



HAL
open science

Rethinking ideation: a cognitive approach of innovation lock-ins

Marine Agogu , Pascal Le Masson

► **To cite this version:**

Marine Agogu , Pascal Le Masson. Rethinking ideation: a cognitive approach of innovation lock-ins. Academy Of Management, Aug 2015, Vancouver, Canada. hal-01132377

HAL Id: hal-01132377

<https://minesparis-psl.hal.science/hal-01132377>

Submitted on 18 Mar 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destin e au d p t et   la diffusion de documents scientifiques de niveau recherche, publi s ou non,  manant des  tablissements d'enseignement et de recherche fran ais ou  trangers, des laboratoires publics ou priv s.

Rethinking ideation: a cognitive approach of innovation lock-ins

AGOGUE, Marine; LE MASSON, Pascal

Abstract: Some industries are lacking the proposal of truly original new ideas to renew existing products and/or services, despite repeated efforts from all stakeholders to make innovative and original proposals. These situations, called orphan innovation, lead to revisit the contemporary approaches to the study of obstacles in ideation, as orphan innovation is a paradoxical situation. Conventional financial constraints and institutional level are released, the market demand is strong, niche strategies are possible and bold entrepreneurs abound. And yet, the proposals do not fulfil expectations regarding innovation.

We advocate in this paper that cognitive sciences can contribute to making sense of this phenomenon. Based on recent studies in cognitive psychology on idea generation, we propose a model of ideation reasoning, contrasting heuristic-based reasoning and exploration-based reasoning. We then apply this model on a case study, showing how a cognitive model of ideation allows to diagnose orphan innovation and more generally innovation lock-ins.

Keywords: ideation; cognition; innovation lock-ins; idea generation

1 Introduction

The generation of new ideas is a key element in any innovation process (Tidd & Bessant 2000). Radically new products and new services are not designed without a prior exploration of novel ideas that break with the dominant logic in the organizational field (Battilana, Leca & Boxenbaum 2009). However, when a cognitive paradigm becomes dominant, it can prevent the generation of new ideas, block innovation and then lead to what design literature as called “fixation” (Janson & Smith 1991, Purcell & Gero 1996, Agogu e et al 2013). Fixation is a blind and sometimes counterproductive stickiness to a limited set of ideas during the generation of new ideas. An important challenge for innovation research is thus to understand how novel ideas can be generated and implemented even when fixation occurs. The answer to this question may illuminate ways in which we can proactively stimulate the generation of new ideas, and thus promote innovation.

To illustrate the difficulties that occur during idea generation, we take an example from the field of elderly care in France. In this field, one way to innovate is to build on information and communication technologies that assist seniors. In the coming decades, France will, like many other western countries, face significant challenges related to the aging of its population. The number of French citizens above the age of 75 is expected to reach a total of 10 million people in 2040, of which approximately 1.2 million people are expected to be dependent upon social programs. According to current trends, most of these seniors will want to remain in their homes until the end of their lives. However, despite the wide recognition of the financial and human resource challenges that this demographic development presents, innovative proposals for how to address them have been surprisingly slow to manifest. One of few innovations developed for this population

is the ability to supervise a person with loss of autonomy in his or her residence via high-technology devices. For instance, a medallion linked to a telealarm system can trigger a remote alarm and activate sensors that detect if a person has made a fall and then initiate a rescue operation if needed. For the past fifteen years, a variety of such devices have appeared on the market, but none of them have until now achieved commercial success. Interviews with users tend to reveal that these devices reinforce a stigma related to age and disabilities: being designed “for elderly people”, they do not fit with how the targeted user groups (mainly the elderly) perceive, or would like to perceive, themselves. In addition, these technologies do not entirely resolve the problem of providing assistance to seniors as most devices trigger an alert but do not prevent the accident from occurring. As a result, this type of innovative proposals has not been very successful. In general, the capacity for innovation among actors in the field of elderly care remains weak compared to societal expectations, and all the innovative efforts are aligned within the same class of ideas, that is the ability to supervise a person with loss of autonomy in his or her residence via high-technology devices.

A situation in which society expects many innovative proposals but no actors produce them has been labelled as orphan innovation situation (Agogu , Le Masson & Robinson, 2012). In such a situation, even if numerous actors are mobilized to propose solutions, few novel ideas are generated and few substantially new products and services come to market, let alone succeed commercially. Orphan innovation is therefore a paradoxical situation. Financial and institutional constraints are relaxed, the market demand is strong, diverse actors are committed, niche strategies are possible and bold entrepreneurs abound. And yet, the proposals remain disappointing in terms of innovation compared with expectations. Understanding this paradox actually requires to examine the

cognitive mechanisms of idea generation outside known paradigms. If different social science streams, such as path-dependence literature, highlight the existence of cognitive mechanisms as part of the innovation process, these theoretical approaches do not open the black box of the idea generation per se and do not provide evidence to clarify the issue of orphan innovation. Part of the explanation for orphan innovation may lie with cognitive lock-ins that reduce the capacity of actors to generate and support ideas that deviate from existing paradigms. An important question is therefore how novel ideas can be stimulated. We explore this topic from an endogenous viewpoint, namely that of individuals' ability to deviate from existing paradigms.

The argument we advance in this paper contains a theoretical component and an empirical component. The paper is organized as follows: we first review existing literature on innovation lock-ins and ideation difficulties. We then bridge to cognitive science to propose and discuss a cognitive model of ideation to diagnose orphan innovation. We present an illustration of this model on an orphan innovation case to highlight the managerial implications of this cognitive approach of ideation, and to underline how an analytical model of ideation also helps to propose managerial levers to stimulate ideation in new directions in order to overcome orphan innovation. Breaking with the common assumption that individual creativity is constrained by collective mechanisms such as social conformity or inhibition, we conclude that there is a need today to rethink the collective action as leverage on the capacity of individuals to generate creative ideas.

2 Innovation lock-ins : the key-role of cognitive bias in ideation

Various streams of research in management and organization theory sought to explain the causes of innovation staleness, in particular in order to better understand the organizational inertia and the impact of past events on the decision-making process. An explanation highlighted by the literature on the possible obstacles to innovation is the lack of knowledge and absorptive capacity (Tödtling & Trippl, 2005). Stakeholders in an industry may indeed not have the skills or resources to innovate, nor the required non-local relationship to thrive (Camagni, 1991). On a more institutional level, the path dependence phenomenon has been studied for over 25 years (David, 1985). The concept of path-dependence was initially used to describe the fact that the long-term evolution of a system depends on its starting point and on potential hazardous events, meaning that past events condition future evolution, preventing new possible future to emerge. However, is the issue to understand why some innovation pathways are achievable or not, chosen or not, or is the issue more about understanding the inability of firms to propose new ideas, to explore new innovation paths? Indeed, the lack of knowledge and the path-dependence approaches propose explanations to innovation blockages that are built on the underlying assumption that stakeholders have different options from which to choose to invest or not, and that those options are known, well-identified, and the blockage lies in the result of a decision based on certain criteria which are not necessarily promoting innovation. However, it is legitimate to assume that the options available already exist? That stakeholders have the capacity to generate all the possible options and that the issue is of decision-making?

2.1. Biased decisions in innovation activities: the path-dependence phenomenon

Individuals and organizations tend to be biased in innovation activities. Literature on path-dependence has shown how historical events could influence the outcome of a stochastic process (Arthur 1989; David 1985; Meyer & Schubert 2007). Path-dependence describes the fact that the long-term evolution of a system depends on its starting point and on hazardous events incurred during its history (David, 1985; 2000). Thus, this concept describes the effects of past events on future developments (Sydow et al, 2009; Liebowitz & Margolis, 1995), and focuses on how certain technologies become standard even though their sub-optimality is proven. Today, the concept of path dependence is expanded in sociology and history to indicate how actors undertake decision due to past events.

Moreover, economic literature points to the existence of certain rules or principles that impact industrial dynamics (Dosi 1982, Cohendet & Llerena 1993, Kaplan & Henderson 2005). These rules may limit the capacity of stakeholders to explore alternatives to the existing paradigm, extending the notion of path dependence to the notion of cognitive path dependence (Kaplan & Tripsas, 2008; Thrane, Blaabjerg, & Møller, 2010). Kaplan and Tripsas (2008) argue indeed that the uncertainty inherent in the nature and trajectory of a new technology requires economic actors working on this technology to make sense of the situation before acting. These studies clarify how actors select ideas within a collective cognitive framework around a dominant technological trajectory. Thrane and colleagues (2010) stress that this collective cognitive framework can lead to constrain the exploration of alternatives, which can be interpreted as cognitive path dependence, i.e. confinement in a privileged way of innovation because of a shared vision. These cognitive factors supplement the purely economic and institutional path-

dependence of the approach, realizing complementary interactions between actors around these cognitive frameworks, shared or not.

Research on path-creation introduces agency into the picture, arguing that entrepreneurs can intentionally deviate from existing ideational structures (Garud & Karnoe, 2001). Actors engage in experimentation and exploration as they probe into the world as it is being created (ibid: p. 8). Garud and Karnoe moreover stress that deviating from existing frames, i.e. deframing, implies appreciating cognitive embeddedness in order to depart from existing representation in mindful ways. In other words, to be able to think "outside of the box", we must already know where the box is. However, the mechanisms that lead individuals to create new paths remain unarticulated.

2.2 Bridging to cognitive science

Being a discipline studying individual reasoning and development, cognitive psychology seems well equipped to study bias at the individual level of analysis. The study of cognitive bias is at the heart of work in cognitive psychology, which has contributed to identify systematic deviations from normative models in multiple areas: probability judgment and decision making (Kahneman & Tversky, 1982), deductive and inductive reasoning (Frederick, 2005, Kahneman & Tversky, 1972); social relations (Drozda-Senkowska, 1999), etc.

Research examines, for instance, the effect of framing on decision-making (Kahneman & Tversky, 1982). This research highlights how individuals can be biased in their decision-making when the frame describing the options changes. The authors explored how two different phrasings affected participants' responses to a choice in a hypothetical life and death situation. In the experiment, participants were asked to choose

between two treatments, A and B. Treatment A was chosen by 72% of participants when it was presented with positive framing ('it will save X lives') dropping to only 22% when the same choice was presented with negative framing ('Y people will die').

2.3 Alternatives Generation: Fixation effect in cognitive psychology

When it comes to idea generation processes per se, recent studies show how individuals tend to generate ideas based on spontaneously activated knowledge (Smith, Ward & Schumacher 1993; Agogu e et al. 2013). This process activates creative reasoning along the path of least resistance (Ward, Patterson & Sifornis 2004). According to these studies, individuals use existing elements to generate new ideas, leading to fixation effects. Cognitive fixation during idea generation refers to a body of work that helped to clarify the obstacles that most people are likely to encounter in creative situations (Abraham & Windmann, 2007, Smith, Ward, & Schumacher, 1993, Smith, Ward, & Finke, 1995; Jansson & Smith, 1991); it characterizes fixation effect as a spontaneously activated knowledge in creative tasks that constrains further explorations.

Agogu e and colleagues (2014) have demonstrated that the ability to generate new ideas could be constrained. From the "task of the egg," in which subjects must design a way to ensure that a hen's egg dropped from a height of 10 meters does not break, the authors examined how individuals are fixed on the same solutions when asked to generate the most creative solutions as possible. Around 80 percents of the answers given are on the following categories: that is to say "damping the shock", "protecting the egg" and "slowing the fall", which are quite classical. The authors argue that two different reasoning systems seem to compete: the use of cognitive routines (called heuristics), that push individuals to take the path of least resistance in order to propose already known

solutions (or not very creative) and the use of expansive reasoning to explore alternatives outside of fixation effect. Besides, research starts to explore today factors that allow to shift from one system of reasoning to another. Typically, some studies (Agogué et al 2013) show that the introduction of an example can impact the competition between the two systems, as classic examples tend to reinforce the activation of heuristics, while disruptive and original examples support creativity and the exploration of new solutions.

3 Towards a cognitive model for the management of ideation

Cognitive science studies can then help shed light on the cognitive processes that occur during ideation and that can constrain or stimulate the generation of truly new ideas. Essentially, individuals tend to activate heuristics and shortcuts that are based on existing representations of known objects, leading to incremental creativity and fixation on classical solutions. This type of reasoning can be labelled as a *Heuristic-based reasoning*. Heuristics are short-cut mental strategies that streamline information (Nisbett et al., 1983). Heuristic-based reasoning in ideation accounts therefore for the tendency to maintain existing paradigms. Since others tend to share the same cognitive paradigm, we are unlikely to encounter opposition, questioning, or challenge from them, shifting to conformity (Ford, 1996; Smith, Ward & Schumacher, 1993). Such reasoning occurs along the path of least resistance (Ward, 1994), therefore requires low cognitive resources and leads to the generation of elements of solutions that fit with the paradigm, bearing a low degree of originality. But another type of reasoning can be described as well, which is built on the extension of the objects we are working on, on the expansion processes that bring new knowledge in (Hatchuel, 2001). Thus, in *Exploration-based reasoning*, individuals engage in the controlled construction of expansions that challenges the existing

paradigms, potentially leading to new ideas and disruptive, innovative solutions. Exploration-based reasoning allows generating original and rare ideas but requires a controlled, costly slow process. Indeed, it takes more cognitive effort to generate multiple alternatives, suspend judgment, and look for originality than to reuse known solutions (Shalley & Gilson, 2004). Table 1 outlines some of the core features of the two types of reasoning as they apply to idea generation.

Insert Table 1 about here

4 Methodology: applying a cognitive model to orphan innovation

4.1 Data selection

We now give an example of how a cognitive model of ideation can help understand orphan innovation and enable to propose managerial levers on this situation. To do so, we present go back to the case presented in the introduction, that is, the ecosystem of new technologies that are designed to assist seniors in the Rhône-Alpes region (South of France). This ecosystem is in an orphan innovation situation: despite favourable institutional conditions and a strong societal demand for innovation, there appears to be a certain lethargy among the stakeholders regarding proposing new, disruptive, out-of-the-box innovations. Indeed, the principal innovation that was developed over a fifteen-year period in this sector is the ability to supervise a person in their residence via high-technology devices, but these innovations did not appear to encounter notable success.

4.2 Data collection

We conducted an intervention research in the Rhône-Alpes region between Septembre 2009 and July 2012. Intervention research aims to contribute to both practice and theory building (Shani et al., 2007; Radaelli, Guerci, Cirella & Shani, 2014; Hatchuel & David, 2007). As such, a distinguishing feature of intervention research, differentiating it from other forms of qualitative method in management studies, is the deliberate involvement of the researcher in changes to the situation being researched (Coghlan, 2011; Huxham and Vangen, 2003). This was considered to be a suitable research design to study the different types of ideation reasoning, those being difficult to capture either in retrospect or through questionnaires.

Our research initiated with the demand in 2009 of the cluster I-Care to study the staleness of the industry in terms of innovation. At the initiative of the director of the cluster, intervention-research began in September 2009 with an analysis of several projects on the subject of elderly autonomy. These projects were submitted to the cluster through a call for proposals in mid-2009. This initial analysis has identified gaps in the knowledge used by the industry, some of which can be listed as:

- knowledge of the physical and mental condition of the elderly, their learning abilities or their perception of their own frailty, for example;
- the diversity of the social system within which a person, taking into account the caregivers, care staff, relatives, neighbors, etc.. ;
- issues of medical ethics, such as the issue of control at all costs, at the expense of individual freedom;
- economic recovery devices in the healthcare market and / or market new technologies etc..

A further study of the products and services available on the market confirmed that these shortcomings were not addressed yet. This analysis helped to establish the knowledge base necessary to start modeling the cognitive field frame. This knowledge map was then supported by interviews with various members of the group of players with the ability of the cluster to mobilize various stakeholders. For example, we met with geriatricians who point to emerging concepts in geriatrics, which guided the exploration of a new notion, the concept of fragility.

Between 2009 and 2012, we met on a regular basis (at least once a month) for work sessions with the management of the cluster I-Care. We iteratively built a cognitive mapping of the different types of reasoning occurring within the industry, and came to a joint understanding with the manager of the cluster in regards with the heuristic-based versus exploration-based reasoning.

4.3 Data analysis

Based on the cognitive model of ideation reasoning described above, we propose to analyse our collected material based on the distinction between heuristic-based reasoning and exploration-based reasoning. To do so, we look at four dimensions: the nature of the cognitive paradigms shared among the field, the nature of the existing objects and/or projects, the nature of the key-words used in the field and the genesis of generated ideas in on-going projects.

Table 2 synthesizes the matrix used to analyse the collected data.

Insert Table 2 about here

5 Findings: diagnosing and acting on orphan innovation

This work resulted in the construction of cognitive mapping, which showed a very strong effect of fixation effect around the monitoring of the elderly people, whereas alternatives remained unexplored. This modeling showed that the innovative proposals are not adapted to the needs of users, are difficult to use, and stigmatize age and handicap. The question of acceptability is a crucial point. Further, current projects do not entirely address the issue because most devices trigger an alert in the case of an incident but do not prevent the accident from occurring. In addition, there are various obstacles beyond the question of users' acceptability, including the absence of a structured health market, difficulties in understanding and complying with regulations, and the need for prescriptions for the devices by medical personnel. Responding to the demand for innovation appears to challenge the innovation capacities that are in place and requires stakeholders to explore new ideas to address a new paradigm.

The discussion that was initiated by the I-Care cluster with geriatricians and some readings has led to a more exploratory type of reasoning, leading to the discovery of the concept of fragility. The problem of autonomy can then be reformulated using this new concept (Fried et al., 2001). Fragility is described as an intermediate state between robustness and dependence. During this period of life, which affects, for example, a large proportion of seniors, the risk of falling or developing a disease is greater. Modeling fragility in this manner implies that an individual is only fragile in relation to the state of the environment in which he or she finds himself. Thus, an individual who has trouble seeing properly will have less difficulty seeing in a brightly lit room than in a dark room. Fragility is then defined by the hostility of an environment.

Table 3 synthesizes the modelling of both heuristic-based and exploration-based reasoning in the field of ICT for the autonomy of elderly in the Rhône-Alpes region in France.

Insert Table 3 about here

Shifting from the concept of ICT for assisting the autonomy of seniors to the concept of fragility makes visible new interdependences among the actors as well as new actors to involve, and helps to understand the current staleness in the innovation processes. It is this new concept of fragility that allows us to characterize the relevant ecosystem in dealing with helping aging people. Thus, the actions of the cluster and the proposed conceptual broadening help to open the field to new stakeholders (e.g., in connection with fragility and the seniors' environment). Therefore, diagnosing ideation reasoning in orphan innovation is a first step in acting on overcoming such situation.

Various actions performed by the cluster led to the appropriation of new alternative technologies by all of the ecosystem's stakeholders and engendered new modalities of interactions among these stakeholders. For instance, from mid 2010, the I-Care cluster has progressively developed new types of activities to tackle the cognitive difficulties diagnosed. One of the first steps was to build a common representation with a network of stakeholders through dedicated seminars. The stakes of some seminars were not as much about providing a detailed view of the field of autonomy for elderly people as exploring new sides of the question. It started with the elicitation of the limits of different heuristic-based reasoning in order to allow a collective awareness of the cognitive difficulties and to stimulate the shift to a more exploration based mind-set.

5 Discussion and conclusion

In this paper, we argue that the study of innovation lock-ins in the innovation process requires a better understanding of cognitive biases at individual and collective level, to understand situations like orphan innovation where very stabilized cognitive routines lead a group of actors to stick with ideas within a dominant paradigm. This study of cognitive biases in the phases of ideation must focus in part on a consideration of the mechanisms of adoption and resistance to spontaneous activation of existing cognitive routines, and secondly on a reflection on the possible forms of collective action that can restore individual capacities when they are constrained by the activation of cognitive routines that have a low creative potential.

5.1 Expanding dual process models

Recent studies from cognitive science (Agogué et al 2014) have underlined the need to distinguish between two types of reasoning that are activated during ideation: (1) a fixated reasoning building on the use of cognitive routines using existing solutions within a stable paradigm and (2) a more explorative reasoning that lead to propose more creative ideas. We have therefore proposed a dual model of ideation reasoning, contrasting heuristic-based reasoning and exploration-based reasoning. Heuristic-based reasoning accounts for the tendency to maintain existing paradigms, when individuals tend to activate heuristics and shortcuts that are based on existing representations of known objects, leading to incremental creativity and fixation on classical solutions. Since others tend to share the same frame, we are unlikely to encounter opposition, questioning, or challenge from them. On the other hand, in exploration-based reasoning, individuals engage in the controlled construction of expansions that challenges the existing

paradigms, potentially leading to new ideas and disruptive, innovative solutions. Exploration-based reasoning allows generating original and rare ideas.

Our model points out that during the production of original ideas, an individual is naturally biased and activate spontaneously existing cognitive routines preventing truly novel solutions to emerge. This notion of cognitive routine recalls the work of evolutionary economists (Nelson and Winter, 1982). However, cognitive science research invites to broaden the perception of cognitive routine not only as an observing and understanding mechanism, but also as a specific type of reasoning activated during the search for original solutions. And this activation is based on the rapid generation of solutions based on the existing knowledge (existing solutions), which make it more difficult to explore new opportunities, leading an individual to lock on solutions that are only variations of the same routines without offering originality.

Our model extends the dual process model proposed to understand decision-making and problem-solving (Kahneman, 2011). Making a bridge with cognitive science is a similar dynamic to that which led to a dialogue between economists and psychologists on decision-making. Indeed, mutual borrowing between the humanities and cognitive sciences are not new. The work of Kahneman and Tversky (1982) helped to deepen the understanding of the cognitive mechanisms that can lead to bias reasoning. Yet, creative reasoning remains out of the scope of such interdisciplinary dialogue, despite the potential such cognitive model bear for the study of innovation and creative processes.

5.2 The role of public actors as middleground to overcome cognitive lock-ins

Based on an intervention-research approach, our findings also suggest that innovation policy can lay a role in helping an industry shifting in terms of ideation

reasoning. The cluster represents indeed a new managerial figure who supports the diagnosis of orphan innovation and leads an industrial dynamics renewal policy from a cognitive lens. This is in line with the new dynamics described by Lefebvre (2013), who focused on the levers of cluster initiatives to boost innovation by stimulating the emergence of joint R&D projects. Yet, our findings bring a new aspect to research on cluster dynamics by stressing the importance for clusters to bridge between meta-levels and individual-levels in order to build cognitive diagnosis to support innovation and overcome lock-in situations. In that sense, we suggest that such cluster acts as a middleground (Cohendet, Grandadam & Simon, 2010) by enabling new knowledge to transit from an informal micro-level to a formal macro-level.

Moreover, besides the public policy in place, the manager of the cluster had a crucial in focusing on diagnosing the cognitive routines embedded in the field. As stressed by Lobo and colleagues (2014) individuals are important to the innovative process, acknowledging non-endogenous factors of innovation performance.

5.3 Perspectives

Our findings open up interesting perspectives. First, experimental protocols can be interpreted as modeling the interaction between a subject and an experimenter, which models therefore the influence of an authority figure on the individual capacity to think of creative ideas. Such a reinterpretation of experiments in closed and controlled laboratory shed a fresh light at the influence of collective action during ideation. Indeed, studies (Shalley, Zhou & Oldham, 2004) have shown that some forms of interaction between a subject and an experimenter have a restraining effect on the number of responses made as well as the originality of the responses, while other forms of interaction have a beneficial

effect on the contrary on these dimensions. This underlines that some specific forms of collective action can support ideation activities and help individuals to overcome fixation and overcome orphan innovation.

In addition, the results presented earlier raise the question of the role of collective action and its management to improve individual skills in generating creative ideas. Some types of collective action can stimulate individuals to generate and revise their organizational but also cognitive routines. Recent research (Chatterjee, 2014) also suggests that leader's cognitive style matters for idea generation. Many factors may influence creative reasoning, and it is therefore necessary to examine the forms of collective action that act on the individual's ability to generate new ideas.

References

Abraham, A., & Windmann, S. (2007). Creative cognition: The diverse operations and the prospect of applying a cognitive neuroscience perspective. *Methods*, 42, pp. 38-48.

Agogu , M., Le Masson, P., & Robinson, D. K. R. (2012). Orphan innovation, or when path-creation goes stale: a design framework to characterize path-dependence in real time. *Technology Analysis and Strategy Management*, 24(6), pp. 603-616.

Agogu  M., Kazak i A.O., Hatchuel A., Le Masson P., Weil B., Poirel N. & Cassotti M., (2013) The impacts of examples on originality: explaining fixation and stimulation effects, *Journal of Creative Behavior*, 48(1), p1-12.

Agogu  M., Poirel N., Pineau A., Houd  O., & Cassotti M., (2014) The impact of age and training on creativity: a design-theory approach to study fixation effects, *Thinking Skills and Creativity*, 11(1), p33-41.

Allais, M. (1953). Le comportement de l'homme rationnel devant le risque: critique des postulats et axiomes de l' cole Am ricaine. *Econometrica*, 21(4), pp. 503-546.

Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal*, 99, 116-131.

Battilana, J., Leca, B. & Boxenbaum, E. (2009). How Actors Change Institutions: Towards a Theory of Institutional Entrepreneurship. *Academy of Management Annals*, 3(1), pp. 65-107.

- Camagni, R., (1991). Local ‘milieu’, uncertainty and innovation networks: towards a new dynamic theory of economic space. In: *Camagni, R. (Ed.), Innovation Networks: Spatial Perspectives*. Belhaven Press, London, pp. 121–144.
- Cassotti, M., Habib, M., Poirel, N., Aïte, A., Houdé, O., & Moutier, S. (2012). Positive emotional context eliminates the framing effect in decision-making. *Emotion*, 12(5), pp. 926-931.
- Chatterjee, D. (2014). Leadership in Innovators and Defenders: The Role of Cognitive Personality Styles. *Industry and Innovation*, (ahead-of-print), 1-24.
- Cohendet, P., Grandadam, D., & Simon, L. (2010). The anatomy of the creative city. *Industry and Innovation*, 17(1), 91-111.
- Cohendet P., Llerena P. (2003). Routines and communities in the theory of the firm, *Industrial and Corporate Change*, 12(3), pp. 271–297.
- Coghlan, D. (2011). Action Research: Exploring Perspectives on a Philosophy of Practical Knowing, *The Academy of Management Annals*, 5, pp. 53-87.
- David, P.A. (1985). Clio and the economics of QWERTY. *The American Economic Review*, 75(2), pp. 332-337.
- David, P.A. (2000). Path dependence, its critics and the quest for “historical economics” In *Garrouste, P. & Ioannides, S., Evolution and path dependence in economic ideas : past and present*, Cheltham : Edward Elgar, pp. 15-40.
- De Neys, W., Rossi, S., & Houdé, O. (2013). Bats, balls, and substitution sensitivity: Cognitive misers are no happy fools. *Psychonomic Bulletin & Review*, 20, 269-273.
- Drozda-Senkowska, E. (1999). *Psychologie sociale expérimentale*, Paris: Armand Colin.

- Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11(3), pp. 147-162.
- Evans, J. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual review of psychology*, 59, pp. 255-78.
- Finucane, M.L., Alhakami, A., Slovic, P., & Johnson, S.M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13, pp. 1-17.
- Frederick, S. (2005). Cognitive Reflection and Decision Making. *Journal of Economic Perspectives*, 19(4), pp. 25-42.
- Ford, C. M. (1996). A theory of individual creative action in multiple social domains. *Academy of Management review*, 21(4), 1112-1142.
- Fried, L. P., Tangen, C. M., Walston, J., Newman, a B., Hirsch, C., Gottdiener, J., et al. (2001). Frailty in older adults: evidence for a phenotype. *The journals of gerontology*, 56(3), M146-56.
- Garud, R., & Karnoe, P. (2001). Path creation as a process of mindful deviation. In: *Garud, R. & Karnøe, P. (Eds.), Path Dependence and Creation. Mahwah, NJ : Lawrence Erlbaum Associates Publishers*, pp. 1–38.
- Garud, R., & Karnoe, P. (2003). Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship. *Research policy*, 32, pp. 277-300.
- Hatchuel, A. (2001). Towards design theory and expandable rationality: the unfinished program of Herbert Simon. *Journal of management and governance*, 5(3), 260-273.

- Hatchuel, A. & A. David (2007). 'Collaborating for Management Research: From action research to Intervention Research in management '. In: *A. B. Shani, M. S. Albers, W. A. Pasmore, B. Stymne and N. Adler (eds.), Handbook of Collaborative Management Research*. pp. 143-162. Thousand Oaks: Sage Publications.
- Huxham, C. & S. Vangen (2003). 'Researching Organizational Practice Through Action Research: Cases studies and Design Choices', *Organizational Research Methods*, 6, pp. 383-403.
- Jansson, D.G., and Smith, S.M. (1991). Design fixation, *Design Studies*, 12 (1), 3-11.
- Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, 3(3), pp. 430-454.
- Kahneman, D., & Tversky, A. (1982). *Judgment under Uncertainty: Heuristics and Biases*. Cambridge : Cambridge University Press.
- Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.,
- Kaplan, S. 2008. Framing contests: Strategy making under uncertainty. *Organization Science*, vol. 19(5): 729-752.
- Kaplan, S., & Tripsas, M. (2008). Thinking about technology: Applying a cognitive lens to technical change. *Research Policy*, 37(5), pp. 790-805.
- Lefebvre, P. (2013). Organising deliberate innovation in knowledge clusters: from accidental brokering to purposeful brokering processes. *International Journal of Technology Management*, 63(3), 212-243.
- Liebowitz, S. J., & Margolis, S. E. (1995). Path Dependence, Lock-In and History. *Journal of Law, Economics, & Organization*, 11(1), pp.205-226.

Lobo, J., Mellander, C., Stolarick, K., & Strumsky, D. (2014). The Inventive, the Educated and the Creative: How Do They Affect Metropolitan Productivity?. *Industry and Innovation*, 21(2), 155-177.

Meyer, U., & Schubert, C. (2007). Integrating path dependency and path creation in a general understanding of path constitution. The role of agency and institutions in the stabilisation of technological innovations. *Science, Technology & Innovation Studies*, 3(1), pp. 23-44.

Nelson, R.R., & Winter, S.G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge and London: The Belknap Press of Harvard University Press.

Nisbett, R. E., Krantz, D. H., Jepson, C., & Kunda, Z. (1983). The use of statistical heuristics in everyday inductive reasoning. *Psychological Review*, 90(4), 339.

Purcell, T. and Gero, J. S. (1996). Design and other types of fixation. *Design Studies*, 17(4), 363-383.

Radaelli, G., M. Guerci, S. Cirella & A. B. R. Shani (2014). Intervention Research as Management Research in Practice: Learning from a Case in the Fashion Design Industry, *British Journal of Management*, 25, pp. 335-351.

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). *The effects of personal and contextual characteristics on creativity: Where should we go from here?*. *Journal of management*, 30(6), 933-958.

Shalley, C. E., & Gilson, L. L. (2004). What leaders need to know: A review of social and contextual factors that can foster or hinder creativity. *The Leadership Quarterly*, 15(1), 33-53.

- Shani, A. B. R., S. Mohrman, W. A. Pasmore, B. A. Stymne & N. Adler (2007). *Handbook of Collaborative Management Research*, Sage, New York.
- Smith, S.M., Ward, T.B., & Schumacher, J.S. (1993). Constraining effects of examples in a creative generation task. *Memory and Cognition*, 21, pp. 837-845.
- Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational path-dependence: opening the black box. *Academy of Management Review*, 34(4), pp. 689-709.
- Thrane, S., Blaabjerg, S., & Møller, R. H. (2010). Innovative path dependence: Making sense of product and service innovation in path dependent innovation processes. *Research Policy*, 39(7), pp. 932-944.
- Tidd J, Bessant J, Pavitt KLR. 2000. *Managing Innovation: Integrating Technological, Market and Organisational Change* (2nd edn). Wiley: Chichester.
- Tödting, F., & Trippel, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research policy*, 34(8), 1203-1219.
- Ward, T. B. (1994). Structured imagination: The role of category structure in exemplar generation. *Cognitive Psychology*, 27(1), 1-40.
- Ward, T., Patterson, M. J., & Sifonis, C. M. (2004). The role of specificity and abstraction in creative idea generation. *Creativity Research Journal*, 16(1), pp. 1-9.

Table 1 Cognitive model of ideation reasoning

<i>Heuristic-based reasoning</i>	<i>Exploration-based reasoning</i>
Maintain existing paradigms	Challenge existing paradigm
Reuse known ideas	Explore new original ideas
Rapid process	Slow process
Automatic and spontaneous	Controlled
Require low cognitive resources	Require high cognitive resources
Emergence of ideas that fit with existing paradigms	Emergence of disruptive creative ideas

Table 2 Data analysis matrix for diagnosing ideation reasoning in orphan innovation

	<i>Heuristic-based reasoning</i>	<i>Exploration-based reasoning</i>
Cognitive paradigms	Explicating known stabilized paradigms	Explicating emerging /conflicted / unstabilized paradigms
Nature of projects	Analyzing existing mainstream objects / projects	Identifying objects / projects related to the problematic but considered as out the scope
Key-words	Identifying key-words and buzz-words in current trends	Identifying neologisms, new words imported from other domains
Genesis of generated ideas	Identifying the roots and the frame of classic known ideas	Identifying emerging frames that not fit with existing frames

Table 3 Diagnosing orphan innovation: the ICT for autonomy of elderly case

	<i>Heuristic-based reasoning</i>	<i>Exploration-based reasoning</i>
Cognitive paradigms	An older person needs to be monitored by products and services designed specifically for an old person	Fragility (in relation to the state of the environment) is a state potentially temporary where a person has higher risk to become dependent
Nature of projects	Tele-alarm, tele-assistance, sensors monitoring the person movement	New interactive objects fighting desocialization
Key-words	Risk detection, fall detection, assisted ambient living	Fragility, enhanced environment, rehabilitation of interaction
Genesis of generated ideas	Elderly-people centered-monitoring aids	Interaction-centered aids for fragile people in an hostile environment
