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# **THE EXPERT OF THE UNKNOWN FOR EXPERTS IN THE UNKNOWN: FOSTERING INNOVATION IN ESTABLISHED INDUSTRY TO ADDRESS GRAND CHALLENGES IN THE AUTOMOTIVE INDUSTRY**

## **Abstract**

Connected/Autonomous/Shared/Electric cars: The automobile industry, like many others, is facing significant challenges. However, established industries are known for their overoptimized New Product Development (NPD) and overstructured strategic knowledge organization through domains of expertise, which are not compatible with radical innovation. Moreover, grand challenges require knowledge in new domains such as Artificial Intelligence, Cybersecurity, Data, Ecology, etc. That's why innovations for grand challenges must involve the management of new expertise alongside the existing ones.

Recent studies report the emergence of a new form of expertise, the experts of the unknown, to assist existing experts in innovating more effectively. However, no study explains concretely how this translates. Thus, the research question is as follows: How can experts of the unknown help traditional experts to learn in the context of grand challenges?

To answer this question, we examined the literature on the learning processes for innovation through R&D in the automotive industry, NPD, and experts. We conducted three studies at Renault with patent authors in AI and innovation experts to understand their learning processes for innovation. We discovered first that the role of experts has changed: they are now responsible for identifying problems from grand challenges that are vital for their company. Then, the experts of the unknown have created a process to help others gain knowledge in new domains of expertise, identify innovative concepts, and develop innovative solutions to face grand challenges. This animation of knowledge acquisition is a new emergence regime of expertise.

**Keywords**: Expert of the unknown – Grand challenges – Established industry - Exploration

## **1. Introduction**

For several years, the emergence of AI has sparked dreams of autonomous cars, the internet and then 5G of connected cars, traffic jams of new intelligent mobilities, and environmental concerns of non-polluting cars. The automotive industry, like many others, faces significant challenges. To overcome them, manufacturers have resisted bringing Google into the car. However, by the end of the 2010s, things change: Volvo and the Renault Nissan Mitsubishi Alliance join forces with Google to develop the connected car, and later with Waymo to develop the autonomous car. In the case of Renault, it is one of the largest automakers to accept a GAFA (Google, Apple, Facebook, Amazon) into the automotive world, causing a seismic shift among other manufacturers in the race for autonomous vehicles. However, despite the complementarity of Renault and Google's expertise, they have still not succeeded in developing autonomous cars.

Furthermore, Renault has a highly developed in-house expertise system, consisting of 56 domains and approximately 700 experts. In 2016, new domains related to the challenges of grand challenges were created in AI and Cybersecurity. Indeed, experts are the main drivers of acquiring new knowledge but also the custodians of historically acquired knowledge. It therefore seems relevant to have experts in these new domains. However, just as the combination of Renault and Google's expertise has yielded no results, the addition of these new domains to historical domains also does not provide a satisfactory solution.

Moreover, recent studies have reported the emergence of a new form of expert: experts of the unknown dedicated to offering tools to foster exploration of innovation fields, as other domain experts need tools to improve their capacities in radical innovation management (Deval et al., 2021). But no study explains concretely how this translates. Thus, the research

question is as follows: How can experts of the unknown help traditional experts to learn in the context of grand challenges?

To answer this question, we examined in the literature the learning processes for innovation through R&D in the automotive industry, through NPD (New Product Development), and experts. In line with the work of Deval, Hooge, and Weil, we conducted three studies at Renault with patent authors in AI and innovation experts to understand their learning processes for innovation. After presenting the case, we discuss the results.

## **2. How is learning and expertise organized and systematized to tackle the unknowns of grand challenges**

### **2.1. Learning in an Extreme Setting of New Product Development: The Automotive Industry**

The automotive industry has based its longstanding success on an established New Product Development (NPD) process (Le Masson et al., 2017). A first stream of literature has focused on how to structure knowledge in the activities of NPD in the automotive industry (Clark & Fujimoto, 1991; Ellison et al., 1995; Moisdon & Weil, 1995; Wheelwright & Clark, 1992). Looking at the learning system, NPD and fuzzy front end engineers heavily draw from internally renewed expertise, following an exploitative innovation logic. The feasibility of activating consistent learning cycles for the integration of new knowledge is questionable (Maniak et al., 2014). Indeed, the innovation process in this industry is mainly oriented towards incremental innovation on sub-parts of the overall product (Candelo, 2019; Candelo et al., 2021). Thus, the NPD process values the reproduction of the overall architecture of vehicles (Henderson & Clark, 1990), limiting the search for exploitable and diverse knowledge practices to deepen internal expertise. The NPD process is highly stable and not easily compatible with a profound renewal of skills and routines (Clark & Fujimoto, 1989). For instance, Bohnsack and Pinkse (2017) demonstrated that automotive companies struggle

to propose innovative paths around electric vehicles, which would be fundamentally different from those developed for internal combustion engine (ICE) cars, due to the amount of reengineering required throughout the industrial process. This example also illustrates that internal expertise strongly influences the development of new products. Therefore, we now turn our attention to the creation and development of industrial expertise.

## **2.2. Technical and Scientific Experts Responsible for Knowledge and Learning in Engineering**

In the 1950s, the survival of scientific enterprises depended on technological innovations to stay competitive and face the competition (Shepard, 1958). It was recognized that having a high level of technical competence in the laboratory ensured better results. Thus, a new managerial class emerged: the experts, gradually taking control of scientific and engineering activities. Managing these specific populations in Research and Development requires a particular approach to human resources management (Oiry et al., 2014). A new human resources management tool appeared: the dual ladder, or technical ladder. This tool provides an alternative technical career path to management and acknowledges the expertise of certain scientists and engineers (Shepard, 1958). They are referred to as technical and scientific experts, whose goal is to build a pool of technical and scientific talents on which the company builds its innovation strategy (Gilbert et al., 2018).

Concretely, the use of technical and scientific experts is illustrated by an exchange between an individual (the expert) providing an explanation to the request of another individual (the requester) (Mieg, 2012). Roqueplo (1997, p. 14) defines expertise as "the expression of knowledge formulated in response to the demand of those who have a decision to make, knowing that this response is intended to be integrated into the decision-making process." There is, therefore, a very clear distinction between those who "make a profession of knowing" and those who "make a profession of deciding." This point is confirmed in the

works of Weil (Weil, 1999), who observes that experts are mobilized to solve a problem identified during the design of new products that seems impossible to address. The expert, not intervening in innovation strategies, must generate knowledge and advice in a domain of expertise (often an identified and established technology (Gilbert et al., 2018; Oiry et al., 2014)) for the manager (Haas, 1992), considered the decision-maker initiating the request. The role of technical and scientific experts has proven to be crucial in the context of hyper-competitiveness in the 1990s (Ilinitch et al., 1996), as they contribute to the dynamic and strategic renewal of industrial expertise within their company (Barley & Tolbert, 1991; Cabanes, Le Masson, et al., 2020), thus fostering innovation capability through the density of knowledge they make accessible to engineering (Cabanes, Masson, et al., 2020; Lelebina, 2013).

Thus, the expert is the "holder of particular knowledge, linked to the practice of their profession; they become a recognized specialist in their field, sought after for their opinions" (Delmas, 2012). This implies two things:

- 1) The knowledge of an expert is not useful if it is not applied within the organization;
- 2) An individual is an expert if the relevance of their scientific or technical opinions is recognized by their peers: (Ericsson, 1996; Hoffman et al., 2019; Lelebina, 2013, 2013; Shanteau, 1992). Peers are understood as members of an institutionalized community in a scientific domain (Evetts et al., 2006; Shappin & Schaffer, 2011)

Finally, numerous studies show that statistically, it takes at least 10 years of experience to become an expert (Chase & Simon, 1973; Ericsson, 1996; Hayes, 1989; Weisberg, 2006). This "10-year rule" has become the gold standard for recognizing individual expertise in industrial organizations. However, this long process of acquiring expertise does not stop after 10 years; it must continue to be dynamic because the expert, as a reference in a technical field,

must master the latest advances and reinforce what they already know. Indeed, an individual is not an expert for life once qualified (Oiry et al., 2014).

In conclusion, regulated design presents two forms of learning: experts, guardians of the strategic knowledge of the company, and responsible for acquiring new knowledge in their field to guide strategic choices for managers; and project managers in the Fuzzy Front End and New Product Development phase who mobilize and direct the acquisition of new knowledge to identify new ideas and differentiate the products to be designed.

### **2.3. Experts Confronting Grand Challenges**

Today, the context has changed for engineering and its experts. The management of industrial innovation projects must address the key transitions of the 21st century. In the automotive sector, this is reflected in projects related to connected, automated, shared, and electric (CASE) vehicles (Iacobucci et al., 2018; Mahdavian et al., 2021), requiring numerous innovations. To manage radical innovation and exploration activities, it appears that the activities of experts cannot be limited to strategic decisions alone. The exploration of the unknown plays a role in the creation of new knowledge, which can subsequently strengthen the emergence of new expertise (Le Masson et al., 2017). Experts in established industrial companies must work on the integration and development of tools, methods, or processes dedicated to exploration.

The literature on the exploration of the unknown by experts, emerging mainly since the 2010s (Le Masson et al., 2017), does not offer many case studies. Four cases have been identified:

1. In his work, Cabanes (2016) begins by noting that while the dual scale allows for the career management of experts, it does not allow for the management and development of expertise. He also observes that, according to the literature in management and organizational theory, the places and processes of knowledge creation in organizations are generally represented through the concept of a community (Brown & Duguid,

2001; Cowan et al., 2000; Lave & Wenger, 1991). Cabanes then proposes the concept of a "proto-epistemic society of experts," characterized as a group of individuals sharing different domains of expertise and having a common cognitive objective to bring about a new proto-expertise and to reorganize the relationships of expertise interdependence to provoke the destabilization and revision of dominant designs. He contrasts this with the concept of an "epistemic community of experts," defined as a group of individuals sharing the same domain of expertise, allowing shared understanding, and having a common cognitive objective of creating knowledge in a specific field (Cabanes et al., 2016). He then observed at STMicroelectronics how the implementation of these concepts helps address exploration management issues in engineering. A new device called the "Technical Staff College," embodying the protoepistemic society of experts, aims to manage and organize the renewal of expertise for innovation, manage the dynamics of expertise within the organization, and allocate resources for the organized exploration of innovation fields. According to its description in the literature, the Technical Staff College consists of seven offices, three dedicated to support functions, two for incremental innovation development, and two for radical innovation. Regarding the latter two, the first organizes various exploration activities, and the second drives the strategy for expertise renewal. A distinction then appears in the roles of experts between the "resource expert," who corresponds to the vision shared by the management literature, meaning that the expert is a resource for decision-makers (generally for managers). They evaluate technological risks, solve complex problems, and propose technical solutions; and the "strategic expert" who assumes that the legitimacy of the expert relies on their ability to prepare for the future, i.e., to go beyond the known to explore the unknown systematically and collectively. Thus, the strategic expert seeks to create new research



programs, guide and define new research strategies, and reconfigure and manage an innovation ecosystem with academic and industrial partners.

2. In practice, several R&D departments of companies have already used the method of collective exploration and design called KCP to organize collective action in innovation activities (Agogu  & Kazakçı, 2014; Berthet et al., 2016; Elmquist & Segrestin, 2009; Hooge et al., 2016). We will present two of these studies. At AutoX, some members of the team responsible for the strategic planning department of products initiated KCP, and R&D department actors participated (Elmquist & Segrestin, 2012). The KCP method allowed R&D actors to identify missing knowledge, design relevant tools, and improve product quality. At Aerofirm, R&D managers initiated the use of the KCP method, through which innovation capabilities were improved through the exploration process (Hooge et al., 2016). In both cases, experts participated in KCP workshops to organize collective exploration of unknowns. However, neither of the two R&D departments adopted the KCP method as a long-term radical innovation process.
3. Rampa, Abrassart, and Agogu  (Rampa et al., 2017) studied how the Hydro-Qu bec Research Center (IREQ) went beyond the limits of its R&D project development to be more innovative and face the energy transition. For this, IREQ trained 20 researchers in innovative design reasoning. The training lasted for 8 days and allowed the dissemination of a new capacity for exploration at the individual, collective, and organizational levels (Rampa, 2020):
  - a. At the individual level, the designer is more comfortable exploring and identifying unknowns;

- b. At the collective level, socialization effects between different people who were not used to collaborating were observed. Furthermore, teams equipped themselves with tools for exploration;
- c. At the organizational level, the training initiated a common transdisciplinary language to talk about exploration and innovation, which gradually spread throughout the research institute. Moreover, thanks to the appropriation of exploration methods and the implementation of new approaches to explore new alternatives, researchers were sensitized to upcoming changes in their sector.

By training technical and scientific experts in the exploration of the unknown, IREQ was able to stimulate the creation of new ideas, new ways of exploring new research fields, and strengthen its ability to collectively organize creative activities. However, IREQ trained only 20 out of its 500 researchers.

- 4. Deval, Hooge, and Weil (2021) showed that the engineering of Renault and SNCF had established an expertise system to support innovation. Their experts must define the innovation strategy of their company by formulating and developing solid innovative industrial concepts. The role of technical and scientific experts has thus changed. However, they are not accustomed to relying on innovation methods or tools to achieve their goals, nor to cooperate in the research and development of cross-domain breakthroughs. Thus, "experts of the unknown" appeared in both companies, working on numerous innovation tools and methods to foster innovation capacity. They showed that experts of the unknown were experts in managing the unknown in industrial contexts and disruptive innovation strategies, using tools and methods for the exploration of disruptive innovation. Secondly, the emergence of this domain highlighted a new type of interaction between innovation and expertise, since

traditionally domains of expertise are technical or scientific. This makes the exploration capacity a strategically important area for the company since it became a domain of expertise. Thirdly, they present a new way of managing radical innovation in an established technological company, since experts are in charge of innovation but don't have the tools to identify the opportunities. This domain proposes tools and organizations suitable for the transdisciplinary exploration of the unknown by all innovation or R&D stakeholders

Thus, we understand, on the one hand, that the context of grand challenges requires engineering to renew itself, whether through production means or products. On the other hand, we understand that the production process of engineering (NPD) is so optimized that it does not allow for innovation, and the learning of new knowledge by experts is limited to their domain. Some companies have institutionalized experts of the unknown to help other experts in the unknown. However, no study proposes a concrete animation of experts in the unknown by experts of the unknown to face grand challenges. Therefore, our study focuses on this specific animation and poses the following question: **How can the experts of the unknown help the experts to learn in the context of major challenges?**

### **3. Research method**

#### **3.1. A Collaborative Study with Experts in an Automotive Company**

To explore this question, our study is based on collaborative management research (Shani et al., 2008), conducted by academics and practitioners. It aims to give actionable knowledge for the organization and new theoretical models in management research (David & Hatchuel, 2008). The partnership has been led since 2019 by the first author, who was both a researcher in design and innovation capability and an employee of the main industrial partner; it has been supported by senior researchers in innovation management, as well as members of industrial expert organizations specialized in radical innovation management. Moreover, the research

relies on a longitudinal partnership on innovation capability (Menard, 2002; Pettigrew, 1990) that the research team leads with Renault, an established French technological firm with strong expertise organizations, and experts dedicated to radical innovation management since 2018. Renault restructured its expertise organization in 2009, and now has 51 domains of expertise, embodied by approximately 779 experts, labeled as “Expert Leader”, “Experts” or “Specialists” of the domain they are charged with. In June 2018, Renault created a new domain called Innovation Patterns and nominated its first Expert Leader of such a domain. At the end of 2020, the Innovation Patterns Domain (IPD) was composed of 1 Expert Leader, 3 experts, and 12 Specialists, and new nominations of experts and Specialists are expected for 2021. These experts were trained for years in both systematic and innovative design, through a large diversity of engineering methods of optimization as well as breakthrough R&D and exploratory methods, such as for example C-K theory tools, Design thinking workshops, TRIZ, etc. Thus, this case study seemed relevant to answer the research question.

### **3.2. Data collection**

The study is based on a qualitative research approach, where semi directive interviews and direct observations of the experts of Innovation Patterns Domains were conducted. Internal documents were also collected to allow triangulation (Flick, 2004). As an employee of Renault, the first author had direct access to the Renault organization, and was officially in charge of leading a study on the structuration of the Innovation Patterns Domains.

First, we based our data collection on the previous study of Deval, Hooge and Weil (Deval et al., 2021), which gave us insight on the history of the domain of expertise and the apparition of experts of the unknown.

To better understand how and why the expert of the unknown should animate experts in the unknown to face grand challenges, we conducted three studies. First, we conducted 10 semi directive interviews with authors of patents in artificial intelligence (AI), to understand their

way to design innovative solutions for AI as a grand challenge. We decided to examine the AI (Artificial Intelligence) patents filed by Renault because patents are easily identifiable objects to account for innovation. We chose AI as a grand challenge because some studies have highlighted the challenges faced by historical operators in the automotive industry in coping with the rise of big data and AI technologies (Bohnsack & Pinkse, 2017; Skeete, 2018). Additionally, all challenges in terms of innovation—autonomous driving, connected cars, electrification of powertrains, and shared mobility—involve the development of AI solutions (Hoffmann, 2019; Mohr et al., 2016). AI is indeed considered a crucial domain of expertise in addressing various unknowns associated with automotive transitions.

We identified patents, including the names of inventors, using the World Intellectual Property Organization (WIPO) database, an international online forum on intellectual property. We obtained 29 patent families for our study, distributed among 10 authors. The authors of these patents were contacted via email, and the interviews took the form of semi-structured interviews conducted on Teams.

In the action research methodology perspective to develop practical solutions for the Innovation Patterns Domain (Mckay & Marshall, 2001), we organized two other studies involving one expert and one specialist from the innovation patterns domain. The first creative workshop aimed to identify innovative concepts to support the Renault-Google partnership. When Google and Renault signed their partnership in 2018, the experts from the IPD saw it as an opportunity to test innovative design tools and observe their impacts. As experts in innovation tools, they wanted to demonstrate how design theories could support the Renault-Google partnership. Since we didn't have the right to communicate with Google employees, we began by tracing all Google mobility projects through internet research to understand what Google expected from this partnership. We conducted 15 semi-directive interviews with Renault employees involved in the partnership to understand expectations and

potential obstacles. Based on this knowledge, we used the CK design method to identify concepts that could add value to both Renault and Google.

The findings of this workshop led us to conduct a collective design workshop focused on data quality to create a new group of data experts for the company. This workshop suggested that IPD experts could lead other internal experts to create a new expertise group. We saw this as a new opportunity to model their interaction with the rest of engineering to address an unknown in the transitions. This workshop, called Dat@CK, was based on the KCP workshop method (Hooge et al., 2016) and aimed to test a new breakthrough R&D exploration tool by mobilizing expert leaders on a strategic issue for the firm.

#### **4. Data findings**

##### **4.1. Historical Overview of the Establishment of Expertise in the Unknown at Renault**

In 2009, Renault decided to implement an expertise system connected to upstream engineering, which defines projects, so that experts can identify strategic innovations to develop. Thus, certain business engineers were appointed as experts, although they continued to be distributed across their original engineering disciplines, benefiting from a dual attachment. The lead experts in each domain have the role of identifying innovations to implement in the disciplines to which they are attached, defining the strategic plan that will then be submitted to the disciplines, i.e., to the business engineers. This is to ensure that the latter develop the proposed solutions. In other words, the traditional role of experts has changed: they define the unknowns in design that business engineers must develop, rather than waiting for business engineers to provide them with known unknowns.

Since the 2010s, automotive manufacturers have faced new innovation imperatives: autonomous cars, connected cars, environmentally friendly vehicles, shared mobility, etc. However, experts have struggled to develop radically innovative solutions. In 2016, Renault's

engineering implemented new expertise domains related to transitions, especially in artificial intelligence, cybersecurity, and batteries. However, today, Renault's engineering still struggles to propose radically innovative solutions to meet these imperatives. This demonstrates that adding new expertise to existing historical expertise does not allow for managing unknowns. The challenge in addressing these transitions lies in animating expertise.

Furthermore, by interviewing AI patent authors, we discovered that these authors were surprised that their patents were classified as AI patents. These authors are primarily associated with the Advanced Driver Assistance Systems (ADAS) expertise domain, not the artificial intelligence expertise domain. Indeed, an external organization to Renault, WIPO, classified these patents as AI. This means that there is external recognition that these ADAS experts also have expertise in AI, even though they are not recognized by the company as having AI expertise. This indicates that internal experts at Renault have managed to grow their expertise by incorporating AI expertise to propose innovative solutions without being aware of it and being identified as such by the company. This confirms that the mere accumulation of external expertise is not sufficient; existing expertise must grow by integrating external expertise.

Finally, in 2018, a domain dedicated to innovative design tools, the Innovation Patterns Domain, appeared among Renault's expertise domains to help experts better define the innovations in the strategic plan. This domain built its expertise through the implementation and facilitation of various innovation tools: Innovation Rooms, Labs, Innovation Community, DKCP, learning expeditions, etc. However, the other experts do not use these tools and engage in the exploration of the unknown.

#### **4.2. Experts of the Unknown to Support Innovation**

To understand how experts in the unknown have been able to assist Renault's engineering in a transition, we accompanied the experts from the Innovation Patterns Domain in supporting the Renault-Google partnership.

The signing of this partnership occurred in a challenging context for Renault designers: in the early 1990s and 2000s, Renault led the market in integrated GPS in cars, thanks to its partnership with Tom-Tom, which helped popularize this new option at a low cost. In 2013, Carlos Ghosn, the then-CEO, predicted that Nissan would market autonomous vehicles by 2020. However, since the Tom-Tom GPS, the development of multimedia and navigation systems that succeeded in cars has been complicated and not as qualitative as hoped. Despite the engineering's strong involvement in these matters, Mr. Ghosn decided to sign a partnership with Google to entrust a significant part of the development of car multimedia to them.

To defend Renault's interests, it was expected that internal expertise in AI and cybersecurity would tackle innovative issues. However, the new expertise related to these topics is not robust enough, as it simply added to historical expertise without having time to acquire all the knowledge about the car and the company. As for experts who have expanded their expertise with external expertise, they could not tackle these issues because, on the one hand, they are not all aware of having these new expertises, and even if they were, they are not recognized by the company as such. Thus, experts from the Innovation Patterns Domain identified that internal actors at Renault involved in the partnership with Google lacked expertise in data.

In this context, experts from the Innovation Patterns Domain used design theories to identify new paths of innovation for the partnership. These concepts were then presented to four sponsors potentially interested in the value that these concepts could generate by developing them. These sponsors were not Expert Leaders but decision-makers in project development in engineering. While the experts in disruptive innovation received confirmation from all these



sponsors that the generated concepts presented significant value for Renault, none could be developed for several reasons: lack of time, budget, internal crisis, etc. These repetitive situations motivated the experts from the Innovation Patterns Domain to study how they could support and ensure the development of the identified disruptive concepts. In other words, how they could genuinely be a support for engineering in the face of transitions. They then decided to revisit the initial observation of the internal lack of data expertise, officially absent from Renault's expertise structure. The experts from the Innovation Patterns Domain, therefore, decided to initiate the development of data expertise to help engineering address the unknown surrounding data.

### **4.3. Experts of the Unknown for Experts in the Unknown**

With the support of the Chief Experts (the Expert Fellow) and the Director of IT and Data, the innovation experts decided to organize a data-focused design workshop for the experts, as they are the main actors concerned with learning for engineering. To engage the experts in data expertise, the Innovation Patterns Domain experts wanted to test a new exploration tool dedicated to facilitating a heterogeneous collective to design new objects: the DKCP. The subject established for this DKCP was "mobility data quality." We thus named this project Dat@ck, referring to data and the C-K theory from which the DKCP derives.

The innovation experts redefined the rules for facilitating the DKCP to adapt it to the post-pandemic context at Renault. For example, the facilitation was conducted remotely due to telecommuting, with a maximum duration of 2 hours, spread over 2 years, instead of the traditional 5 full days in person. During the Definition phase, 16 internal experts were interviewed on the topic, allowing for the mapping of existing expertise in engineering and identifying the strategic knowledge gaps that needed to be filled. A collective of 37 experts from different domains was formed to participate in the process. Around twenty of these experts regularly participated in the K, C, and P workshops. In the Knowledge phase, 10

presentations were organized for these 37 heterogeneous experts, 6 on the state of the art (on what Renault already knows about data), and 4 on the non-art (about what exists in other companies which seems to be strategic for Renault). These presentations enabled the experts to acquire and share the same level of knowledge about the new expertise and identify unknowns.

Based on this newly acquired knowledge, participating experts individually formulated 72 concepts that seemed innovative to them, which they presented. Subsequently, they collectively selected 19 concepts that seemed the most strategic. In this way, the Conceptualization phase allowed experts to identify solutions that appeared to be the most radically innovative. Finally, during the Project phase, the experts translated these 19 concepts into potential projects, which they presented to the Expert Fellow and the IT and Data Director. The latter validated the development of 7 projects.

Through this workshop, the experts in the unknown facilitated heterogeneous experts in managing grand challenges. Specifically, they helped them acquire missing strategic knowledge about data, allowing them to expand their original expertise by integrating new expertise (data); they assisted them in formulating innovative concepts and collectively selecting the most promising ones; and they guided them in tackling the subjects by creating project sheets and developing 7 projects. In other words, they achieved their first objective of supporting engineering and, secondly, institutionalized a method for facilitating a heterogeneous group of experts to explore unknowns related to grand challenges.

## **5. Discussion of the results**

### **5.1. Experts to Identify Unknowns in Transitions**

Our work allows for a reexamination and enrichment of several points. To begin, the context of intensive innovation from the 1990s has given way to an innovation context for transitions starting in the 2010s. This new context calls for formalizing a new regime of expertise.

Indeed, grand challenges require mastery of numerous new high-level expertises. It becomes apparent that the expertise structure of an established company will enter into a crisis as soon as an unknown related to grand challenges, involving complex external expertises unfamiliar to the industry, must be mastered by internal expertise structures to ensure the company's survival. A new regime of expertise emergence is then necessary to integrate complex external expertises and adapt them to internal expertises. This mastery of complex expertises raises the question of their compatibility with existing expertises and the conditions for their integration into the company's expertise. Our study shows that there are essential steps to enable industrial expertise structures to manage these new expertises:

- To begin, internal experts must be able to identify new, specific needs that are vital for the company and complex to integrate (the unknowns of the grand challenge to be managed). To achieve this, they regularly exchange information among experts in the same domain or among expert leaders to assess the strategic importance of the questions posed by transitions on the industrial objects they develop and the introduction of their consideration into the "product" and "industrial" architecture.
- Internal experts must then organize an exploration around this unknown. They can mobilize their internal networks with other experts in the company and their external network related to their area of expertise.
- This exploration should lead to a technical inability to meet these needs with the existing networks. It is then necessary to identify the reason for delimiting the expertise to be acquired and the coordination challenges with the expertise structure.
- The identification should then lead to the coordination of impacted expertises internally through the animation of their representatives, resulting in the appointment of experts responsible for animating the new expertises in engineering.

This process highlights the role and limits of action of existing experts: they are capable of identifying new expertises to be integrated and justifying the reason for doing so; that is, to meet a specific need vital to the company. They do not wait for the decision-maker to submit a problem; they can themselves identify new unknowns within and outside their area of expertise. They are capable of identifying and justifying the need to integrate complex external expertises concerning the sustainability of engineering and the technical viability of the industrial objects it develops. This point aligns with Cabanes' (2016) assertion regarding the evolving role of technical or scientific experts: their role is not limited to being a resource for the decision-maker; they must also collectively define the boundaries of the company's expertises.

## **5.2. The Expert of The Unknown To Support Experts In The Unknown in the Face of Grand Challenges**

Our research demonstrates that the unknown expert assists other experts in identifying vital future needs. Additionally, they aid technical and scientific experts who have identified crucial needs for the company in developing a strategy to address them. This assistance is manifested through the facilitation of experts from various domains. Initially, the goal is to familiarize them with new, complex external expertises, then to mobilize these new expertises in formulating innovative solutions, and finally, in organizing the development of these solutions. Our work contributes to enriching the description of the role of the unknown expert: they must be capable of animating heterogeneous experts, helping them acquire new expertises, fostering a common language, identifying common unknowns, and formulating new ideas to develop. They can thus be considered dedicated to animating innovation fields in the sciences and engineering. In other words, we are witnessing the institutionalization of unknown experts for experts in the unknown.

This implies one thing: as it takes about a decade to be institutionally recognized as an expert in a field, we assume that there are actors across different companies who embody a form of expertise in the unknown. We posit that these forms of unknown actors have gradually and simultaneously emerged with innovative design theories that offer tools for exploring the unknown (DKCP, CK theory and its derivatives, as well as design thinking, prospective conceptive, etc.).

### **5.3. Institutionalization of a Process for the Emergence of New Expertise for Grand Challenges**

The literature on experts asserts that technical or scientific experts know how to expand their expertise by absorbing external knowledge specific to their fields. However, they do not know how to extend their expertise based on another expertise when it becomes necessary for the survival of the company. Regarding transitions, the expert must renew their expertise in their field by integrating and adapting the previously identified external expertise. Here, we see that the way they must build their expertise based on others will gradually lead them to become multi-expertise experts. However, experts lack the skills or tools to ensure the integration of these new expertises. It is necessary to identify the organization of the expertise network that will enable this new regime. The animation of these experts by experts of the unknown is established in a process that can be described as follows. First, scientific or technical experts, considered as actors in the system of regulated design, identify vital needs and a technical inability to respond because new complex external expertises must be identified and integrated. Then, the experts of the unknown organize a sequence of animation for scientific or technical experts in various stages:

- They anchor the exploration by forming a new group of experts who do not initially share the same expertise, aiming to map internal expertises and their limits to guide the acquisition of new knowledge, organizing the creation of new knowledge around

the transition to allow this group to share new common expertise (thus expanding knowledge useful for regulated design through oriented exploration);

- This new knowledge contributes to enriching the design by formulating desirable concepts for transitions (expanding innovative concepts useful for innovative design);
- The feasibility of these new concepts, translated into specifications, allows for the extension of quality standards for exploitation (a new extension of regulated design), thus ensuring a bridge between innovative and regulated design activities.

The implementation of this process at Renault has had several lasting managerial impacts:

- Initially, creativity tools did not address technical fields or involve diverse groups. With an adaptation of DKCP to their industrial context, unknown experts have implemented a tool for collective, technical, and multi-expertise creativity.
- Furthermore, the exploration of unknowns was previously organized by a homogeneous group of technical or scientific experts, i.e., within the same domain. However, the performance of unknown experts lies in their ability to facilitate an exploration based on a heterogeneous group of experts in various fields.
- Finally, the collective integration of new expertises enables experts to formulate innovative concepts and organize their development, transcending the divisions of expertise domains.

In other words, unknown experts assist experts when immersed in the unknown challenges of restructuring their expertise field by acquiring knowledge, know-how, and skills specific to complex external expertises. The mapping of internal expertises during the exploration phase serves as an evaluation modality for internal competencies. During phase K, this operation of acquiring new expertises is carried out by heterogeneous experts, meaning that multiple domains of internal expertise acquire the same external knowledge, progressively creating a stronger interdependence between expertise fields. Furthermore, the heterogeneous group

mobilized in the workshop constitutes a new group of experts focused on an unknown transition. This emphasizes that expertise structures also evolve. In this way, this workshop for collective exploration and design values working in connection with internal actors, thereby promoting the collective management of expertise. It is more of a combinatorial mode of knowledge management than additive (Defélix et al., 2014). Thus, in continuation of Cabanes' work on the emergence regimes of expertise based on the innovation context, we propose a new regime for transitions: an emergence regime based on the integration of external expertise fields and the co-extension of existing expertise fields.

## **6. Conclusion**

In conclusion, the works of Deval, Weil, and Hooge (2021) have led us to understand that experts of the unknown have been established to develop tools for experts to enhance their learning. Our study demonstrates that the role of experts of the unknown is more specific in the context of grand challenges: technical and scientific experts identify unknowns, and experts of the unknown design tools and workshops to engage these experts in identifying and acquiring new expertise, formulating innovative concepts, and initiating the production of satisfactory solutions for grand challenges. This method of animation and acquisition of new expertise gives rise to a new regime of expertise based on the combination of new expertise with historical ones. From a scientific standpoint, our study contributes to defining experts of the unknown and to the literature on expertise regimes. From a practical perspective, our study proposes a replicable method of exploration and design to assist experts in innovating in the face of grand challenges.

This study opens up several avenues for further research. Firstly, it would be interesting to model the different forms of experts of the unknown in other industrial companies to further refine the definition of experts of the unknown. It would also be valuable to examine their

tools and practices to identify various processes for managing grand challenges through engineering.

## 7. Bibliography

- Agogu , M., & Kazakçı, A. O. (2014). 10 Years of C-K Theory : A Survey on the Academic and Industrial Impacts of a Design Theory. In *An Anthology of Theories and Models of Design : Philosophy, Approaches and Empirical Explorations* (p. 219- 236). Springer.  
<https://hal-mines-paristech.archives-ouvertes.fr/hal-00983009>
- Barley, S., & Tolbert, P. S. (1991). *Introduction : At the Intersection of Organizations and Occupations*.
- Berthet, E., Barnaud, C., Girard, N., Labatut, J., & Martin, G. (2016). How to foster agroecological innovations? A comparison of participatory design methods. *Journal of Environmental Planning and Management*, 59, 280- 301.  
<https://doi.org/10.1080/09640568.2015.1009627>
- Bohnsack, R., & Pinkse, J. (2017). Value propositions for disruptive technologies : Reconfiguration tactics in the case of electric vehicles. *California Management Review*, 59(4), 79- 96.
- Brown, J., & Duguid, P. (2001). Knowledge and Organization : A Social-Practice Perspective. *Organization Science*, 12. <https://doi.org/10.1287/orsc.12.2.198.10116>
- Cabanes, B., Galy, P., Le Masson, P., & Weil, B. (2016). *Technical Staff Management for Radical Innovation in Science-based Organizations : A New Framework Based on Design Theory*.
- Cabanes, B., Le Masson, P., & Weil, B. (2020). Les r gimes de cr ation d'expertise : Innovation et gouvernance de l'expertise dans les organisations industrielles. *Entreprises et histoire*, n  98(1), 15- 41.



- Cabanes, B., Masson, P. L., & Weil, B. (2020). Regimes of expertise creation : Innovation and governance of expertise in industrial organizations. *Entreprises et Histoire, No 98(1)*, 15- 41.
- Candelo, E. (2019). *Marketing innovations in the automotive industry: Meeting the challenges of the digital age*. Springer.
- Candelo, E., Troise, C., Matricano, D., Lepore, A., & Sorrentino, M. (2021). The evolution of the pathways of innovation strategies in the automotive industry. The case of Fiat Chrysler Automobiles. *European Journal of Innovation Management*.
- Chase, W. G., & Simon, H. A. (1973). The mind's eye in chess. In W. G. Chase (Éd.), *Visual Information Processing* (p. 215- 281). Academic Press.
- Clark, K. B., & Fujimoto, T. (1989). Lead time in automobile product development explaining the Japanese advantage. *Journal of Engineering and Technology Management, 6(1)*, 25- 58.
- Clark, K. B., & Fujimoto, T. (1991). Heavyweight product managers. *McKinsey Quarterly, 1*, 42- 60.
- Cowan, R., David, P. A., & Foray, D. (2000). The explicit economics of knowledge codification and tacitness. *Industrial and corporate change, 9(2)*, 211- 253.
- David, A., & Hatchuel, A. (2008). From Actionable Knowledge to Universal Theory in Management Research. In A. B. (Rami) Shani, S. A. Mohrman, W. A. Pasmore, B. Stymne, & N. Adler, *Handbook of Collaborative Management Research* (p. 33- 48). SAGE Publications, Inc. <https://doi.org/10.4135/9781412976671.n2>
- Deval, M.-A., Hooge, S., & Weil, B. (2021, juin). The emergence of “experts of the unknown” – Learnings from Renault and SNCF. *Euram*. <https://hal.archives-ouvertes.fr/hal-03264373>

- Ellison, D. J., Clark, K. B., Takahiro, F., & Young-suk, H. (1995). *Product Development Performance in the Auto Industry: 1990s Update*.  
<https://dspace.mit.edu/handle/1721.1/1649>
- Elmqvist, M., & Segrestin, B. (2009). Sustainable development through innovative design : Lessons from the KCP method experimented with an automotive firm. *International Journal of Automotive Technology and Management*, 9(2), 229- 244.  
<https://doi.org/10.1504/IJATM.2009.026399>
- Elmqvist, M., & Segrestin, B. (2012). Towards New R&D Processes for Sustainable Development in the Automotive Industry : Experiencing Innovative Design. In G. Calabrese (Éd.), *The Greening of the Automotive Industry* (p. 69- 85). Palgrave Macmillan UK. [https://doi.org/10.1057/9781137018908\\_5](https://doi.org/10.1057/9781137018908_5)
- Ericsson, K. A. (1996). *The Road To Excellence : The Acquisition of Expert Performance in the Arts and Sciences, Sports, and Games* (1st edition). Lawrence Erlbaum Associates.
- Evetts, J., Mieg, H. A., & Felt, U. (2006). Professionalization, Scientific Expertise, and Elitism : A Sociological Perspective. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Éds.), *The Cambridge Handbook of Expertise and Expert Performance* (p. 105- 124). Cambridge University Press.  
<https://www.cambridge.org/core/books/cambridge-handbook-of-expertise-and-expert-performance/professionalization-scientific-expertise-and-elitism-a-sociological-perspective/074223E6BE521B77136058E764DBFFF6>
- Flick, U. (2004). Triangulation in qualitative research. *Triangulation in Qualitative Research*.
- Gilbert, P., Bobadilla, N., Gastaldi, L., Le Boulaire, M., & Lelebina, O. (2018). *Innovation, Research and Development Management*. John Wiley & Sons.
- Haas, P. M. (1992). Introduction : Epistemic Communities and International Policy Coordination. *International Organization*, 46(1), 1- 35.

- Hayes, J. R. (1989). Cognitive Processes in Creativity. In J. A. Glover, R. R. Ronning, & C. R. Reynolds (Éds.), *Handbook of Creativity* (p. 135- 145). Springer US.
- Henderson, R. M., & Clark, K. B. (1990). Architectural innovation : The reconfiguration of existing product technologies and the failure of established firms. *Administrative science quarterly*, 9- 30.
- Hoffman, M., Zayer, E., & Stempel, K. (2019). A Survival Guide for Europe's Car Dealers. *Bain & Company*.
- Hoffmann, M. (2019). A Survival Guide for Europe's Car Dealers. *Bain & Company*.
- Hooge, S., Béjean, M., & Arnoux, F. (2016). Organising For Radical Innovation : The Benefits Of The Interplay Between Cognitive And Organisational Processes In KCP Workshops. *International Journal of Innovation Management*.
- Iacobucci, R., McLellan, B., & Tezuka, T. (2018). Modeling shared autonomous electric vehicles : Potential for transport and power grid integration. *Energy*, 158, 148- 163. <https://doi.org/10.1016/j.energy.2018.06.024>
- Ilinitch, A., D'Aveni, R., & Lewin, A. (1996). New Organizational Forms and Strategies for Managing Hypercompetitive Environments. *Organization Science - ORGAN SCI*, 7, 211- 220.
- Lave, J., & Wenger, E. (1991). Learning in doing : Social, cognitive, and computational perspectives. *Situated learning: Legitimate peripheral participation*, 10.
- Le Masson, P., Weil, B., & Hatchuel, A. (2017). *Design Theory : Methods and Organization for Innovation* (1st ed. 2017). Springer International Publishing.
- Lelebina, O. (2013). Initiating and managing career creativity of corporate professionals. *13th Annual Conference of the European Academy of Management, EURAM 2013*, 32 p.
- Mahdavian, A., Shojaei, A., McCormick, S., Papandreou, T., Eluru, N., & Oloufa, A. A. (2021). Drivers and Barriers to Implementation of Connected, Automated, Shared, and

- Electric Vehicles : An Agenda for Future Research. *IEEE Access*, 9, 22195- 22213.  
<https://doi.org/10.1109/ACCESS.2021.3056025>
- Maniak, R., Midler, C., Lenfle, S., & Le Pellec-Dairon, M. (2014). Value Management for Exploration Projects. *Project Management Journal*, 45(4), 55- 66.  
<https://doi.org/10.1002/pmj.21436>
- Mckay, J., & Marshall, P. (2001). The dual imperatives of action research. *Information Technology & People*, 14, 46- 59. <https://doi.org/10.1108/09593840110384771>
- Menard, S. (2002). *Longitudinal Research*. SAGE.
- Mieg, H. A. (2012). *The Social Psychology of Expertise : Case Studies in Research, Professional Domains, and Expert Roles*. Psychology Press.
- Mohr, D., Kaas, H., & Gao, P. (2016). Automotive revolution & perspective towards 2030. *Auto Tech Review*, 4(5), 20- 25.
- Moisdon, J. C., & Weil, B. (1995). Collective design : Lack of communication or shortage of expertise ? Analysis of coordination in the development of new vehicles. *Designs, networks and strategies, European Commission*, 97- 110.
- Oiry, E., Barbet, P., Defélix, C., & Louart, P. (2014). Innovation et Management. *RIMHE: Revue Interdisciplinaire Management, Homme Entreprise*, 123(3), 3- 9.
- Pettigrew, A. M. (1990). Longitudinal Field Research on Change : Theory and Practice. *Organization Science*, 1(3), 267- 292. <https://doi.org/10.1287/orsc.1.3.267>
- Rampa, R. (2020). *Émergence et Organisation d'une fonction d'innovation disséminée : Ethnographie d'un institut de recherche en mutation*. HEC Montréal.
- Rampa, R., Abrassart, C., & Agogué, M. (2017). *Training for Innovative Design to Increase Organizational Creativity : A Longitudinal Study of Hydro-Québec's Research Center: State of the Art and Future Research Outlook* (p. 97- 113).  
[https://doi.org/10.1142/9781786342010\\_0005](https://doi.org/10.1142/9781786342010_0005)

- Roqueplo, P. (1997). *Entre savoir et décision, l'expertise scientifique*. Editions Quæ; Cairn.info.
- Shani, A. B. (Rami), Mohrman, S. A., Pasmore, W. A., Stymne, B., & Adler, N. (2008). *Handbook of Collaborative Management Research*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412976671>
- Shanteau, J. (1992). Competence in experts : The role of task characteristics. *Organizational Behavior and Human Decision Processes*, 53(2), 252- 266.
- Shappin, S., & Schaffer, S. (2011). *Leviathan And the Air-Pump – Hobbes, Boyle, and the Experimental Life* (Revised édition). Princeton University Press.
- Shepard, H. A. (1958). The dual hierarchy in research. *Research Management*, 1(3), 177- 187. JSTOR.
- Skeete, J.-P. (2018). Level 5 autonomy : The new face of disruption in road transport. *Technological Forecasting and Social Change*, 134(C), 22- 34.
- Weil, B. (1999). *Conception collective, coordination et savoirs : Les rationalisations de la conception automobile* [Thesis]. Paris, ENMP.
- Weisberg, R. W. (2006). *Modes of Expertise in Creative Thinking : Evidence from Case Studies*.
- Wheelwright, S. C., & Clark, K. B. (1992). *Revolutionizing Product Development : Quantum Leaps in Speed, Efficiency, and Quality*. Simon and Schuster.