figure 7), which describes the internal price of carbon as having four dimensions. Our interpretation of these different dimensions was as follows: (i) Height: price level allocated to a unit of CO2 equivalent, (ii) Width: the emissions covered by the carbon pricing approach, (iii) Depth: how ICP is integrated into decisions and its instrumentation, (iv) Time: evolution through time depending on the objectives.

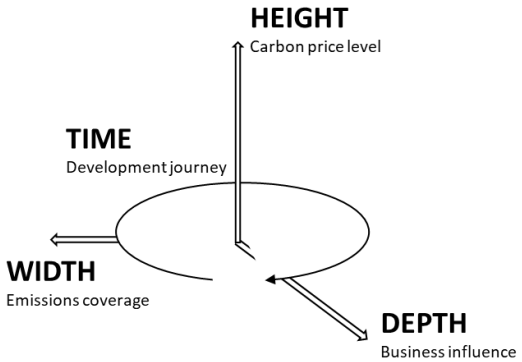



*Figure 7: four dimensions of ICP. Source: Carbon Pricing Unlocked, 2017*

[1] Internal Carbon Price

The idea was to start from the CO2 emissions of the parts and materials purchased (assuming these data are available, reliable and comparable), multiply them by a CO2 value that is agreed upon and relevant over the entire life cycle, and thus obtain the ranking of suppliers according to the CO2 criterion.

### *3.2.2. From evaluation to investigation: the difficulty of extending the scope to the supply chain (width dimension)*

The transition between theory and practice revealed implementation difficulties, particularly regarding data structuration. Our discussions have shown that defining a perimeter that makes it possible to obtain comparable data while considering available resources is not trivial. Indeed, as a first step, we decided with the buyers to consider only Tier 1 suppliers, who may be parts suppliers or materials suppliers (see Figure 8). If only direct emissions were considered, the carbon intensity of materials production would be considered in the case of materials suppliers, but only emissions due to the processing of materials would be covered in the case of parts suppliers, which does not reflect the total carbon impact of the parts. If both direct and indirect emissions are to be considered, it would be necessary to take into account the entire value chain (not only Tier 1 suppliers). This second solution requires traceability and knowledge of the impacts on the entire sector, which does not seem to be mature today.

To overcome these difficulties, we have begun an investigation process with the buyers to assess the available data on CO2 emissions in the value chain. The search for centralized databases was an unsuccessful first step. For this reason, we decided to produce our own data by sending questionnaires to suppliers and organizing interviews with them to better understand the sources of CO2 emissions in the supply chains. This, in itself, is a signal sent to suppliers signifying a demand for low carbon products. Indeed, by demanding accountability for the carbon footprint of parts and products purchased, companies can play a key role in the development of low carbon alternatives by suppliers. The higher cost of low-carbon solutions is today one of the reasons why buyers do not select them. This would be reduced if investment in the relevant sectors increased, leading to economies of scale. This is a virtuous circle that can only be encouraged if buyers show their intention to value the CO2 savings that these solutions allow.

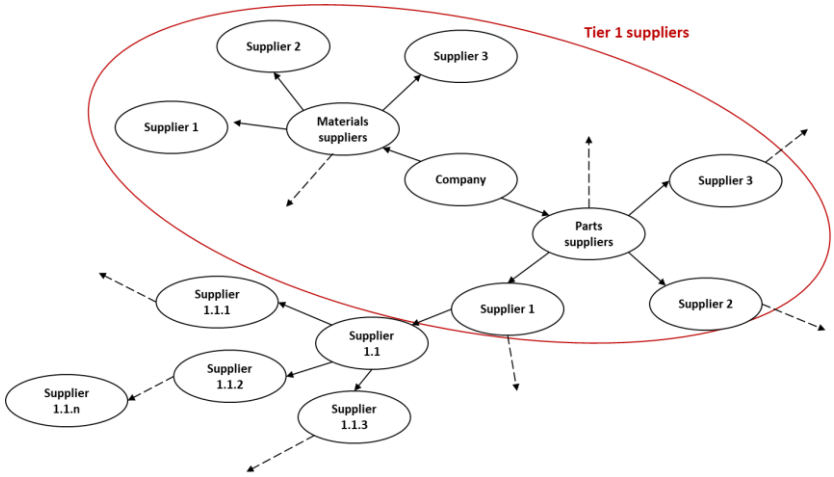


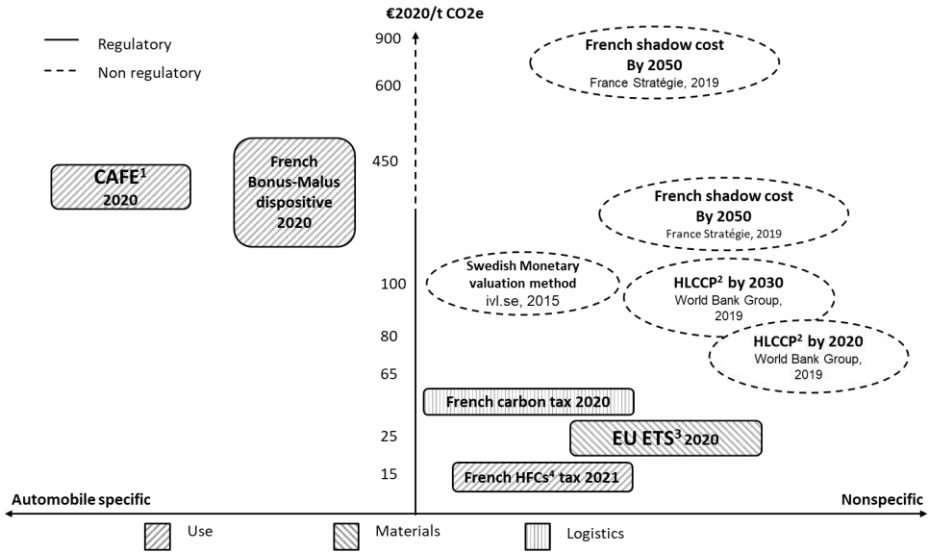

*Figure 8: simplified mapping of the company's supply chain*

### *3.2.3. Carbon price: an unexpected definition of what the right value is (height dimension)*

Several definitions of carbon value exist today in the academic literature, each associated with a certain approach (Duong & Mainguy, 2009). For example, this value can be based on the marginal damage due to climate change − itself based on a certain economic valuation of ecosystems −, on the emissions reduction cost (which depends on the perimeter and reduction methods considered), or on the price that emanates from an emissions trading market (the EU-ETS for instance). Indeed, although some economists advocate the adoption of a single global carbon value − a position that is strongly criticized because based on a purely rational and idealized vision of the markets and institutions in place − there is no consensus on a universal carbon value (Weitzman, 2014).

However, economic analyses are carried out by international institutions (IMF, 2019; OECD, 2018; World Bank Group, 2019) to recommend the use of a carbon value to policies, with the aim of achieving a certain target (usually in line with the 1.5°C global warming target at the end of the century). The value of CO2 therefore depends on a multitude of parameters: the approach chosen, the geographical perimeter, the CO2 reduction methods considered, the time horizons, the objective to be achieved, etc., which makes it a relative and conventional value.

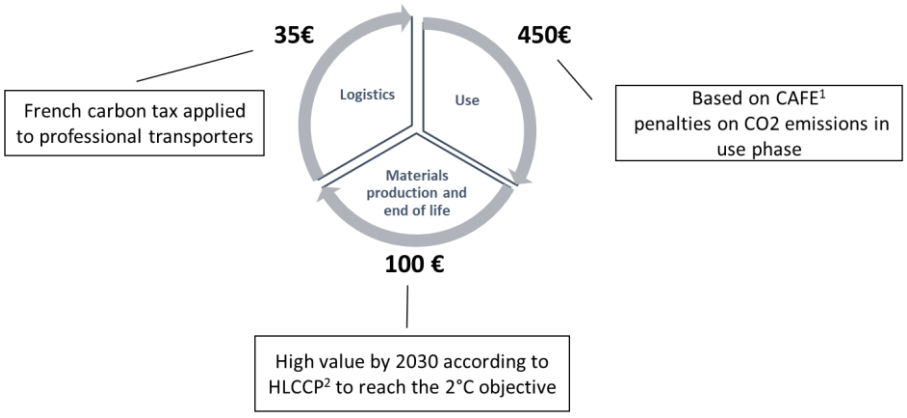
In order to select the most relevant carbon value for the company with the buyers, we began by giving them orders of magnitude of the carbon values that are in force in the regulations of certain European countries (France in particular), but also those recommended by some institutions. As shown in the Figure 9, the regulatory values are different depending on the stage of the life cycle of the vehicles being considered. They are stricter for emissions during the use phase (e.g. the CAFE standard penalties which value CO2 at 95€/ gram of excess compared to a given target).




(1) Corporate Average Fuel Economy, (2) High Level Commission on Carbon Prices, (3) European emissions trading system, (4) Hydrofluorocarbons

*Figure 9: examples of carbon values in force and carbon values recommended by some institutions*

Based on these values, we proposed a first carbon pricing approach which consists of assigning a different value to each stage of the life cycle, in order to be as close as possible to regulatory trends. As the current values cover only a small part of the emissions due to the production of materials, we have chosen to take a value of 100€/t CO2e to make them more visible.




(1) Corporate Average Fuel Economy, (2) High Level Commission on Carbon Prices

*Figure 10: illustration of a carbon pricing approach differentiated by life cycle stage*

Finally, this approach was not perceived as relevant by the buyers as well as members of the environmental strategy department, for several reasons. Indeed, mixing up regulatory values (and therefore otherwise paid for by the company) with a shadow cost creates confusion. Also, using several CO2 values depending on the stage of the life cycle adds complexity to the message conveyed by the tool and confuses the approach.

For this reason, we proposed another approach, which consists in proposing several levels of values to be applied throughout the life cycle, from which the company can choose according to its degree of

ambition. To build these values, we used the same sources as in the first approach, supplemented by internal carbon prices used by private sector companies from the Carbon Disclosure Project reports (CDP, 2017)

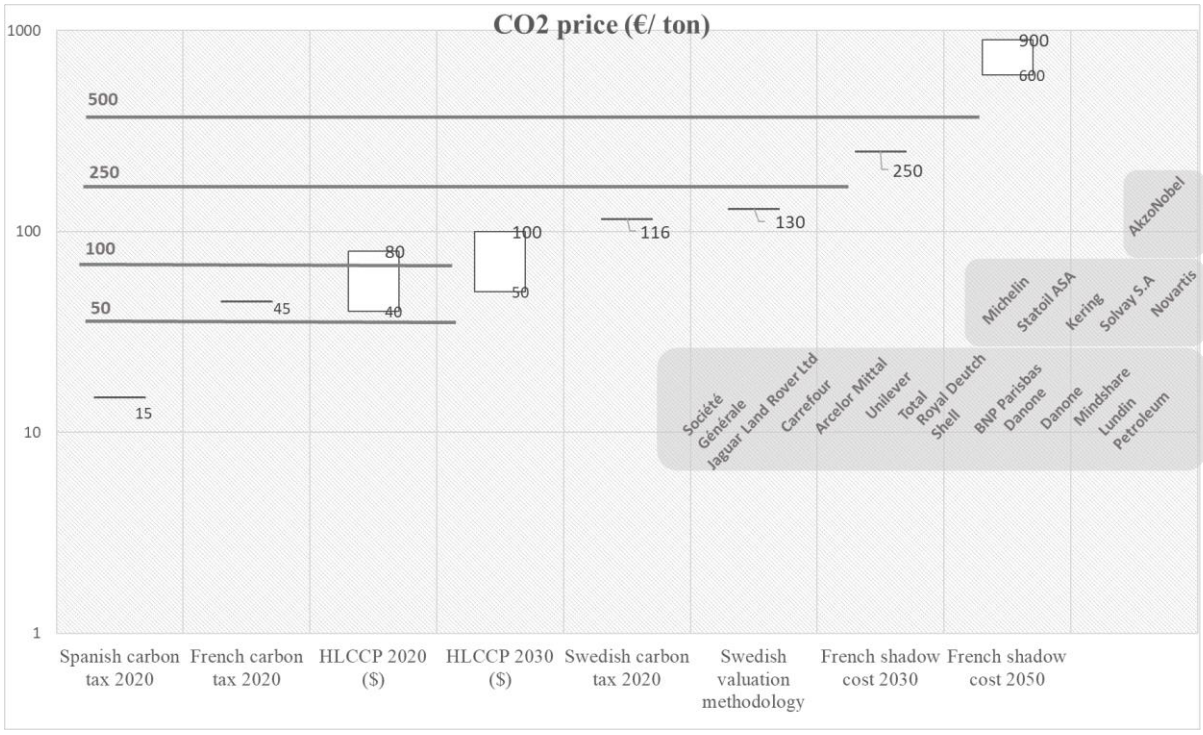



*Figure 11: Illustration of a carbon pricing approach based on different logics: benchmark, values in force and recommended values*

Here, we observe that to a certain extent, the simplicity of the tool and its coherence with the company's strategy is more important than its scientific validity for the actors in the field – in this case buyers, but also members of the department of environmental strategy that were included in the discussion later on –. Indeed, we have had little debate on the justification and theoretical inking of ICP values, but rather on what these values would imply in the company and their appropriateness by different actors (on the environmental strategy department side), in addition to their consensual nature and hierarchical validation ( on the buyers side).

### *3.2.4. Business impact: the importance of storytelling (depth dimension)*

Promoters of the practice of monetary valuation of environmental or social externalities argue that by switching to monetary language, decision-makers will give more weight to the environmental and social impacts in their decisions, because the financial language is the one they understand. However, through our exchanges with companies, we observed that this conversion alone does not in itself make sense of the implications of these environmental or social costs for businesses. It is therefore necessary to look for a way to use these values in such a way that it speaks to the actors. For example, a company can use the ICP as the basis for environmental reporting, for an internal carbon tax or as a shadow cost in financial calculations (I4CE, 2016). One of our propositions consisted of accounting

for ICP in the calculation of the NPV[2] indicator in supplier selection process. Inspired by an approach communicated by another company (Natural Capital Coalition & Dow Chemical, 2017), this method allows to demonstrate that the supplier that would be selected based on this completed version of NPV would be different than the one that would be chosen based on traditional purely financial NPV. This is a way of showing that company's today procurement decisions are not robust in a world where the climate issue is increasingly becoming a financial stake. This tool has had some success with buyers because of their familiarity with this indicator, although its evolution in the company is conditioned by the ability to calculate CO2 emissions of suppliers (section 3.2.2) and convergence towards one or several consensual CO2 values (section 3.2.3). We also observed that ICP has been appropriated by some actors as an additional argument in some of the cases they defend (example: recycled plastics *versus* virgin plastics). This is often the case when it comes to promoting solutions that are more virtuous in terms of GHG emissions but less competitive financially.

Furthermore, some companies such as Solvay present certain management tools − in this case the SPM tool (Solvay, 2017) which combines LCA, monetary valuation of externalities and qualitative assessment methodologies) − as a means of capturing market signals that are invisible through purely financial performance indicators, and thus a way of assessing the risks and opportunities for the company.

## 4. Discussion

### 4.1. The conditions in which management tools are performative

Through our experiments, we have seen that the transformation of environmental expert tools into managerial mediating instruments was a necessary condition to produce positive legitimacy judgments (Tost, 2011), and therefore facilitate their adoption by actors in the company. In the case of vehicle parts experts and the simplified LCA, this legitimacy seems to be based more on the technical validity and accuracy of the calculations, whereas in the case of buyers, the expectations were less focused on the technical-economic aspects of carbon pricing, but rather on the conventional aspect of the CO2 values used.

In both cases, it seems to be necessary to go through this work of convention building and reciprocal prescription to obtain the adhesion of the actors in the field – tools' users –, and prepare the ground so that the outcomes of the tools can be integrated into their decision-making processes, and thus act as transformation management tools. The foundations of this legitimacy are not universal even within the same company but are specific to each case. Indeed, it is through a process of co-designing management tools that we were able to reveal the expectations of the different categories of actors in the field.

[2] Net Present Value

In addition, since a bottom-up initiative is not enough to institutionalize and embed a practice in the company's processes, there is also a strategy of enrolling decision-makers at higher management levels to be constructed. Based on our observations in the field, we have identified how environmental or CSR experts act as gatekeepers to identify external jolts or events – a regulatory threat, the example of pioneering competitors, scandals – and use them to make sense of the external environment and attract the interest of top managers. By doing this, they create windows of opportunity that are used to convince top managers to inscribe the sustainability transition in the strategic agenda setting of the company. In this perspective, windows of opportunity are based on a storytelling in which events, external jolts or crises are put forward in a scenario that has the potential to momentarily disrupt the routines in place and justify the engagement in a sustainability transition.

In our case, some of these events were external (European Green New Deal, plastic bashing, the Dieselgate scandal…), and some were internal. An example of the latter is a low carbon concept car project that constitutes a protected space that is receptive to simplified LCA use, but also parallel working groups whose objectives are to build a case on the reduction of CO2 emissions through alternative materials, who used ICP as an additional argument. Moreover, these events do not act spontaneously on the company and its decisions, but their impact depends on the way gatekeepers build a coherent and rational narrative around them, in which management tools play a key role in objectifying risks and opportunities.

### 4.2. The myth of top-down transition processes in companies

There is a widespread belief in companies and in the media that in order for a company to give more importance to sustainability, it is necessary and sufficient to have an impulse from top management. This common discourse reveals that in the collective imagination a sustainability transition in a business is the fact of a centralized decision-making authority: "I think it starts with a push from the top management and an agreement on a direction for the company to go in. Usually, it's then reflected in the company's strategy, and then, that's where it's further reflected in the company's activities." Senior Consultant in Sustainability-KPMG

However, our fieldwork and the testimony of some of the interviewed companies highlight that transformation processes towards sustainability rather refer to a distributed ontology. Indeed, as well as for socio-technical systems, several levels are involved. As shown by the Figure 12, the MLP framework helps illustrate this analogy. Indeed, while the top-down deployment of a transformation plan that aims to change the way in which business decisions are made is the most visible and structured phase, there is a whole phase of upstream experimentation, mostly invisible form outside, that precedes this process. These experimentations can be bottom-up initiatives, pilot projects, case studies, etc., which constitute a key stage in organizational learning, the construction of relays, networks and tools: "The tool was taken in hand by the corporate sustainable development team and

was tested on a sample of businesses first. It was done iteratively, and after that, it was deployed with a top-down decision to implement the methodology" Corporate Sustainability Sr Officer about the SPM tool (Solvay, 2017). This corresponds to the social processes within niches in the niche-innovation literature: learning process, articulation process and building of social networks and the enrolment of more actors (Geels, 2004).

Thereafter, these experiments sometimes crystallize into strategic decisions by obtaining the support of decision-makers, by seizing windows of opportunity: "At the time that we were doing this work, Texas was in a very large drought. In New Mexico, Texas and Colorado, we have all kinds of water crises that we're dealing with. And so, the leaders of our company were very interested in hearing this kind of scenarios because they were feeling the impacts of the drought, and they understood this. Some people would say never waste a good crisis, and this was a good crisis." Director of Sustainability- Dow Chemical, about the integration of water shadow cost in the NPV calculation (Natural Capital Coalition & Dow Chemical, 2017).

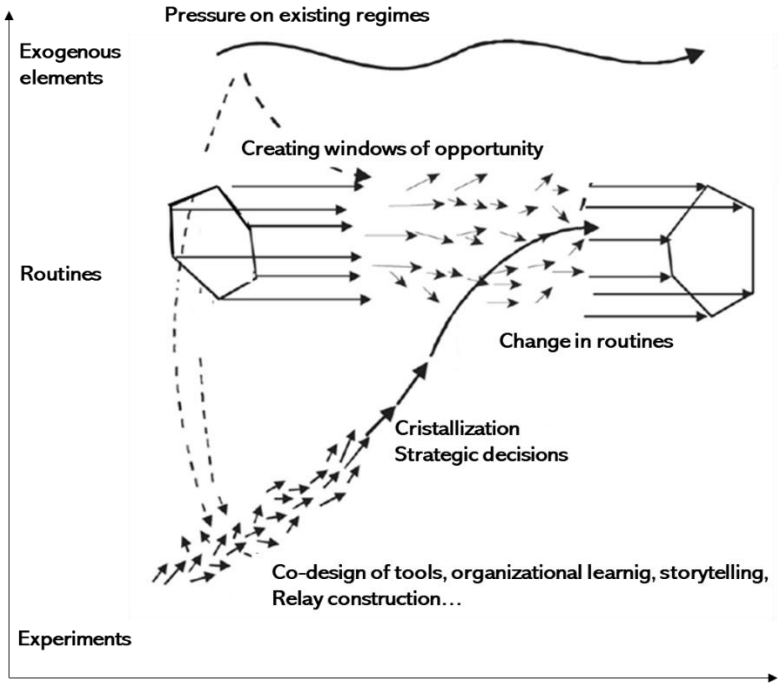



*Figure 12: a model of a transition path at the organization level. Adapted from: Geels, 2011*

### 4.3. Limits of the study and research perspectives

Based on our experiments, we proposed an ideal-typical transition model at company level inspired by the MLP framework. This raises several issues, the first of which concerns the definition of a sustainability transition in a company and the tangible signs that a transition process has begun. Indeed, sustainability transitions are "long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of

production and consumption." (Markard and al., 2012), which are in fact rare and therefore difficult to observe and analyze. In our model, we considered that a sustainability transition may be initiated in a company when the decision tools (and therefore the routines) start to change. That said, management practices can change faster than socio-technical systems, and these changes can unravel just as quickly. Here, therefore, the model does not describe a changeover process, but rather an ongoing performation journey (Garud and al., 2017). As with socio-technical systems, there is no guarantee that a transition will actually take place. Experiments carried out in companies may never succeed for a variety of reasons.

In addition, sustainability transitions refer to fundamental changes that go through radical innovations and a strong sustainability paradigm, which raises questions about the contribution of incremental improvements (at the scale of vehicle parts, for example) to a transition at the level of a company. The contribution of this organization-wide transformation to a transition across the entire social-technical system is also to be discussed.

Therefore, one avenue of research would be to analyze the process of emergence of disruptive and sustainable innovations in a company and analyze how these changes are connected to transformations at other levels (niche, and regimes).

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**Appendix I: interview list**

**1- Internal discussions- from December 2019 to June 2020**

| Topic | Number of meetings | Participant | Type of discussion |
|---|---|---|---|
| **Presentation of simplified LCA tool** | 3 | Vehicle parts experts and engineers | Work meetings |
| **Actors' feedback and improvement of simplified LCA tool** | 13 | Vehicle parts experts and engineers | Work meetings |
| **Internal carbon pricing and NPV** | 30 | Buyers and purchasing managers | Work meetings |

**2- External interviews – from June 2018 to February 2019**

| Topic | Number of meetings | Participant | Type of discussion |
|---|---|---|---|
| **Management instruments, monetary valuation of externalities, sustainability transitions** | 1 | Dow Chemical, Director of Sustainability | Semi-structured interviews |
| | 2 | Solvay, Corporate Sustainability Sr Officer | |
| | 1 | Cementos Argos, Senior Risk Management Analyst | |
| | 1 | BASF, Head of Sustainability Assessment Methods | |
| | 1 | Volvo Buses, Director Business Solutions | |
| | 1 | NovoNordisk, Associate Director and Sr Advisor Corporate Sustainability | |
| | 1 | Lafarge Holcim, Head of Sustainability Performance and Tools | |
| | 1 | Akzo Nobel, social responsibility manager | |
| | 1 | KPMG, consultants Sustainability Services | |
| | 1 | True Price, Founder and Director | |
| | 1 | Trucost, Director ESG and Sustainability | |
| | 1 | Natural Capital Coalition, Operations Manager | |

**Appendix II: examples of interview guides**

**1- Interview with Dow Chemical Director of Sustainability, December 2018**

- Could you tell us where did the initiative to assess the risks related to water come from? Was it related to a particular event or a particular person?
- Why did you choose to use the natural capital protocol as a basis for this work? Did you have other options ?
- What is the procedure exactly, do they support you during all the project or did you hire a consulting firm to support you?
- How was the project organized, did you organize meetings regularly with them?
- Why did you choose to calculate a net present value of water rather than a classical water footprint, or other qualitative methods?
- This work was done for a specific manufacturing site, which is in Texas. Why did you choose this site?
- Was this approach applied to other projects or was it a onetime experiment?
- Who was involved in this project? inside and outside the company?
- How did the tool evolve during this project?
- What data did you use?
- Did you have to acquire new skills for example in environmental economics?
- What effects did you observe in your company? Did this tool lead to new partnerships or unexpected connections, new performance indicators … Etc.?
- How was it integrated to the existing processes?
- What kind of difficulties did you meet during the environmental assessment process? (ex: lack of resource, lack of skills, the complexity of the topics, a lack of support…etc.) and during the implementation of these tools?
- What were the levers that have facilitated your process? (ex: the personal motivation of some decision makers, the emergence of a new customer demand…etc.)
- What are your personal definitions, or vision of a responsible company?
- According to you, what are the necessary conditions to conduct a sustainability transition within a company towards a responsible management mode?

**2- Interview with the founder of True Price and Impact Institute, December 2018**

- According to you, what is the added value of using pricing and monetary valuation instead of usual impact valuation methodologies?
- Do you observe that this topic is becoming more important and popular in the business world, and according to you why?

- How do you handle critics regarding monetary valuation of impacts, whether for the uncertainty or the ethical issues?
- With how many companies have you worked? In how were they distributed in terms of sectors of activities?
- Why do companies like AkzoNobel or DSM come to you? What are their typical motivations according to you?
- How long does a project typically last?
- How is it organized, are there regular meetings and trainings? Was it important for you to make sure that there was knowledge transfer?
- You calculate the true price of products, so you bring complementary information to companies, but how do they use this information in practice? (risk assessment? Business decisions? Disclosure?)
- What effects did you observe within the organizations you've worked with? Did your work lead to new partnerships or unexpected connections, new performance indicators or cultural changes…etc.
- What kind of tools have you developed within Impact Institute? Can you give us a quick typology?
- What kind of challenges do you usually meet during the projects with the organizations you've worked with? (ex: lack of resource, lack of skills, the complexity of the topics, a lack of support…etc.) and during the implementation of these tools?
- Do you work with policy makers, or do you know if Dutch policy makers are interested in these topics? For example, in France there is a discussion on a tax that would be correlated to environmental costs of products called circular value added tax.
- What are your personal definitions, or vision of a company with a responsible management of its resources?
- According to you, what are the necessary conditions to conduct a sustainability transition within a company towards a responsible?

**3- Interview with the Corporate Sustainability Sr Officer- Sustainable Portfolio Management, December 2019**

**Part I: Origins and design of the SPM tool**

- What problematizations led to its production? What were the conditions for its emergence?
- When the SPM was designed by the ADL and TNO consulting firms in 2009, who from Solvay was involved in the process? Was there a pilot project?
- Who were the pioneering users? Have there been back-and-forth exchanges between consultants and future users of the tool to determine the "right" form of the tool in relation to its use?

- How was the buy-in of managers and users of the tool obtained for its adoption? Were there any compromises or versions that did not come out?
- The tool is integrated into a more global strategy called "Solvay Way". Have other tools been deployed to achieve the Solvay Way objectives?

**Part II: what is it made of?**

- What ideas are reified by the methodological choices, the indicators chosen, etc.?
- What is the meaning of the different axes? What are the calculation scopes?
- What about the "cost of production" criterion, how is this criterion combined with the SPM results?

**Part III: what does it do**

- How was the tool deployed? Was it done progressively?
- Was there a test phase? How long did it last?
- Which actors (individuals or groups) were concerned and able to intervene? (during the design, the deployment and the use of the tool)?
- What is their emotional relationship to the tool (positive-neutral-negative)?
- What changes has it induced? Were new skills solicited within the company?
- Who were the promoters/detractors of the tool at the beginning and why? What were the controversies around the tool? How were they resolved?
- What kind of dialogue about the tool? What discourse does the tool carry within the company (risk/opportunity? common vision of the future of the company and its strategy)?
- Who keeps the tool alive and allows its use? Who supports it? How did we go from a "measurement" tool to a "strategic instrument"?
- Is SPM applied to a sample of representative products-applications?
- What are the consequences of a negative SPM assessment result on product development? (mandatory, indicative, possibility of derogation...etc.)?
- How have you convinced engineers/marketers to consider the long term in their decisions?

**Part IV: evolution through time**

- Has the tool evolved over time? If so, how and why?
- Have there been crises or moments of uncertainty?
- Is there a measure of what the SPM tool produces for the company in terms of measurable indicators (so many products changed, so many markets abandoned, so many innovations ... etc.)?
- Have there been any transformations in the company in terms of working atmosphere, motivation, job structure, worker profiles, relationships between professions, or mindsets?