Can organisational ambidexterity kill innovation? A case for non-expected utility decision making

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Abstract

The academic construction of ambidexterity articulated around notions such as exploration, exploitation (J. March 1991) has been flourishing over the years with a strong background in organisational theory to explain levels of performance and innovation. However, they have also made a call for in-depth studies to understand managerial capabilities such as decision-making (Birkinshaw & Gupta 2013; O'Reilly & Tushman 2013; Benner & Tushman 2015) supporting the tension of competing objectives. In this paper, we show that organisational ambidexterity can kill innovation as the underlying decision theories are not fully supporting the nature of decision required in regimes such as contextual ambidexterity (Gibson & Birkinshaw 2004). Two case studies from the aircraft cabin equipment industry are presented and analysed at the project management level with descriptors from organisational ambidexterity and decision-making. We propose to consider unconventional decision theories, taking into account non-expected utilities such as potential regret of imagined prospects, as a means to support management tools enabling ambidexterity at the decisional and contextual levels. First, we show that common decision models based on expected utility encoded in management tools mobilised for contextual ambidexterity can fail to support innovation. Second, we propose that a non-expected utility, such as potential regret of imagined prospects, serves the management of competing exploration/exploitation objectives. Third, the case studies help contouring a management tool extending observed attempts to sustain or extend contextual ambidexterity through unconventional decision-making.

Keywords: decision, project management, design, ambidexterity, management tool

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1. Introduction

In the aircraft cabin market, cabin equipment manufacturers are pulled by two out of step dynamics: aircraft manufacturers providing a platform and airlines with brand management and continuously retrofitting cabin for improved passenger experience. With this two-speed setting and stringent safety regulations, deciding to pioneer with innovative products/concepts for a greater competitive advantage (Rumelt et al. 1994) becomes key despite having few players in the market to share the demand volume – a quasi-duopoly. As dominant designs (Abernathy & Utterback 1978) are rather settled in the aircraft industry but following improvements in safety and the search for stronger/lighter materials for CO2 emissions reduction, deciding which design choices should be made to offer to the market becomes rather complex as one offer is highly interdependent of other designs that may not be fully controlled.

What are the decisions to be made to preserve a competitive advantage envisioned through exploration for an effective exploitation? In this paper, we show these strategic questions for an industrial group could be supported by unconventional decision theories and their translation into management tools supporting the tension of competing ambidextrous objectives. Literature in organisation theory has described the (dis-)advantages of being a first-mover or early follower (Lieberman & Montgomery 1998), along with the forms of organisational ambidexterity to adopt depending on product class uncertainties (Benner & Tushman 2015). Here, with the strategic and survival background of ambidexterity (O'Reilly & Tushman 2013) and calls for studies on managerial capabilities, we propose to study what happens at the project management level with a perspective from decision theories

considering the unknown and non-expected utility (Feduzi et al. 2016; Faulkner et al. 2017; Starmer 2000) and design theories (Hatchuel & Weil 2002) to understand design choices in relationship with the body of knowledge and appropriate management tools (Labatut et al. 2009; Labatut et al. 2012; Segrestin et al. 2017; Hatchuel & Molet 1986).

The research relies on two cases studies of exploratory project management conducted in a large equipment manufacturer specialised in aircraft cabin equipment. The cases differ in nature and practices and thus allow giving a global picture of the decision-making process and forms of organisational ambidexterity. The main result of the research is to empirically show that *ad-hoc* decision making processes to articulate innovative design activities for product development in a mode of contextual ambidexterity creates a paradoxical tension as valued exploration prospects are regretted and, separately (Birkinshaw & Gupta 2013; O'Reilly & Tushman 2013) exploration/exploitation performances are degraded. The subsequent result is a call for a proper management tool (Segrestin et al. 2017; Moisdon 1997) based on non-expected utilities – decisional ambidexterity (Le Glatin et al. 2017) – supporting the contextual ambidexterity constructed by (Gibson & Birkinshaw 2004) in order to gradually uncover the unknown (Feduzi & Runde 2014) associated with exploratory projects as practice reveals senior/middle management are only partially prototyping and experimenting potential instruments with scarce resources.

Management tools taking into account (non-)expected utilities could support the decision-making process for pioneer/follower strategies and also dynamically consider the tension between simultaneously competing objectives of exploration and exploitation. Instead of opposing and forcing a transition from exploration to exploitation and vice-versa on a same continuum (Birkinshaw & Gupta 2013), we advocate a regime of where both of them are dynamically coupled to generate knowledge and generate choices to enhance dynamic capabilities (Lakhani et al. 2013; O'Reilly & Tushman 2007).

2. Literature review

2.1. To Pioneer or to follow early

In the field of strategic management, the question of competitive advantage being core (Rumelt et al. 1994), one of the key feature of building a competitive advantage is to fight for primacy and sustain the first-mover configuration. Among the variety of pre-emptive strategies (Macmillan 1983), timing the offer to the market a new concept (product, service, feature, architecture etc.) is crucial, as it comes with its set of advantages and disadvantages (Lieberman & Montgomery 1998; Lieberman & Montgomery 1988). As described by Lieberman, the decision to enter at a certain order the new market and value space created will be dependent on luck and dynamic capabilities (Teece et al. 1997). Here, we propose to discuss the case where the market or operational ecosystem's dynamics and competitiveness are pretty stable. In the aircraft cabin equipment, there are no visible threats of new entrants due to high entry barriers and strong dominant design (Abernathy & Utterback 1978). The long term strategy is to be able to be ready when the new dominant design comes out (Macmillan 1983; Christensen 1997) and to be able to fit the prescribed architecture (Sanchez 1995; Sanchez & Mahoney 1996). If in addition, new product development costs are high due to stringent regulation constraints, such as in aerospace, it becomes rather complex to support the necessity to decide on exploration and exploitation activities into resources and dynamic capabilities for a risky and uncertain course of action (Jansen et al. 2006) due to intermediate environment moderators (Jansen et al. 2009).

2.2. The case for ambidextrous organisation

The dilemma when competing for primacy may be replaced by the debate of strategic nature of exploration/exploitation trade-off (J. March 1991), and literature's refinements (O'Reilly &

Tushman 2013, p.332; Birkinshaw & Gupta 2013, p.294) show there may be other observables when considering these two patterns: multi-level analysis, boundary conditions and other descriptors such as senior leadership and firm's ecosystem. Those recent reviews on in the organisational ambidexterity field have addressed future perspectives requiring "qualitative and in-depth studies"(O'Reilly & Tushman 2013, p.332) on how allocation of resources are balanced, how choices are made, who is responsible for those choices, what are the consequences (Birkinshaw & Gupta 2013, p.296), and how conflicts are managed. For instance in (Lavie et al. 2010) when considering different ambidexterity forms (structural, sequential and contextual) features are highlighted such as: "proactive management is essential", "management provides a supportive infrastructure". Yet, several underlying challenges are not addressed.

At the intra or inter-firm level, organisational ambidexterity was correlated with how exploration/exploitation regimes should be balanced across mergers & acquisitions, alliances and internally (Stettner & Lavie 2014). Others have also looked how ambidexterity is dealt with leadership skills (authority in decision-making, formalisation, cross-functionality, and connectedness, intent, vision) (Mom et al. 2009; O'Reilly & Tushman 2011), is supported by knowledge inflows (bottom-up, top-down, horizontal), or is linked with organisational features (centralization, formalisation, connectedness) and environmental moderators (competitiveness and dynamic) (Jansen et al. 2006).

In their reflexions on their decade award (Benner & Tushman 2015; Benner & Thushman 2003), they call for a review of extant theories as there is a shift in the locus of innovation: new forms of association for a given organisation, increasing complexity and modularity (Lakhani et al. 2013; Sanchez & Mahoney 1996). They maintain their former article's critique of the limitations of process management adoption (TQM, Lean, ISO 9000, and now design thinking, ERP systems, balanced scorecard, rapid prototyping, lean startup, etc.) and

associated risk for exploitation and exploration. It is then crucial to be able to stress in which ways those processes are taken on board in relationship with innovation transitions, organisational structures and senior/middle management culture and decision-making.

The decision pattern behind the support, generation of knowledge, generation of decisions for exploration/exploitation activities has highlighted the gap between decision theory and decision-making in organizations (March & Shapira 1987). Probabilities and preferences may not be as clearly stated and calculated as stated in descriptive/normative views of decision theories (Cabantous & Gond 2011). Others have argued that decision are made *ex-post facto* (Langley et al. 1995; Tsoukas 2010; Laroche 1995; Cabantous & Gond 2011), i.e. after conducting the actions for legitimacy.

The question of how, who, and what are the ins and outs of decision-making for ambidexterity becomes crucial due to difference in nature of tasks performed separately (Tushman & O'Reilly 1996), sequentially (Brown & Eisenhardt 1997) or contextually (Gibson & Birkinshaw 2004). As a matter of fact, the construct of contextual ambidexterity for successful firms came from a large survey revealing a tight link between ambidexterity, performance and organisational context but the underlying decision-making practice is not spelled out as explained by the author (Birkinshaw & Gupta 2013, p.293). In practice, managers tend to rely on different processes or methodologies such as business score cards, business model canvas (Osterwalder/Strategyzer) or Strength Weakness Opportunities Threats analyses (SWOT) and others go for design thinking methodology(Brown 2008) requiring ad-hoc practices to feet existing organisation routines (Carlgren et al. 2016; Carlgren 2016; Beyhl et al. 2014; Beyhl & Giese 2015; Beyhl & Giese 2016). In the oil industry, cases of decision trees as standalone management tools (Moisdon 1997) or even scenario making (Loasby 1990) have been reported. However, we found little research on the type of management tools to support decisions that go beyond risk and uncertainty, namely the

unknown. The place of management tools as unit of analysis has indeed been recorded in several approaches linked with the place of artefacts in organisations (Labatut et al. 2009; D'Adderio 2008; Labatut et al. 2012; Hatchuel & Molet 1986).

2.3. Decision with (non-)expected utility

Exploration/exploitation activities as two different self-reinforcing patterns of learning (Birkinshaw & Gupta 2013; J. G. March 1991), call for different managerial capabilities including decision-making to oversee the relevant tasks beyond organisational design (Smith & Tushman 2005). Starting from Black Swans (Taleb 2008) and double unknown situations (Loch et al. 2006; Loch et al. 2008), a series of articles having been discussing decision making and innovative project management (Feduzi et al. 2016; Feduzi & Runde 2014; Lenfle 2016), or in other words ways of conducting exploration (Lenfle 2016; Lenfle 2008). Framing the unknown with respect to risk and uncertainty (Faulkner et al. 2017; Runde 1998; Knight 1921) reveals where decision theories fail to support exploratory project management or even to describe the difficulty of endogenising unknown parameters at a decision gate. Unimagined events, by opposition to events regarded (im-)possible, lie outside of most conventional and unconventional theories of choice (Starmer 2000). It is also a case for unknowledge and surprise potential by G.L.S Shackle (Shackle 1955; Shackle 1952; Frowen 1990) as reported by Richard Bronk in his chapter "Imagination and creativity in markets" (Bronk 2009): "Choice is in a very real sense amongst products of imagination and invention" (p.218).

In an instrumental view of rationality (Boudon 2012), with an agent deciding to invest for future prospects implying a competitive advantage or cost reductions dependent on deep hypotheses (potentially challenged by Black Swans, such as the sure-thing principle(Savage 1954)), one may wonder what decision tools can support such extreme commitment.

Reaching out for high uncertainty and the unknown raises challenges that are already hard to address in complex risk management (Ansar et al. 2016) where prediction, collective decisions, and learning through time (even at the ecosystem level) appear almost impossible.

However, cases of unknown management have been reported in literature with a design perspective (Kokshagina et al. 2016; Hatchuel et al. 2010; Le Masson et al. 2012; Loch et al. 2006). There are strategies that consist in using intermediaries (Agogué et al. 2017) or ecosystem's vehicles to build a path for the industry (Sydow et al. 2013; Lange et al. 2013) such as in the semi-conductor industry where the common purpose was to go beyond Moore's law due to physical limits being reached in other road-mapping activities.

An approach to deciding in a context where innovation incentives are low, and where the operational ecosystem is rather pushing for exploitation behaviours, could be in non-expected utility theories as convention rational theories of choice are insufficient (Starmer 2000). The idea developed by several academics is to relax several axioms that are violated through experimentation (Heath & Tversky 1991; Cabantous 2007). Those shortcomings may be then backed up by organisational practices (Heath et al. 1998) in the same way operational research was implemented and refined over the years (Hatchuel & Molet 1986). Stretching goals (Sitkin et al. 2011) given by a charismatic leader (Ezzat et al. 2017) can also be seen as an exploration vector into the unknown, paradoxically for firms that can least afford those. Considering that a decision maker uses ambiguity or have support from the ecosystem to discover the unknown, models of decision based on regret could be an alternative for strategic management: what is the cost of not committing to a designed course of action? Models proposed by (Loomes & Sugden 1982; Loomes et al. 1989; Loomes & Taylor 1992) considers the possibility to have preferences reversal, cycle of preferences and raise the question of regret estimation compared to experienced regret (Sevdalis & Harvey 2007). Yet, we would

like to take the discussion further down the line of risk and uncertainty and consider the domain of the unknown: imagined and designed prospects to innovate.

2.4. Management tools to support decisions in the unknown

Considering that decisions may be imperceptible depending on their consequences' appreciation or paradoxically highly praised (Chia & Nayak 2012; Chia 1994), or even highly perturbed (Taleb 2008), making decisions in the unknown becomes a question of design (Hatchuel et al. 2001). The difficulty for organisation is of course to manage the tension between a decision model and another. As (Starmer 2000) specifies, having a general theory of choice whose special cases are the classical theories appears crucial for the scientific continuity. In experimental management situations, it could call for a "decisional ambidexterity" (Le Glatin et al. 2017), i.e. being able to deliberately reverse preferences to generate decisions that allow exploration while keeping exploitation constraints and meet economic performance criteria. Designing decisions, beyond designing possible states of nature (Feduzi et al. 2016), comes with a price since it requires "the proactive use of techniques to enhance robustness, resilience, preparedness" as to extend the probabilistic approach and engineering design to face risks (Maes & Dann 2017, p.28). As such approaches would imply listing, imagining all sorts of courses of actions and associated gains/losses; we may question the practicality of its implementation with heavy-weight learning practices and resources. The idea that it can be programmed or turned into business operations is quite attractive and avoids falling into the "myth of the entrepreneur as tragic hero in the large corporation" (Burgelman 1983, p.241). It also helps to understand the place for a new management practice of augmented decision-making in an organisation as it is the case with the emergence of new design rules in engineering department: "*generative bureaucracy"* (Hatchuel, Garel, et al. 2009). It echoes who a possible transition from structural to contextual

ambidexterity could be conducted (O'Reilly & Tushman 2013, p.504) and a detailed look on decisions addressed in contextual ambidexterity but where associated research hasn't revealed its full potential (Birkinshaw & Gupta 2013, p.293).

Finally, we propose to have a "management tool" approach (Segrestin et al. 2017; Moisdon 1997; Labatut et al. 2009) to contour the articulation between (non-)expected utility decision making and organisational ambidexterity. Armand Hatchuel's work (Segrestin et al. 2017) has contributed to the idea that learning and organisational dynamics are tightly bound, proposing a theory of collective action where in a post-decisional paradigm design-theory-based management tools – such as C-K theory (Hatchuel & Weil 2002) – can coordinate knowledge and relationships. In this perspective, the issue of managing ambidexterity from the perspective of unconventional decision theories embedded in a management tool could allow endogenising the unknown, its discovery process and deal with the tension of competing objectives of exploration and exploitation to support the regeneration of the existing based on threats and opportunities valued by non-expected utilities such as regret. This instrument would be an instrumentation of a dynamic capability to explain and support underlying dynamics of contextual ambidexterity (O'Reilly & Tushman 2007; Birkinshaw & Gupta 2013).

2.5. Research questions

Based on our literature review, we propose to discuss the following questions:

- Why decision models underlying organisational ambidexterity can fail?
- Can potential regret of imagined prospects support a better tension management between exploration and exploitation objectives?
- What management tools could support decisional ambidexterity?

3. Methodology and data

This research relies on a case-study analysis (Eisenhardt 1989; Yin 2009) with a logic of anomaly (Siggelkow 2007) of two product concepts for aircraft equipment developed by Zodiac Aerospace (ZA). Data was investigated through analysis most of projects documentation and semi-directive interviews with the projects teams and stakeholders among the business units.

3.1. Validity of the case-study context: aircraft industry's ambiguous incentives for radical innovation and ambidexterity

The aircraft industry in the last decade has been facing a shift in the nature of uncertainties forcing market players to change their strategy. First, the major aircraft manufacturers seem, for now, to stop proposing completely new aircraft platforms. Previously, platforms would imply the alignment of design strategies for a least a decade naturally feeding suppliers' income and engineering effort. Markets would be granted easily between the few major players in a quasi-duopoly configuration. A particular feature of the cabin aircraft market is that it a business-to-business-to-consumer (B2B2C) situation; the consumer being the airline (aircraft operator) with its pilots, cabin crew and its end-customers (passengers). The airline's dynamics, its marketing and brand management has shorter cycles (5 years) than aircraft platform engineering (10-20 years). Naturally, cabin equipment manufacturers would play on both grounds to have supplier-furnished equipment (SFE; on aircraft manufacturer's approved catalogue) and buyer-furnished equipment (BFE; directly bought by airline and installed before aircraft delivery). A dominant design (Utterback & Abernathy 1975; Abernathy & Utterback 1978) is then imposed on an architectural level (interfaces and contingent cabin elements) stabilising certain specifications. Orders and subsequent engineering design efforts are then mainly driven by airlines and their possible design office looking for differentiation

and to retrofit their fleet's cabins. So despite strong demand for developing new product & service concepts for an enhanced passenger experience, the product development conducted by the equipment manufacturer remains locked by a set of design constraints given by the aircraft platform architecture and other uncontrolled interfaces. For instance design briefs are usually distributed separately and taken care of different cabin equipment manufacturers, which complexifies the choices to be made to meet expected modularity (Sanchez & Mahoney 1996; Sanchez 1995)

Second, the safety regulations and industrial standards reinforce the dominant designs with highly stringent constraints to protect passengers from potential wounds that may occur in regular flight situations, but also from fire and impact (head, neck and body injuries). Public funding opportunities exist to meet with those requirements by developing new materials and designs. And it is reinforced by most of the whole industrial effort (Abernathy & Utterback 1978). However, the European Aviation Safety Agency (EASA) has recognized in 2015 the certification had become far too demanding and costly; and it should become in the coming years 'risk-based' whilst guaranteeing same safety levels. It would imply a shift in the Design Organisation Approval (DOA) and more room for innovation as long as safety is maintained.

Consequently, as the incentives to radically innovate are ambiguous, cabin equipment manufacturers work on optimizing their cost structures to deliver orders (logic of exploitation (J. G. March 1991) with top-down inflows of knowledge (Mom et al. 2007) and a series of mergers & acquisitions have started to consolidate and create synergies and economies of scale. See for instance recent series from B/E Aerospace, Rockwell Collins and United Technologies Corporation. Moreover, alliances exist in the context of joint research programs to support incremental innovations (Lavie et al. 2011) through public funding structures. A review of the past years' issues of Aircraft Interior Magazine and Aviation Week gives also a taste of steadiness of cabin products architecture, despite numerous incremental innovations

(additional functionalities from connectivity and *Internet Of Things*, new stronger/lighters materials, mood lighting, etc.). Some radical concepts have emerged from several players relating to new uses of cabin space (see for example: Airbus A^3 Transpose proposal for a modular cabin, urban mobility or supersonic flight return). Yet from an industrial readiness viewpoint those concepts may lie quite far in the future, adding to the uncertainty and unknown of what would be the next architecture for the aircraft industry.

3.2. Relevancy of the two projects for contextual ambidexterity and their descriptors: cabin waste management and business class seating

The cases were selected from two different units of ZA in the cabin equipment domain as they are representative of the nature of projects conducted in the organisation. ZA has a long history and track record of successful innovations in the industry. Numerous awards were granted for product designs and several innovative airlines rely on ZA capabilities.

Cabin Waste Management (case 1)

The project was initiated internally by a standalone team, hosted by group management, whose purpose is "to make boundary-spanning proposals" as requested by the ZA's Vice-President. The team reports to Business Development director and is constituted of 7 designers and engineers with several years of experience from different ZA business units. The "cabin waste management" topic was identified through their regular contacts they have with aircraft manufacturer and airlines in their local industrial ecosystem. The methodology of Design Thinking (Brown 2008) was deployed by d.school educated team members and used with additional project management features (Ben Mahmoud-jouini et al. 2016). In addition, several workshops were organised to share discovered user and internal knowledge for bottom-up and horizontal knowledge inflows (Mom et al. 2007), and to create social acceptance among their internal clients: marketing and engineering department of business

units relevant for cabin waste management. A lot of effort was put into the user value exploration and knowledge gained through Design Thinking methodology; these takeaways were presented and shared with topic-concerned business units. The concepts were ranked, selected by the team members and validated by the Vice-President, and were all presented to relevant business units for further development with their support. These internal clients are mostly organised with traditional engineering activities for SFE/BFE as explained above, and R&T activities mainly addressing incremental innovation and a few disruptive concepts with tight bounds with airlines aiming for differentiation.

Overall we have a separate structure in charge of exploration through user and customer empathy to create synergies between business units on federating concepts, with an objective of exploitation for cross-business-units product development. A ambidexterity mode that we could identify as contextual at the firm level (Gibson & Birkinshaw 2004) with a deep concern for the variety of sources to innovate from (Benner & Tushman 2015; Lakhani et al. 2013). In addition to that, the team manager thanks to his experience in the company has a dense network (connectedness) and with his team are able to identify what has to be addressed in different business units to formalise and meet centralisation routines (Jansen et al. 2006).

Business class seat platform engineering (case 2)

Initially, the project started as a Research & Technology (R&T) initiative to design a new business class (BC) seat architecture that would facilitate packaging and installation activities for the internal engineering purposes and final assembly line operators. The team generated numerous alternatives and the possibility to define a generic platform for BC seat emerged. The core element would meet the initial brief but require to define further the genericity envelop to allow future module sub-assemblies design. As the modularity was worked out (Baldwin & Clark 2006; Sanchez & Mahoney 1996), sales & marketing were in discussion with a client (airline) who had requests meeting some specifications of the *in progress* BC

modular seat design. R&T and Development Engineering resources were then allocated to support the bidding and customer requirements definition with the airline and third-party design office. Traditional engineering practice for BC aircraft seating industry is very much customer-driven for branding and differentiation purposes. Usually, one would speak of "bespoke" seats and forces designs to be reinvented for almost each BFE airline retrofit opportunity. In a way, the organisation is not fully mechanistic (Burns & Stalker 1961) despite strict regulations and imposed quality and project practices standards. Along the development, complexity increased as the product was to be fitted on a new aircraft platform for the engineering team. The platform's variability influences directly through determining parameters such as cabin floor fixtures and cabin volumes. Furthermore, safety regulations evolution demanded additional and more demanding testing, requiring the design to gain in strength and integrate adapted features.

Here, we have an internal exploration regime isolated from operational activities but flexible to feed the R&T team with valuable knowledge for the modular design and its strategic intent for the business unit (Sanchez 1995; Sanchez & Mahoney 1996). When it comes to exploiting, we have a rather internal sequential mode (Brown & Eisenhardt 1998) but the team is reshaped – in an internal change perspective – to integrate the product development mode, so we also have a flavour of contextual ambidexterity (Gibson & Birkinshaw 2004). Moreover, exploitation of the modular architecture is performed with costly flexibility requirements as customer's design office, aircraft platform and safety regulations adding to the design and engineering complexity. This openness required from the team echoes the displacement of the locus of innovation (Benner & Tushman 2015).

Rich cases for contextual ambidexterity and managerial capabilities

The two projects are then relevant for: (a) decision pattern generated by managers for exploration/exploitation transition in order to pioneer or to adapt quickly enough with novel

product/service concepts, (b) generation of rich and numerous concepts to decide on their expected utility for the business and (c) understanding of *a posteriori* valuation of (non)chosen concepts for further exploitation/exploration.

3.3. Descriptors for decision-making in support of exploration/exploitation

In order to track the decision pattern to commit to the development of certain product/service concepts, we used a C-K mapping (Hatchuel & Weil 2002; Hatchuel, Le Masson, et al. 2009; Hatchuel et al. 2016) rooted by the dominant designs traditionally engineered by business units. This allowed us to *measure* where the proposed concepts where situated and which ones were selected compared to dominant designs (Magnusson et al. 2014; Hooge et al. 2016). Valuation and selection were recorded in documents and questioned during interviews, for instance we searched for reasons why some concepts or design paths were discarded and simultaneously we asked for the positive arguments that may not had been formalised as we were looking for signs of regret. In other words, we were looking for which different/unseen states of nature could support the enactment of certain concepts despite given underlying hypotheses; the idea was then look for signs of ambiguity requiring further design activities to change the decision situation.

Exploration activities were then detailed through the C-K mapping and the *ad-hoc* decision-making and mobilised managerial capabilities to articulate the transition to exploiting concepts for product development. The interviews allowed us also to understand the valuation of selected concepts, their relevancy for day-to-day business, and signs of regret and prospects for further exploration.

3.4. Data collection

Both projects were investigated with the same data collection process. The authors had full access to project documentation and several interviews were conducted with project teams and stakeholders. A reverse engineering approach helped building the history of the projects with the support of several drawings, presentations, meeting minutes with validation from team members. The purpose was to trace which decisions were made that influenced the selection of concepts design for the clients. As explained in the previous paragraph, C-K mapping were used and helped to formalise valuation parameters: positive/negative for exploration and exploitation and where regret was stressed.

4. Results

4.1. A selection bias despite a rich exploration

Both projects despite their different nature and organisational context:

- Case 1: aiming for high user-value products/services unaddressed or ill-addressed by existing dominant designs;
- Case 2: aiming for a modular design development for a line of products.

Numerous concepts were proposed and referenced in a C-K mapping. Five groups of concepts were carefully detailed by the team over 9 design paths for the B/C seat project. For the waste management project, 12 groups of concepts were designed by the team over 33 options. In both cases, the additional group of concepts were envisioned thanks to C-K theory as it helps with simple heuristics in the concept space to partition concepts into new ones, it is also part of the reference tool (Hatchuel, Le Masson, et al. 2009; Hooge et al. 2016). The difference in number comes from the fact that the design brief were tackling different portfolios of products so that larger combination or at least links could be made between them; so in the B/C seat

case the problem was isolated to a standalone equipment (seat) with no interaction except for the passenger and the cabin floor as they were aiming for high modularity within their design space sanctuarised by safety regulation, certification standards and organisational boundaries in the industrial ecosystem. Whereas in the waste management case, concepts were designed by taking into account the full variety of equipment in the cabin (galleys, inserts, trolleys, lavatories, seats, cabin dividers, etc.).

In case 1, a ranking spreadsheet was defined by the project team based on the trio: Desirability, Viability and Feasibility. The categories were amended by value propositions relevant to the waste management topic and a category relating to ZA's scope. Scoring was conducted by members, individually, business units as potential candidates to develop concepts were identified. A final round of selection and valuation was discussed by the Vice-President, as he is the chief party for the team's activity. Emphasis was then stressed on strategy as concepts were in between organisational lines and would require close collaboration between existing business units to address topics that are at the frontier of their design space and engineering scope. For example, by opposition with today's sales channel and design requirements prescription, inserts/trolleys/galleys are designed and engineered by different business units. Some concepts identified looked indeed for synergies between these quasi-independent equipment for greater user-value as justified by the empathy developed with cabin crews. All concepts were supported by strong user-value and effective interest from airline personnel; yet all required a certain level disruption with existing design & engineering rules, marketing perspectives and organisational boundaries. Selected concepts, with emphasis on the Vice-President's shortlist, were presented to business units' managers and engineers, with strong background knowledge to justify and remember the value and potential of concepts as seen in previous workshops. However, despite recognition of the user-value and airline's discourse, most of concepts were discarded even those close enough

to dominant design. To safeguard concepts and buy some time, some concepts were transformed into provisional patent applications before business units would effectively start working on these. Even though the decision-making took into account criteria stemming from exploration and exploitation, it seems the selected prospects were not suitable enough to lead to new product development or clear further exploration activities for business units despite supported strategic views and user-value recognition by all stakeholders.

In case 2, R&T engineers deeply explored the constraints behind the packaging and installation issues of B/C seats. The design approach turned into the necessity to have a central and modular base frame for all sub-elements of the seat. Options were considered and discarded based on existing patents and designs in the seating market. All five concepts were turned into digital mock-ups, underwent several redesigns based on numerous meetings and valuation from team members (engineering, industrial design and marketing); a shortlist of preferred concepts also underwent numerical crash test as it is the main determining criteria. However, the design had some interesting features in terms of clutter and greater freedom for customization and living space design which raised a lot of interest among marketing/sales team. The project was discussed with a major airline that awarded a contract for a new aircraft platform (i.e. new interface to be designed and layout arrangement considerations given aircraft manufacturer). By doing so, the project became prescribed by the airline's requirement, so the proto-modular approach and exploration was cut short by a product development management. Consequently, the product was halfway between modular equipment and bespoke B/C seat (dominant design). This hybrid unfortunately raised several engineering issues that demanded a lot of resources allocation to deliver the product on time. It implied new design and engineering rules that revealed unexpected mechanical behaviours and mitigation issues as specifications were gradually frozen by the customer. In addition, a new safety regulation was imposed which translated into higher constraints on certain design

parameters. So, the genericity and robustness/resilience (Maes & Dann 2017) that originally aimed by the project was partly jeopardised by a reallocation to short term exploitation objectives. We had then here an exploration activity with strategic intents for modular design that would also have the engineering and marketing activities to be reshaped to the designed modularity (Sanchez & Mahoney 1996; Lakhani et al. 2013). Nevertheless, as a potential lead-user (von Hippel 1986) had awarded a contract where the modular concept could fit, the exploration efforts were channelled into a bespoke design without leaving enough room to benefit from the original modular intent and that lead to an ill-defined concept which may be have complicated engineering activities to meet the requirements.

4.2. Paradoxical signs of regret to avoid forcing exploration into exploitation

With the support of the C-K mapping and interviews, we questioned why some design options were not selected or why some hypotheses were not challenged to open new design paths. These underlying assumptions were ranging from design rules taken for granted, to product interfaces up to regulations/certification constraints where we have a stake in it. Those discussions raised several comments such as: “They are short-term NPV driven so they won’t see the value of projects without clients and taking more than a couple of years” (NPV = Net Present Value). Paradoxically, business units sincerely acknowledge the potential of presented concepts in several terms: high user-value, desirability, user pain removed, harmonisation between products, avoiding reinventing the wheel, non-recurring cost reduction, etc.

In case 1, the team developing the concepts was rather disappointed that some of the ideation sessions they had with business units were not as creative as those conducted on their own. As a matter of fact they were very close to the dominant design, or fixated by their designed products (Agogué et al. 2014; Gillier et al. 2016). Some concepts were transformed into provisional patent applications, yet no budget allocation was made by business units to isolate

resources to work on these worth of interest concepts. In parallel, the team reported that two concepts were on display at trade shows by minor competitors; they were incremental innovations that remained very close to dominant designs. However some features of concepts were kept alive and disseminated across business units thanks to the team manager whose place in the organisation and network across the industrial can circulate ideas. But above all, he extracted from this project and previous ones, a recurring generic concept that could be twisted to address different federating topics for the ZA business units. It has a potential to generate new use-cases for passenger experience and crew activities, but also goes beyond the ZA established design space. A new project was launched including technical investigation and market testing with airlines to test viability of the concept. By doing so another round of exploration activities was launched for the team with clear exploitation objectives as potential airlines customers were kept in the loop, with buy-in from business development activities. Senior management was crucial as resources were allocated in a disconnected way from business units to support exploration and channel discussions with airlines.

In case 2, the case for a modular BC seat is recurrent topic for program management, marketing and design/engineering departments, and yet it was never done properly on any seating class. The net present value evaluation was made and despite there is no doubt that the first modular product development is more expensive than a one-shot development, it reduces non-recurring cost in the long term for the product line stemming from the modular approach as the engineering effort is conducted. The authors performed a rough calculation based on the cost evaluation methods for program management and despite the launching investment; it is financially more interesting to do so compared to the average budget variance of the actual product development. The latter is being usually attributed to customer requirements changing (contract management) and other engineering mitigation issues. Moreover, we must stress the fact that it appears that no single player in the aircraft seating business has offered a full

modular seating solution for business class. The modular design is then forced into exploitation without being able to carry its original strategic intent for the firm and the industrial ecosystem. The business unit has for matter of fact launched again projects on modularity as the exploitation regime was not able to insulate sufficiently the valued explorative features (e.g. non-recurring costs balanced over novel product line). We have found traces of modularity projects for more than ten years in the firm without a proper outcome.

Finally, in both cases, we show that the transition from exploration to exploitation with the support of an *ad-hoc* decision-making processes reflecting the way tension are managed between competing objectives was not fully satisfactory. Selected prospects, and non-selected ones, were left on a side or partly jeopardised. Only some features were extracted to feed knowledge inflows for the business units or a potential new cycle of exploration activities thanks to key managers. It appears in some way the benefits of ambidexterity did not outweigh the costs (O'Reilly & Tushman 2013, p.333); or it didn't at least for one transition. Regarding the team in case 1, it has been greatly reduced after 3 years of existence, so their exploration activities have taken another flavour. The modularity topic for BC aircraft seating is present in every roadmap with a readiness level below 3 (Technology Readiness Level). We may ask ourselves what could have been done to really outweigh the costs and value the extent of exploration/exploitation transition.

4.1. Contouring a management tool

As explained above, interviewees did report regret for not being able to promote further their initial intentions through existing the management tools such as accounting and reporting systems. Some concepts or features leave traces after they have been discarded in the decision-making process and resource allocation. These become part of the design and

engineering body of knowledge in respective business units with no guarantee of surfacing again. Identified prospects not being exploited *per se*, or with some rework by business units become regret for their originators. During interviewees they struggled to justify clearly what was missing to better articulate the transition. They all reported that it had such strategic weight for the firm that it should be treated at a higher hierarchical level. The question of timing as first-mover was discarded, as the market dynamics tends to guarantee market shares; rather they stressed the high uncertainty associated with interfaces that may not be as easily controlled: market prescription with its design language, regulation evolution and other equipment design footprint.

Both cases reveal an absence of a real practice to support a decision-making that does not fit operational constraints (mainly short-term profitability), and dominant designs. Paradoxically, a strategic move from the competition, a customer or unexpected events may dramatically change valuation of a project shaped to the operational decision-making. By not being able to think of other forms of utility, or go beyond delay devices such as provisional patent applications, or even other forms of contract management to safeguard some design choices, their efforts transform into regret. The high uncertainty and unknown are here associated with engineering design parameters and market prescription dynamics. They are also given as exogenous parameters and sometimes hidden as underlying hypotheses that are not be revised as part of dominant design situation.

In case 1, due to the team being at the corporate level and not being backed up by operations such as manufacturing facility, they have put a lot of effort into translating, reworking the selected concepts and outputs of their user-exploration through Design Thinking to trigger a genuine decision to invest on the concepts specially after the final handover with the Vice President's input. The aim was to complement what expected utility for exploitation could not foresee and try opening paths for future decisions to be made on their prospects. In case 2, the

original modular design was not able to be safeguarded through the exploitation phase, and may have complicated meeting customer's requirements. So it didn't even benefit a proper learning on modular design for R&T and Development teams.

In other words, the concepts being forced through the ambidexterity transition with available managerial capabilities diminished the performance for exploration and exploitation separately. Yet, it also gave birth to bricolage activities (Cabantous et al. 2010, p.582) to support and adapt their prospects for utilities that are not able to clearly state given the available conventional management tools, as they appear to be *a posteriori* in the realm of regret.

Moreover, verified competition threats, technical systemic threats, high levels of uncertainty and unexpected events, these ecosystem parameters are only discovered on the spot and fed into a risk management tool. We may ask ourselves if it would be preferable to pay the price of the unknown when it becomes observable by existing means rather than to extend and allocate resources from the awareness and potential regret built through the early stages of exploratory projects.

5. Discussion and conclusion

First, we have elucidated an *ad-hoc* decision making process occurring on top of exploration activities when trying to push designs into an exploitation regime. It is a means of sensemaking (Weick et al. 2005) for the team involved in the exploratory project and associated design efforts. This process comes with a strong selection bias anchored by the dominant design (Abernathy & Utterback 1978) thus altering forms of utility associated to the objects of decision making. Second, regret, as a non-expected utility (Quiggin 2014; Loomes & Sugden 1982) is reported as teams following modes of ambidexterity. Selected exploratory prospects were skewed when being treated as exploitation objects. Third, the cases have

shown that despite recognised potential value and ex-post regret, teams struggle to find support among management tools. They make attempts to value their prospects in different ways but still struggle to find an efficient exploration/exploitation articulation with existing and *ad-hoc* decision-making processes as they try to have their prospects in a state where regret may be valued for high uncertainty and unknown factors and avoiding pure exploitation or exploitation. We advocate that performing ambidexterity by the book may kill the innovation held within exploratory prospects due to the absence of unconventional decision-making processes in management capabilities. These prospects should rather be managed in a *quantic state* that is nor exploration nor exploitation but a dynamic orchestration to benefit from exploitation for exploration and vice-versa. It may be a branch out, refinement or differentiation from contextual ambidexterity (Gibson & Birkinshaw 2004), as we are not putting exploration/exploitation "as poles on a continuum". They are on two separate dimensions for which trying to reach contextual ambidexterity requires reviewing decision theories encoded in management capabilities. By opposition, bi-stability of exploration-exploitation may prejudice a separate regime on its own.

5.1. Deciding with other utilities

The cases show it is rather complex to formalise non-expected utilities such as regret and make a case for these in the organisation. They face a long history of management tools that are a mirror of rational theories of choice (Keeney & Raiffa 1979; Raiffa 1968; Fourcade & Khurana 2013). Consequently extreme uncertainties and unknown parameters are not fully endogenised in the decision-making process. Endeavours are made in *divergent* phases through different practices such as Design Thinking or envelop characterisation for modular and robust design, but these are partly jeopardised by exploiting reflexes encoded in the organisation. Other attempts were made to keep some of the projects alive long enough whilst

hoping they would find a home. But whilst surveying the business units, only hints of the original prospects remain, or where started again altogether like in the case of seat modularity.

Tools such as net present value calculation do not take into account the unknown or at least means of uncovering unexpected events. They only consider identified risk taken formalised by experience, "lessons-learnt" and other forms of learning. Unfortunately, they do not reflect in any form ways of uncovering and endogenising the unknown, forcing to challenge the order of preferences, underlying hypotheses. They don't even consider future prospects as long term planning. Conversely, having public funding to support R&T activities or consortia (Sydow et al. 2013; Le Masson et al. 2012) are means to create decision situations that are unconventional compared to expected utility models (Le Glatin et al. 2017).

5.2. Managing the tension of competing objectives

As discussed in (Birkinshaw & Gupta 2013; O'Reilly & Tushman 2013) deciding if one should invest more in exploitation or exploration for better performances, the debate may not lie in a continuum between two patterns. They advise that allocated projects should be measure on two different scales but it still leaves open the question of the transition between a regime and another. The five whys remain opened questions as there is no clear understanding of managerial capabilities set in motion for such transitions. In this paper, we have endeavoured to show examples of contextual ambidexterity in the complex strategic environment of aircraft cabin equipment. It appears pushing concepts through a regime to another may be not satisfactory. We proposed with concern for extended decision theories, that non-expected utilities could support a *quantic state* for concepts where they contribute to the two competing objectives simultaneously; to avoid forcing a state or another. It is not a matter of incubation and structural separation as proposed by several authors (Tushman & O'Reilly 1996; Christensen 1997), but rather a question of internal regeneration of the

organisation (O'Reilly & Tushman 2007), or internal change management, through management tools supporting non-expected utilities decision theories.

The case of making decisions based on non-expected utility allows covering rational theories, as a special case, in addition to other forms of utilities such as regret (Starmer 2000) with the possibility for instance to reverse preferences. By extending the endeavours reported in the different cases, hints of what a management tool supporting their collective action would essentially raise awareness on the unknown and its value:

- Positive: increasing returns for immediate exploitation, optimising resource allocation, considering lobbying and marketing activities, designing imagined favourable situations
- Negative: Black Swans and systemic disturbing elements undermining dominant designs

In (Macmillan 1983, p.17) several pre-emptive strategies are discussed around the idea that one should shape one's luck: "Good generals make their luck by shaping the odds in their favour and by being able to spot and rapidly capitalize on every emergent opportunity created by the mistakes of their opponents, or by the good fortune they have helped to shape". This approach largely echoes Shackle's viewpoint notably with the idea of potential of surprise (Shackle 1952). It also adds to the idea that one will design the next decision situation based on more favourable consequences that can also be designed. Economic vigilance is then required to dynamically change the course action or at least to design in a robust and resilient manner to avoid being disturbed by the unknown. It is in that sense that forcing concepts into one of the two ambidextrous regimes and managing the transition, may lead to unnecessary costs and budget variance, especially in a context where there is shift in the locus of innovation (Benner & Tushman 2015) and the generation of choices and knowledge are made

through different modes (decentralisation, open innovation, alliances) and moving organisational boundaries (Lakhani et al. 2013).

A management tool dedicated to ambidexterity, as a cognitive extension for decision-making (Heath et al. 1998), that would keep and value the tension of exploration/exploitation without forcing the transition, could then allow the following:

- Identification of mixed projects that contribute simultaneously to competing objectives on a Pareto front by considering (non)-expected utilities. Consideration on how the frontier could be shifted: architectural innovation for instance (Birkinshaw & Gupta 2013).

[Insert here Figure 1]

- Using exploitation opportunities to nest exploration prospects features
- Driving exploration prospects with exploitation objectives, as a reference point to design from (Heath et al. 1999)
- Repurposing of design features across project portfolio as utilities differ in nature and time among projects
- Regeneration of organisational rules (design, engineering, sales and marketing)

5.3. Perspectives

The portrait given in the previous may rise questions on what sort of organisation could support such management tool. Yet, calls have been made such to understand forms of continuous innovation (Steiber & Alänge 2013) for instance with a case for Google Inc.. However we may question why the allocation of resources for “Pet Projects” for exploration contributes to its overall performance (exploitation and exploration separately), as its core

business has mainly become internet advertisement in parallel to a proliferation of numerous products/services that struggle find a place in our markets and societies.

In contrast with our aircraft industry cases, the automotive industry has been practising modular design in a high competitive and dynamic context, and cases of multilevel integration of exploration units (Mahmoud-Jouini et al. 2007). Parallels could be drawn to understand the importance of connectedness within the firm, and alliances with suppliers and customers to support exploration and exploitation. In the space industry, project that do not really fit and circulate through the organisation also reflect the difficulty to manage the competing objectives (Lenfle 2016) and its "floating nature".

Forms of organisations such as adhocracy (Mintzberg & McHugh 1985) are possible bearers of such management tool, yet as have an internal change perspective, we believe it could be encoded deeper in organisational routines as an augmented version of common operational concerns as in the idea of a *generative bureaucracy* for instance (Hatchuel, Garel, et al. 2009). The tight relationship between the topics of organisation theory such as the different modes of ambidexterity as decision models encoded in management capabilities tends to support the idea it cannot remain a standalone theory as the nature of decisions is a determining factor.

Finally, this constant renewal recalls lean start-up modes (Ries 2011; Blank 2013) and effectuation (Sarasvathy 2001) as it can be implemented in the start-up environment where organisational rules and routines are far from being settled. However, there is a gap with our discussed cases situation with no strong incentive from the ecosystem, rather long economic cycles, strong dominant designs, and yet crucial threats and opportunities for first mover and early follower.

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7. Figures and tables

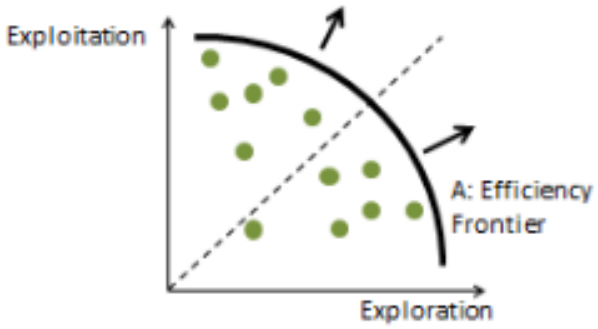

Figure 1 - Different Approaches to Managing Ambidexterity (Birkinshaw & Gupta 2013, p.295–Fig.2)