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Learning Through Scenario Planning

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LEARNING THROUGH SCENARIO PLANNING

Jose Daniel Balarezo

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The PhD School of Economics and Management

PhD Series 17.2015

CBS  COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

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LEARNING THROUGH SCENARIO PLANNING

PhD Thesis

Jose Daniel Balarezo

Supervisor: Prof. Bo Bernhard Nielsen

Ph.D. School in Economics and Management

Copenhagen Business School

Jose Daniel Balarezo
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To

Ariana, Maia and Jette

ABSTRACT

This project investigates the uses and effects of scenario planning in companies operating in highly uncertain and dynamic environments. Whereas previous research on scenario planning has fallen short of providing sufficient evidence of its mechanisms and effects on individual or organizational level variables, this research corrects this void by investigating the dynamics of organizational learning through the lenses of a corporate scenario planning process. This enhances our scientific understanding of the role that scenario planning might play in the context of organizational learning and strategic renewal. Empirical evidence of the various difficulties that learning flows has to overcome as it journeys through organizational and hierarchical levels are presented. Despite various cognitive and social psychological barriers identified along the way, the results show the novel and counterintuitive ways in which an organization uses scenario planning in balancing the tension between exploration and exploitation. Moreover, this research proposes two novel mechanisms designed to enhance learning flows. At the core of this dissertation are four papers which in combination solidify our theoretical understanding of scenario planning while simultaneously presenting a more nuanced account of the individual behaviors and social dynamics underpinning organizational learning.

ABSTRACT

Dette projekt undersøger brugen og effekterne af scenarie planlægning i virksomheder der operer i usikre og dynamiske omgivelser. Eksisterende forskning i scenarie planlægning har ikke i tilstrækkelig grad frembragt empirisk belæg for de forskellige mekanismer og effekter der gør sig gældende på individuelt og organisatorisk niveau. Denne afhandling udfylder dette tomrum ved at undersøge dynamikkerne i organisatorisk læring set fra et scenarie-planlægningsspektiv. Dette styrker vores videnskabelig forståelse af den rolle som scenarie planlægning kan spille i forhold til organisatorisk lærings- og strategiske fornyelsesprocesser. Afhandlingen præsenterer empirisk data som dokumenterer de vanskeligheder der kan opstå når ny viden bevæger sig igennem forskellige organisatoriske og hierarkiske lag. På trods af kognitive og socialpsykologiske barrierer viser afhandlingen nye og overraskende måder hvorpå organisationer kan bruge scenarie planlægning til at balancerer spændingen mellem exploration og exploitation. Ydermere præsenteres to nye teknikker designet til at forbedre læringsprocesser. Afhandling er bygget op af fire artikler der samlet set både konsoliderer vores teoretiske forståelse af scenarie planlægning og præsenterer et nuanceret billede af den individuelle adfærd og de sociale dynamikker der udgør grundlaget for organisatorisk læring.

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It has been a journey and a great learning experience. I am thrilled to be writing these lines 3 and half years after this PhD project started. Along the way I got out of my comfort zone, challenged myself, learned a lot, balanced the different demands of business and academia, meet fantastic people in both social environments. I also got married and had two beautiful baby girls. It has been a fantastic journey, but a difficult one, and it was only possible because of the help of so many people.

First I want to thank my family. Ana, Carlos, Sharon and Carlitos. Their love and constant support fuelled my intellectual curiosity as young kid, and encouraged me into pursuing this PhD project when the opportunity presented itself. Second, I thank Otto Rasmussen for envisioning this project, and for his trust in me. In a field where success is measured in quarters, it takes courage to push for a project with a long term view. Within the same lines, I want to acknowledge the Novozymes' organization for the financial support to this project. The department of Strategic Management and Globalization (SMG) at Copenhagen Business School (CBS) is a truly world class institution supported by inspiring and engaging people. I want to thank all the wonderful colleagues and friends at CBS for their support during this journey. In particular; Torben Andersen, my secondary academic supervisor for being the link that connected me to this project. I thank you very much for trusting in my capabilities and for your counselling; Peter Ørberg and Christoph Grimpe for their invaluable comments while acting as discussants at my pre-defense. Their insights and constructive feedback has undoubtedly enhanced the final output of this PhD project; Louise Mors and Nikolaj Foss for their helpful comments in two of the papers included in this dissertation; and my outmost appreciation to my fellow PhD students - it was a great motivation to share our struggles and ideas day after day. Still within academia, I also want to express gratitude to Dr. Megan Woods with the University of Tasmania for her insightful

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INTRODUCTION

Research motivation

This project was motivated by Novozyme's (business partner for this Industrial PhD project) desire to look into its scenario planning process and ways to improve it. Anchored by this organizational process, I had the exceptional opportunity to have, for three years, full access to the insights of a world leading corporation and observe the actors, processes and decisions involved on its scenario process leading into strategy. Consequently, I was in a unique position to provide evidence about the individual and organizational effects of scenario planning as the process unfolds and evolves over time.

A limitation on the scenario planning literature is the predominance of self-reported and often biased accounts of scenario planning practitioners and their interventions (Hodgkinson and Healey, 2008). Rather than providing empirical evidence of the prescribed individual and organizational outcomes (Chermack and Nimon, 2008; Glick, Chermack, Luckel, and Gauck, 2012; Harries, 2003; Hodgkinson, Maule, Bown, Pearman, and Glaister, 2002; O'Keefe and Wright, 2010) the scenario planning literature has focused on legitimizing and justifying scenario planning as a managerial tool (Chermack, Lynham, and Ruona, 2001; Hodgkinson and Healey, 2008). Consequently, an unbiased and methodologically rigorous research of scenario planning with focus on its dynamics and outcomes has the potential to become an important contribution to management practitioners and academics alike.

Moreover, the scenario planning literature is also hindered by a lack of theoretical grounding and understanding of causal relationships (Chermack, 2005; Harries, 2003; Hodgkinson and Healey, 2008). Improved individual and organizational learning, counter of individual cognitive biases, better decision making, or to sustain organizational ambidexterity are some of the intended benefits of scenario planning (Bodwell and Chermack, 2010;

Chermack, 2004; van der Heijden, 2004, 2005; van der Heijden, Bradfield, Burt, Cairns, and Wright, 2002; Schoemaker, 1993, 1995; Schwartz, 1991; Wack, 1985; Wright, 2005). Surprisingly, the literature has leveraged very little from the more consolidated research streams that it speaks to – e.g. organizational learning, human cognition or ambidexterity. Consequently, this research makes a point on leveraging and interacting with these more established research streams in an effort to blend knowledge and strengthen the theoretical basis in the scenario planning literature. Similarly, the theoretical ideas and empirical results presented throughout this dissertation contribute in different ways to the organizational learning and ambidexterity literature.

Theoretical foundation

The four papers included in this dissertation are self-contained and intended as potential journal articles. Therefore, the papers contain sections such as theoretical background, methodology, research questions and so forth. Consequently, I will not bore the reader with theoretical and methodological concepts already discussed in each paper. Instead this section defines the overall research question for this PhD project, and provides an overarching theoretical framing that binds the four papers together.

The starting point is the scenario planning literature. Given my professional background (e.g. as opposed to academic background) and little *ex ante* knowledge of this literature, deep, methodological review of this literature was necessary. This occupied a large part of my first year in this project. After a while I became well acquainted with this literature and was able to identify various areas where our understanding was limited. It daunted on me the disconnection between the intended benefits of scenario planning (e.g. organizational learning or individual cognition) and the little it leveraged from these streams. For instance, most models of organizational learning (for a review see Flores, Zheng, Rau, and Thomas,

2012) depict the phenomenon as a multilevel process starting at the individual and culminating at the organizational level. Further, there are several potential blockers and barriers that might restrict the flow of learning into the organizational level (Crossan, Maurer, and White, 2011; Lawrence, Mauws, Dyck, and Kleysen, 2005; Schilling and Kluge, 2009). The scenario planning normatively says it improves organizational learning, without addressing how exactly the learning from scenario planning moves from the individual into the organization, or how it overcomes the potential barriers to organizational learning at various levels of analysis. Similarly, much of the scenario planning literature uses externally driven stand-alone interventions (e.g. workshops for scenario construction) as mechanism to create change. Conceptually, these single interventions resemble what change and intervention theory calls episodic change (Weick and Quinn, 1999). Interestingly, the scenario literature ignores some key features of the episodic change literature. Namely, it is doubtful that episodic interventions can achieve lasting effects and relapse to previous patterns – e.g. before intervention - is likely (Weick and Quinn, 1999) thus having limited effect on organizational outcomes.

Another good example of the inconsistencies of the scenario planning literature is the role the scenarios themselves - a core construct in this literature. Scenario are said to be good devices in changing individual mental frames via the introduction of uncertainties, which in turn reduces individual cognitive biases such as overconfidence in estimates or anchoring in strategies (Schoemaker 1993). However, there is also evidence that scenario-like presentations introduce the same biases – e.g. overconfidence or anchoring (e.g. Sedor, 2002). Consequently, the empirical evidence does not support, or at least warrants further research on the effects of scenarios over individual cognition and mental frames.

In sum, I was struck by the normativity of the scenario literature and the lack of evidence to support its claims. It was evident that in order to make an academic contribution

to the scenario planning literature and to the fields that this literature speaks to (e.g. organizational learning, individual and social cognition, strategic management) I had to get a basic understanding of the literature in these fields, and blend such knowledge.

It is only so much one can do in a three year project in terms of acquiring a deep understanding of different research streams. Consequently, I focused on the organizational learning literature and so it became one of the core pillars supporting the theoretical background of this research. Specifically, I wanted to understand what this literature had to say about the processes and mechanisms that might facilitate the movement of learning from the individual into the organization at large. I concentrated in the work of Crossan and colleagues (Crossan, Lane, and White, 1999) because its beauty simplicity in depicting the rather complex concept of organizational learning. Specifically, their 4I learning framework is supported by 4 key premises: (1) organizational learning is a multilevel process; (2) learning moves between levels via 4 sub-processes (the 4I's); (3) it interacts between cognition and action, and (4) it acknowledges the tension between the assimilation of new learning (exploration) and using what has been previously learned (exploitation). In 2009, the work of Crossan and colleagues received the prestigious AMR (Academy of Management Review) "Decade Award" for most cited AMR article in the last 10 years. This is a statement of the impact on the field of this 4I framework for organizational learning. As important, it became a foundation for further research on organizational learning as the original 4I framework has received various extensions and empirical studies (Berends and Lammers, 2010; Crossan and Berdrow, 2003; Holmqvist, 2004; Lawrence *et al.*, 2005; Schilling and Kluge, 2009; Vera and Crossan, 2004). However, there are still several pressing areas in need of further research (Crossan, Maurer, and White, 2011); for instance in relation to potential learning barriers that might restrict the flow of learning across the 4I processes, or to meaningfully integrate various barriers of learning in a framework to organizational learning (Crossan *et al.*, 2011).

To be certain, the literature links scenario planning and organizational learning (Schoemaker 1995; Schwartz 1991; van der Heijden 2004; van der Heijden *et al.*, 2002). The selection of the 4I model of organizational learning as core theoretical framework for this project is explained by its importance to the field, its simplicity in portraying a complex process, and the various areas still in need of exploration that can be supported by this framework. Specifically, because of my unique position - being embedded in the social setting where organizational learning occurs - I saw the potential of this project to not only contribute to the scenario planning literature, but also to the organizational learning literature in regards to two underdeveloped areas: better understanding of the learning flow along the 4 processes, and the potential barriers to this flow.

The work of Crossan and colleagues is highly influenced by March's (1991) paper on the tension between exploration and exploitation. March's work also set the basis for academic interest in organizational ambidexterity, or the balance between exploration and exploitation as cornerstone for long run success in organizations (Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2004). March's work convincingly represented the various contradictory goals of combined exploration and exploitation in organizations. Crossan and colleagues (1999) integrated these ideas into a coherent framework for organizational learning. The ambidexterity literature provides some clues into the potential mechanisms that make some companies better than others in overcoming these contradictions. Consequently, and partially because of my practical background, I was also attracted to the ambidexterity literature. Scenario planning and ambidexterity have also been linked before (Bodwell and Chermack, 2010). Coincidentally, I had unlimited access to an ambidextrous and very successful organization. Novozymes has a long history of success, it is a worldwide market leader in its field and has innovation (exploration) and efficiency (exploitation) as core elements in its strategy (Novozymes A/S, 2013). According to Sarkees and Hulland (2009),

revenue, profits, product innovation and customer satisfaction are four dimensions of performance characteristic of ambidextrous organizational. Novozymes excels at all these metrics (refer to paper 3 in this dissertation: Managing ambidexterity: An analysis of the design, actors and decisions at a market leading bio-tech firm, pg 9). Naturally, I leveraged this opportunity and set to investigate an area in ambidexterity research which needs further clarification; namely, the actors, decisions and mechanisms that make ambidexterity work in organizations (Birkinshaw and Gupta, 2013; Eisenhardt, Furr, and Bingham, 2010; O'Reilly and Tushman, 2013; Rogan and Mors, 2014). Consequently, the ambidexterity literature is another research area supporting this project.

Lastly, I wanted this research to capture the essence of doing an industrial PhD; that is, to bridge academia with management practice. To do so, this research had to be rooted in realistic assumptions and observations of the individuals interacting in the social context of an organization. For instance, a limitation of organizational learning models is the assumption of an unremitting progression in the learning flows from the individual to the organizational level thus portraying organizational learning as easily implemented and leading to positive organizational results (Berthoin-Antal, Lenhardt, and Rosenbrock, 2003; Crossan and Berdrow, 2003). As noted by Crossan and Berdrow, (2003), "organizational learning often remains a black box as researchers presume that positive transformation can and will happen" (p.1089). Clearly, this is not how things happen inside an organization.

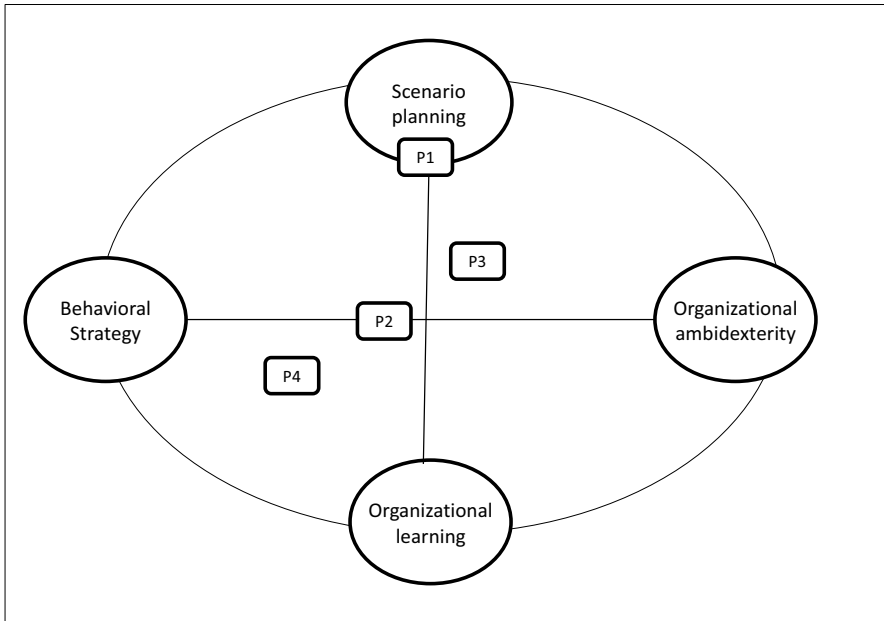
The same criticism is true for the scenario planning literature which, saving few exceptions, leaves important human and social interaction elements such as cognitive biases, effects of social settings, or individual and group emotions out of the analysis (Hodgkinson and Wright, 2002; MacKay and McKiernan, 2010; O'Keefe and Wright, 2010). Consequently, I became acquainted with literature pointing to human cognitive biases and heuristics (e.g. Dörner and Schaub, 1994; Hogarth, 1987; Kahneman, Slovic, and Tversky,

1982; Tversky and Kahneman, 1974), individual and social emotions (e.g. Hodgkinson and Healey, 2011; Huy, 2011; Karlsson, Loewenstein, and Seppi, 2009) and social contexts pertaining for instance to social identity, inclination for consensus building, or political considerations (e.g. Coopey and Burgoyne, 2000; Eisenhardt and Zbaracki, 1992; Fiske and Taylor, 1984; Fox, 2000; Turner and Oakes, 1986). Having spent more than 10 years inside organizations as a practitioner, I could easily relate to the ideas put forward in these literature streams. Emotions, personal considerations, political games and so on are part of the daily operations of an organization, and academic research in strategic management abstracting from these facts is not in tune with reality. Most of the before mentioned literature streams are integrated under the umbrella of behavioral strategy (Powell, Lovallo, and Fox, 2011) and thus it becomes another central block in this research.

In sum, the literatures of scenario planning, organizational learning, ambidexterity and behavioral strategy provide the theoretical framework for this research. The fundamental research question driving this project is: What are the effects of scenario planning on organizational learning in companies operating in highly dynamic environments? The position of the author is that scenario planning research has done a poor job in explaining its basic processes, mechanisms and outcomes. Furthermore, the evidence the literature presents is largely aloof to the reality and complexity of social behaviors and organizational environments. Consequently, this project proposes that whether scenario planning in organizations might seek exploratory learning, a combination of poorly designed processes and a variety of learning barriers at various levels renders organizational outcomes that have little to do with exploration.

This research question and thesis proposition are investigated along four papers. Each paper addresses at least one of the four core literature stream supporting this research, as it can be seen on Figure 1

Figure 1
Thesis structure and theoretical foundations



- P1: Paper 1: Scenario planning as organizational intervention. Integrative review, current debates, and future directions
P2: Paper 2: Organizational learning through scenario planning
P3: Paper 3: Managing ambidexterity: An analysis of the design, actors and decisions at a market leading bio-tech firm
P4: Paper 4: Overcoming barriers to organizational learning: Integrating behavioral strategy into the 4I organizational learning framework

Thesis structure and contribution

The first paper: “*Scenario Planning as organizational intervention. Integrative review, current debates, and future directions*”, is directed for the most part to the literature in scenario planning. Given my limited knowledge in this literature, I had to read a lot of material. As I started gradually to understand the literature, various unanswered questions surfaced. Chiefly, there was a lack of a generalizable theoretical framework and basic understanding of the central mechanisms and relationships behind scenario planning. This

first paper provides the literature with such coherent framework and basic understanding of the potential relationships present in scenario planning. It is a systematic review of the literature which collapses it into an integrative framework. Most importantly, it highlights areas in need for further research and iteratively makes connections to more established literatures with the intention to highlight inconsistencies in the scenario planning literature as well as potential ways to address the identified gaps and inconsistencies. The aim is at setting the foundations for future theoretical and empirical work in scenario planning. Thus it addresses calls in this literature for strengthening its theoretical foundation (e.g. Burt and Chermack, 2008; Chermack, 2005; Harries, 2003; Hodgkinson and Healey, 2008).

The proposed integrative framework includes process and outcome variables as well as antecedents (2), moderators (5) and mediator (1), which is novel in this literature. Four research areas were identified in particular need of further theoretical or empirical investigation: (1) efficiency of scenarios as cognitive devices – e.g. do they eliminate or rather generate bias? (2) analysis of the influences of the organizational and social context on scenario planning; (3) better understanding of various dimensions around the scenario planning team such as its composition, purpose and positioning within the organizational structure; and (4) research with focus on understanding the mechanisms that make learning from scenario planning transcends the individual level into organizational level outcomes. Some of these underdeveloped research areas are indeed investigated in the next three papers included in this dissertation.

Paper 2: “*Organizational learning through scenario planning*” is an empirical piece written in collaboration with professors Bo Nielsen and Megan Woods. It integrates the scenario planning and organizational learning literatures by conceptualizing scenario planning as a learning system. We use the extended case method (Burawoy, 1998) to explore the dynamics of organizational learning in the context of the scenario planning process used at

Novozymes. The focus is on the mechanisms that might enhance or restrict the flow of learning generated from the scenario planning. Using the 4I framework for organizational learning (Crossan *et al.*, 1999) this longitudinal case study follows the learning generated by this process as it traverses different levels both organizationally (from the individual to the organization) and hierarchically (from analysts to senior executives). We identify numerous cognitive and socio-psychological barriers that affect the transmission of learning between levels. Namely, individual cognitive biases, searching and scanning routines, the functional bias of scenarios, power and political dynamics, the organization's structure and culture of decision making biased the learning generated by the scenario process. Although scenario planning is said to overcome individual or organizational biases by challenging existing frames of mind (van der Heijden, 2005; Schoemaker, 1995) our findings illustrate how in reality various barriers at different levels exert effect over the process thus potentially preventing its learning benefits. Additionally, by theorizing and demonstrating how scenario planning acts as a learning system, we contribute to the theoretical grounding of scenario planning.

Paper 3: "*Managing ambidexterity: An analysis of the design, actors and decisions at a market leading bio-tech firm*" is also an empirical paper motivated by the need to better understand the individual actions that underpin organizational ambidexterity (Birkinshaw and Gupta, 2013; Eisenhardt *et al.*, 2010; Raisch, Birkinshaw, Probst, and Tushman, 2009; Rogan and Mors, 2014). In this paper, the focus of analysis changes from the scenario planning process into the design, actors and decisions that make ambidexterity work at Novozymes. Scenario planning is found to serve as an integrating mechanism across functional and hierarchical levels amidst the deliberate and dynamic design at Novozymes to manage the conflicting interest of exploration and exploitation. The evidence shows the simultaneous use of structures, culture, processes and networks in supporting ambidexterity at

Novozymes. Furthermore, these mechanisms for managing ambidexterity are constantly refined and adjusted in response to internal or external changes. Re-design of contracts, partnerships, networks and so on is what rejuvenates the ambidextrous design at Novozymes. In the absence of such rearrangements, contemporary ambidextrous behaviors and designs might become a source of organizational inertia tomorrow. Consequently, the research augments prior empirical evidence (Siggelkow and Levinthal, 2003; Westerman, McFarlan, and Iansiti, 2006) of the dynamic alignments and refinements needed to constantly support long run exploration and exploitation.

In response to calls for further research on the role of managerial capabilities and the decisions that go into managing ambidexterity, this paper identifies some of the roles and actions of senior and middle managers. Among other tasks, senior managers – executives – are found to have the critical role of creating and accepting contradictions as an organizational mental frame. The study reveals some of the actions and mechanism used to achieve this. The paper also brings some new insights into the important role of middle managers in managing ambidexterity. Middle managers are found to actively promote and reinforce ambidextrous behaviors, while at the same time managing the dilemma of which ambidextrous behaviors are allowed to move up into the next organizational level. Finally, this paper finds evidence of the role of organizational and individual networks, both internal and external, at managing ambidexterity. In doing so, it extends recent work in this area (e.g. Rogan and Mors, 2014).

The last paper of this dissertation, “*Overcoming barriers to organizational learning: Integrating behavioral strategy into the 4I organizational learning framework*” is a theory piece developed with Professor Bo Nielsen. Much of the ideas contained in this paper came from the constant iteration along this PhD project between the diverse literature I had read, the observations at Novozymes, and the findings from the previous two empirical papers. It is a nice way to close this dissertation in the sense that it incorporates most of that was learned

throughout my PhD studies. Importantly, it proposes some mechanisms on how to overcome some of the observed learning barriers (e.g. in paper 2). The paper integrates real assumptions about human behaviors and social interaction – e.g. behavioral strategy (Powell *et al.*, 2011) – into the 4I organizational learning framework (Crossan *et al.*, 1999). We identify and integrate five specific behavioral and social processes that constrain the acquisition and flow along the feed-forward and feed-backward process of the 4I framework. Importantly, we introduce *intervening* and *instigating* as two potential mechanisms for dealing with these barriers in order to open up learning flows. *Intervening* is a mechanism for cognitive frame-breaking and reduction of ego defenses at the individual and group level. It has three underlying processes: (1) forcing discrepancies and shifts in information processing modes; (2) challenging of expert knowledge capacity; and (3) promoting dialogue and critical self-reflexivity. Building on insights from the power and dependence perspective (Emerson, 1962), *instigating* is our mechanism that alters the power dynamics within the social context of organizational learning. This allows learning to be transmitted upwards from individual to group and organizational levels.

By integrating potential behavioral and social processes that constrain the acquisition and flow of learning into a well-established learning model, we present a more complete account of the difficult journey of organizational learning. Importantly, by designing two mechanisms for opening up learning flows, we provide insights into how organizational might manage the tension between exploration and exploitation. We close this paper by circling back to scenario planning to highlight how the literature has partly focused on some of the processes underlying our *intervening* mechanism, while mostly ignored the processes suggested under our second mechanism - *instigating*. This provides a more nuanced explanation to why successful scenario planning interventions are likely the exception rather

than the rule, and potential ways to correct this in pursue of organizational learning and strategic renewal.

Taken together, this PhD project provides a detailed account of the various behavioral and social influences over scenario planning which greatly affect its ability to generate exploratory learning (e.g. Paper 2). Instead, scenario planning ends up being mainly used as an integrating mechanism guiding exploitative needs (e.g. Paper 3). These empirical findings addressed some of the underdeveloped areas identified in the scenario planning literature (e.g. Paper 1) while also provided some key insights about learning systems in general. These insights created a fertile terrain to advance various propositions pointing to mechanisms with the potential to overcome various learning barriers (e.g. Paper 4). The four papers are presented in the following sections.

**Scenario planning as organizational intervention. Integrative review,
current debates, and future directions**

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Copenhagen Business School

ABSTRACT

Scenario planning is said to be a capable intervention in improving important organizational outcomes such as organizational learning and strategic renewal. Yet, the theoretical understanding of the mechanisms governing scenario planning as well as empirical evidence of its effects on organizations is underdeveloped. This paper critically reviews and reflects on the current state and progress of the scenario planning literature. Based on a systematic literature review, an integrative framework is provided to a largely normative literature that has dealt with issues in isolation. The framework includes antecedents, processes, outcomes, moderators and mediators. The paper highlights debates and under-researched areas while iteratively making connections to more established research streams, the insights from which have not been sufficiently integrated into the scenario planning literature. The review reveals four areas in need for future research in order to enhance our theoretical understanding of scenario planning and set the stage for future empirical examination on its effects on individual and organizational level outcomes.

Keywords: Scenario planning; strategic renewal; organizational learning

INTRODUCTION

Strategic renewal is necessary for the long term survival and success in organizations (Agarwal and Helfat, 2009); yet such strategic renewal is very difficult to achieve (Bettis and Prahalad, 1995; Corner, Kinicki, and Keats, 1994; Huff, Huff, and Thomas, 1992; Tripsas and Gavetti, 2000). An organizational intervention with the potential for improving strategic adaptation and renewal is Scenario Planning (SP). SP is thought to bring strategies more in tune with changing business environments due to its ability to improve learning (van der Heijden, 2004; Schoemaker, 1995), enhance sense making, remedy cognitive biases and challenge prevailing mindsets (van der Heijden, 2005; Schoemaker, 1993, 1995; Schwartz, 1991; Wack, 1985a, 1985b), or devise better strategic options and thus aid decision making (Chermack, 2004a; van der Heijden, 2005; Wack, 1985a, 1985b). Accordingly, the use of SP creates organizations better prepared for coping with the uncertainty inherent in the business environment (Wack, 1985a). In short, SP works under the basic assumption that the future will not be constant or similar to the current business environment; therefore it questions the deepest assumptions about an organization's strategy - thus promoting strategic renewal. The normative aspects in this literature are quite appealing and its potential benefits have been fleetingly recognized by the strategic management literature. For instance, important research streams such as dynamic capabilities (Teece, 2007) or organization identity and learning (Brown and Starkey, 2000) have briefly touched upon the potential benefits of SP.

However, the SP literature does not provide sufficient understanding of the process and its causal mechanisms thus preventing scientific verification of its merits (Chermack, 2005; Harries, 2003; Hodgkinson and Healey, 2008). Empirical evidence supporting its individual and organizational outcomes is insufficient (Chermack and Nimon, 2008; Glick, Chermack, Luckel and Gauck, 2012; Harries, 2003; O'Keefe and Wright, 2010) and potentially unreliable because of the anecdotal and subjective-based nature of self-reported

practitioners' often-biased-accounts of their interventions (Hodgkinson and Healey, 2008). Instead, the literature is dominated by a relatively large number of publications focusing on “techniques” or “methodological approaches” for building scenarios, many of which are at odds with each other leading to methodological confusion (Varum and Melo, 2010). Consequently, SP research can be described as “Popularist Science” where practical relevance is high but theoretical and methodological rigor are low (Anderson, Herriot, and Hodgkinson, 2001). To advance, the SP literature must be grounded in better theoretical understanding and empirical evidence of its governing mechanisms – e.g. move towards “Pragmatic Science” where both relevance and methodological rigor are high (Anderson *et al.*, 2001). Therefore, having a generalizable theoretical framework and better understanding of the relationships governing SP is much needed (Burt and Chermack 2008; Walton 2008).

This research responds to these calls by critically reviewing and synthesizing this fragmented literature and providing a coherent conceptual framework. Previous literature reviews have organized the SP literature mainly by clustering in different ways the various techniques for developing scenarios (e.g., Bishop, Hines, and Collins, 2007; Börjeson, Höjer, Dreborg, Ekvall, and Finnveden, 2006; Bradfield, Wright, Burt, Cairns, and van der Heijden, 2005). Instead, this study systematically reviews, integrates, and links the SP literature to other relevant streams with focus on theoretical, methodological, and empirical development. Specifically, the current study aims to: 1) synthesize and integrate the SP literature into a coherent framework; 2) offer a systems view of a process mainly researched in isolation, and 3) identify areas of debate and highlight priorities for future research. The proposed framework includes antecedents, processes variables, outcomes and moderating / mediating variables. It intends to provide a solid starting point for solidifying the theoretical foundations of the SP literature, and setting the stage for future empirical testing of the relationships and outcomes.

A methodological section follows this introduction. The next section presents a conceptual framework for SP and discusses in detail its components. Discussion of the main debate areas in need of future research follows as well as its implications for theory and practice.

METHODOLOGY

An analytical review scheme is necessary for a systematical evaluation of the literature in a research field, and especially suited for evaluating contributions and discerning patterns from a widely different set of studies or domains (Ginsberg and Venkatraman, 1985). Statistical methods such as meta-analysis are also employed when reviewing academic research; however, meta-analysis is most appropriate when the number of empirical results is large and some commonalities are present in the criteria used in such studies (Salipante, Notz, and Bigelow, 1982). Given the lack of a common framework in the SP literature and the limited empirical work, meta-analysis is prohibitive for this research. Consequently, a systematical review of the literature is used, which is explained in the following.

The research started with an electronic search drawing from the Science Citation Index Expanded (SCI-expanded) and the Social Science Citation Index (SSCI). These two databases are widely used in social sciences and humanities due to their cross disciplinary coverage and archival depth. These two databases were accessed through the Web of Knowledge platform on November 2012. Dates were not constrained hence the search included the widest possible range – from 1900 to November 2012 for the SCI-Expanded, and from 1956 to November 2012 for the SSCI. The search did not yield any record older than 1977. The search was restricted to articles in peer-reviewed journals to make the research manageable while ensuring the quality of it as articles in such journals are considered

validated knowledge, and are expected to have the highest impact on their fields (Podsakoff, Mackenzie, Bachrach, and Podsakoff, 2005).

The key words used were “scenario planning”, “scenario thinking” and “scenario building”, which are commonly used in this literature (Varum and Melo, 2010). 12 categories were selected, these being “management”, “economics”, “business”, “business finance”, “operations research management science”, “planning development”, “computer science interdisciplinary applications”, “sociology”, “psychology”, “applied psychology”, “psychology multidisciplinary” and “multidisciplinary sciences”. This search yielded 223 records. Management, economics, business, business finance and operations research management were obvious choices as SP is often related to many of the core streams in management research such as strategic cognition or organizational learning. Planning development was chosen as SP aligns with the flexible approach to strategic development and thus acquired popularity as an alternative to more formal planning (Chermack, Bodwell, and Glick, 2010) yet, they share common roots. Computer science interdisciplinary applications was chosen since one of the two historical centers for scenario techniques - the USA center, which subsequently gave birth to the Intuitive Logic School, and Probabilistic Modified Trends School (PMT) – was originally influenced by computer power and simulations (Bradfield *et al.*, 2005). Sociology, psychology, applied psychology and psychology multidisciplinary were also included as SP intends to challenge individual and collective mental frames. Multidisciplinary sciences broadened the search due to the wide array of applications for SP.

The increased availability of databases has raised questions related to the accuracy of research based only on one database due to the differences in journal coverage (Basu, 2010). For example, research comparing the Scopus and Web of Knowledge databases has shown that using only one of these databases risks missing relevant research (Vieira and Gomes,

2009), especially when the search is limited to smaller citing entities – i.e. journals, conference proceedings or institutions (Meho and Sugimoto, 2009). Hence, to strengthen the research, a secondary search was performed using the Scopus database. The parameters selected followed as closely as possible the search in the Web of Knowledge. This search yielded 317 articles. After a manual review and de-selection of duplicated results, the final raw number of articles used in this research was 396.

The 396 articles were subjected to a manual selection process to assess their contributions and were selected for final inclusion based on presence of: (1) a theoretical contribution (such as frameworks, mechanisms, antecedents, moderators, variables or boundary conditions); (2) empirical nature (quantitative or qualitative) and; (3) detailed case studies of SP or scenario intervention which could potentially increase our understanding of the variables and mechanisms at play. After reviewing the 396 articles, 120 were finally included in this research.

CONCEPTUAL FRAMEWORK FOR UNDERSTANDING SP

What follows is the development and discussion of the integrative framework built from the literature review. Table 1 (later) presents the final selection of articles used in constructing this integrative framework. It contains a summary of the main objectives, key findings, and theoretical underpinnings of each article along with their links within the proposed integrative framework which is presented in Figure 1. The framework integrates past and current research on SP and represents a stylized understanding of the different constructs and mechanisms underpinning SP as proposed by prior research. Major antecedents, moderators and mediators along with the different processes and intended outcomes of SP are included in the framework.

The framework advances previous theoretical attempts to synthesize the literature (Chermack, 2004b, 2005; Chermack and Lynham, 2002; Keough and Shanahan, 2008) by presenting antecedents, moderators and mediators which is novel in this literature. It emphasizes two antecedents, five processes, three main outcome categories, five main moderators and a mediator. In combination, Table 1 and Figure 1 provide the basis for understanding the processes and variables underpinning SP. This processual analysis (Pettigrew, 1997) contributes to the SP literature by integrating relationships between antecedents, processes and outcomes which have mainly been studied in isolation. Moreover, the analysis provides much needed theoretical foundations for SP (Burt and Chermack 2008; Walton 2008) and thus it intends to guide future discussions and empirical research.

Insert Figure 1 about here

Two antecedents [Box 1] influence the processes and outcomes. Environmental uncertainty becomes an antecedent working under the basic assumption that the future will not be constant or similar to the current business environment thus supporting the need for SP. Conceptualizing SP as a recurrent process allows understanding of prior strategy in addition to individual and organizational frames as the context for the following iteration. There are five processes [Box 2 and 5], starting with environmental scanning and culminating in active monitoring which influence, over time, individual and organizational level responses – e.g. by directing scanning teams’ attention towards important trends to follow which might improve organizational learning. Three main outcome categories are identified [Box 3, 4 and 6]. Box 3 holds cognitive and learning outcomes, box 4 decision making outcomes, and box 6 performance outcomes. These outcomes are sequential, meaning that cognitive and learning outcomes are necessary for better decision making and later organizational performance.

Similarly, in reaching these outcomes, SP moves progressively from the individual (i.e., cognition) or group level into the organizational level (e.g. strategic renewal). These processes and outcomes are moderated [Box 7] or mediated [Box 8] by several variables. The following explains the different parts of the framework in greater detail.

Insert Table 1 about here

Antecedents

Two antecedents are identified. Increased environmental uncertainty combined with engrained individual or organizational mental models puts the organization at a disadvantaged position towards long term strategic adaptation and survival. This combination creates the domain where SP operates in its quest for enhanced individual and organizational outcomes.

Environmental uncertainty. The importance of an organization's external environment and its ability to match strategies to external changes has long been discussed in the strategic management literature (Daft, Sormunen, and Parks, 1988; Duncan, 1972; Eisenhardt and Martin, 2000; Miller, 1994; Milliken, 1987). In a similar vein, the SP literature also acknowledges the importance for organizations to be in tune with their external environment; in fact much of the adoption of the method is attributed to heightened external uncertainty. Linneman & Klein (1983) studied the use of scenarios in US firms for the period 1977-1981 and found that its adoption increased substantially after a number of external shocks. Similarly, Malaska and colleagues (Malaska, Malmivirta, and Hansen, 1984) surveyed 166 firms and found evidence that scenario analysis was associated with increased unpredictability of corporate environments. More recently, studies correlate adoption of SP with higher external uncertainty faced by decision makers (Ramirez, Van Der Heijden, and

Selsky, 2010; Varum & Melo, 2010). Hence, the literature establishes a positive relationship between increased environmental uncertainty and adoption of SP in search for strategic adaptation.

Individual and organizational mental models. The cognitive perspective of strategy making acknowledges the bounded rationality of the individual (Simon, 1979) and the important role that cognition plays in strategic contexts (Hodgkinson and Maule, 2002). Individuals have limited information processing capabilities which make them prone to creating economic tendencies – e.g. heuristics - and to process information under the filters created by core beliefs, cognitive categorizations and mental frames (Barnes, 1984; Duhaime and Schwenk, 1985; Hodgkinson, 2003; Hogarth, 1987; Kahneman, Slovic, and Tversky, 1982; Kiesler and Sproull, 1982; Tversky and Kahneman, 1974; Porac and Thomas 1990; Reger and Palmer 1996; Walsh 1995). Therefore, the way individuals act is explained by past experiences and economic tendencies on information processing. These might blind managers to important environmental changes and lead them to inaccurate interpretations and wrong decisions.

The SP process is said to be an efficient organizational intervention in reducing these cognitive limitations. Good scenarios can challenge preconceptions through a deeper appreciation of the factors that could shape the future (Schoemaker, 1995). Further, scenarios aim at enhancing sense-making capabilities (Wright, 2005) and reduce individual bounded rationality by presenting vast amounts of relevant information easily accessible by memory, thus likely able to affect individual mental frames (Chermack 2004a). According to van der Heijden, (2005) scenarios develop the ability in managers to interpret information from the environment differently and force them to “think the unthinkable”. Therefore, cognitive benefits are prescribed by this literature under the assumption that individuals and

organizations are unlikely to timely update their mental models in face of dynamic environments. Consequently, given the existence of mental models in individuals and organizations, these become antecedent to SP and part of the context in which SP occurs.

Processes

Five main processes in SP are identified. The first is environmental scanning which provides input for scenario building. The output of scenario building is the scenarios themselves which subsequently are disseminated throughout the organization. Active monitoring links current SP process to future ones. Research on SP processes has mainly focused on two areas, scenario building techniques and the scenarios themselves. In doing so, much of the interesting features of SP are left unexplored – e.g. movements across and within levels or the effects of the process over time.

Environmental scanning is an important input for scenario building, for example in the identification of key factors and driving forces in the company's external environment (van der Heijden, 2005; Schoemaker, 1993; Schwartz, 1991; Wack, 1985a). Therefore, the quality of information gathered from the scanning process will have a great influence on the ensuing scenarios built. However, little attention is giving in this literature to the different biases that scanning is potentially vulnerable to. For instance, scanning can be detrimental for changing perceptions due to biases such as hindsight (Barnes, 1984; Kuvaas, 2002) or confirmation (Darley and Gross, 1983) which predisposes individuals to look for information that confirms their initial beliefs rather than finding contradictory evidence. As pointed out by Dorner and Schaub (1994), most information collection mistakes are due to preformed images of reality as people fail to look at the whole range of information. Instead, people focus to what is considered important from the point of view of their preconceived image of reality.

Therefore, standard ways of scanning are likely to be oriented towards known events rather than unknown (Beck and Plowman, 2009).

Hence, although the SP literature acknowledges the importance of environmental scanning - and the effects of engrained mental models as antecedent - it does not recognize or discusses the potential biases that scanning brings into the process. This constitutes a limitation in this literature.

Scenario Building. This is the area within SP that has drawn most scholarly attention. The number of methodologies proposed for creating scenarios is large. Bishop et al. (2007), Börjeson et al. (2006), Bradfield et al. (2005), Huss and Honton (1987), Schnaars (1987), and Varum and Melo (2010) provide good overviews and classifications of different methodologies for scenario building. However, despite the noble attempts at synthesizing the literature, many methodologies are at odds with each other (Varum and Melo, 2010). Most importantly, the literature offers no theoretical reasons or empirical evidence to explain why a particular methodology should be preferred over another.

Moreover, the confusion is not only associated with the methodologies for creating scenarios but also with the construct definition. Scenarios, scenario building, scenario thinking, and SP are often confused or used interchangeably. For instance, Miller and Waller (2003) defined SP as a “process for structured thinking in which stories are created that bring together factual data and human insight to create scenario plots exploring possible futures” (p. 95). However, according to van der Heijden (2005), SP should have an integrating focus where decisions and actions to implement strategies should be part of the process. There is a clear difference in these two definitions; the first one is centered on creating scenarios, thus missing integration into strategy development or implementation as proposed by the second definition. As pointed out by Chermack and Lynham (2002), SP definitions are unclear about

what the primary intentions of the process are. This not only confuses readers but also potentially misdirects researchers in this field as it is often unclear whether a particular study is about scenario building, SP, or something else. The lack of precision on the construct definition is indeed a critical issue in this literature. Without clear construct definition, efforts to strengthen the theoretical foundations of SP and unearth its mechanisms are seriously undermined. Bishop et al. (2007) briefly addressed the misuse of the word “scenarios” as it is often used indiscriminately to refer to scenario development and SP. The authors suggested using the word SP only when referring to a “complete foresight study” which generally should include 6 steps (framing, scanning, forecasting, visioning, planning and acting). Scenario development should be used only in the context of creating or building the “stories about the future” (Bishop et al. 2007).

These limitations notwithstanding, this review identifies 4 building blocks frequently associated with building scenarios; 1) *predetermined elements*, or driving forces pushing for inevitable outcomes, although the timing and impact of these outcomes are not yet known (Wack 1985a; Wack 1985b). The identification of these predetermined elements is central to SP projects (Burt 2006); 2) the *strategic conversation*, or “carefully thought out but loosely facilitated series of in-depth conversations for key decision makers throughout the organization” (Schwarz, 1991, p. 221). The *strategic conversation* incorporates a wide range of unstructured thoughts and views and out of this creates a common interpretation (van der Heijden, 2005); 3) *consensus*, as scenario building is a consensus and legitimation device around key strategic issues challenging the organization (Schoemaker, 1993). Finally, 4) “*thinking the unthinkable*” which attempts to entice out of the box thinking, usually by the inclusion of “remarkable people” (van der Heijden, 1997) to better challenge institutionalized thinking and broaden views. The four constructs appear to combine quantitative and qualitative dimensions in developing the scenarios.

Interestingly, the literature generally has not reflected on further biases introduced during scenario building. For instance, research points to potential problems in large group settings (used in scenario building workshops) such as stereotyping, decreased ownership of ideas or unwillingness to express novel thoughts (Weick and Quinn, 1999) and this constitutes an area which needs to be better integrated with insight from other research streams.

Scenarios are a central element of SP. However, their ability to effectively stretch people's thinking or challenge firm's strategic decisions is increasingly challenged as noted by a recent trend which points to fundamental problems with scenarios. For instance, scenarios tend to be unimaginative, constrained to a standard range of possibilities, focused on current issues, predictable on their factors and theme selection, and prone to leaving uncertainties out of the analysis (Bacon, 2012; van Notten, Slegers, and van Asselt, 2005; O'Brien, 2004). Rather, scenarios seem to be misleading and ill-prepared to entice novel thinking or anticipate rare events (Goodwin and Wright, 2010; Postma and Liebl, 2005). As illustration, Bacon (2012) analyzed 13 different scenario-based studies regarding the "future of Russia" and found that in all cases the scenarios constructed were too close to each other and reduced to a standard set of futures, usually within the lines of best case, worst case, continuity, and regional variation. Similarly, van Notten et al. (2005) reviewed 22 scenario studies and found only half of them included discontinuities. Methodological choice, tendency to consider only attractive futures and avoid threatening ones, organizational resistance towards uncertainty, or assumptions that the future will not be meaningfully different from the present are some of the reasons for this omission (van Notten et al. 2005).

The evidence points to a problematic area of SP: the scenarios themselves. Despite the large number of proposed methodologies, scenarios remain unimaginative, similar to each other, or gravitating toward current, known trends. In such state, scenarios are ineffective to

accomplish their prime objective - challenging mental frames. Instead, the restrictive array of scenarios might reinforce current views and status quo (Wright and Goodwin, 2009). Indeed, many companies in their approach to scenarios are simply quantifying the obvious (Wack 1985a). The response has been more methodologies for reducing these weaknesses. For instance, the combination of quantitative and qualitative dimensions (von der Gracht and Darkow, 2010; Söderholm, Hildingsson, Johansson, Khan, and Wilhelmsson, 2011), use of fuzzy cognitive mapping (Amer, Jetter, and Daim, 2011; Jetter and Schweinfert, 2011), combination of different methodologies (Dammers, 2010), or inclusion of different types of scenarios such as inconsistent, context, recombinant, or scenarios that highlight key vulnerabilities (Bryant and Lempert, 2010; Muskat, Blackman, and Muskat, 2013; Postma and Liebl, 2005).

Rather than proposing further methodologies, a more fruitful line of research is to dig deeper in understanding the mechanisms that out to be driving the process towards its intended outcomes. Scenarios and SP in general are social processes involving individuals and embedded in the organizational context. As such, it is surprising that this literature has not sufficiently leveraged research streams which might provide insights into how to improve the effectiveness of scenarios and SP –e.g. psychology, social psychology, or social cognition.

Contextual sharing and disseminating. A critically underdeveloped area of SP is the lack of clarity on how the process transcends into the organizational level (Burt and Chermack 2008). The organizational learning literature provides insights on how information residing at individual levels of analysis is likely to reach organizational levels. For instance, dissemination is a key process for organizational learning and the only way to move learning from lower levels (individual or team) into higher levels (Flores, Zheng, Rau, and Thomas, 2012). Within the SP literature, the case study at Shell provides good evidence of how

knowledge from scenarios moved from the individual into the organizational at large – e.g. changes in strategy. The company engineered this dissemination process by asking their line managers how they would react to the different scenarios created (De Geus, 1997; Wack, 1985a). Hence, similar to organizational learning models, it appears through dissemination SP transcends the individual level.

However, transferring knowledge is not a simple task and requires a two sided cooperation. For instance, research on information transfer among teams found that teams must make the necessary effort to translate the knowledge into meaningful realities and contexts for the recipient side (Bresman, 2012). Although limited, there are few examples within the SP literature where the efforts to disseminate scenarios and make it context specific are clear (Cornelius, Van de Putte, and Romani, 2005; Mobasheri, Orren, and Sioshansi, 1989; Moyer, 1996; Wack, 1985a). For instance, in the case presented by Wack (1985a), after a series of failed attempts for SP to reach organizational level responses, scenarios presented to line managers evolved into a “tailored made fit between the scenarios and their [line manager’s] deepest concerns” (p 88). Thus, scenarios and their potential outcomes were made contextual depending on which part of the organization they were meant to reach.

Hence, it appears that through the dissemination of the different scenarios and the efforts in making the implications context specific for the recipients that SP effects transcends progressively from the individual to the organizational level. The handful of studies identified provides important insights but many questions remain unanswered; for instance in relation to barriers and enablers that might restrict or allow learning from SP to move from the group level (e.g. scenario building workshops) into the organization at large. Consequently, further research looking into the transferring mechanisms and potential blockers of this transfer is much needed.

Active monitoring and SP as continuous process. Some researchers understand SP as a continuous organizational process. For instance, SP needs to continuously bridge the organization with its external environments by fine-tuning strategies and their implementation (Miller and Waller, 2003). Hence, SP is a continuous learning process that enhances organizational responsiveness by actively monitoring the key uncertainties identified during the scenario process, tracking environmental changes, and having frequent exposure updates (Miller and Waller, 2003). Most SP projects fail because there is no link between the scenarios and strategies; a lack of implementation which can only be remedied with time and practice (Wilson, 2000). Consequently, SP acts as a trend following an alert mechanism where signposts are used as early warning indicators for flagging which scenario might be developing (Chermack, Lynham, and Ruona, 2001; Ramirez, Österman, and Grönquist, 2013; Schoemaker, 1995).

Furthermore, as input for scenario building, the quality of information gathered from active monitoring will greatly influence subsequent iterations. Due to the high uncertainty inherent in long term scenarios, these should be refined and adjusted regularly as a way to assist decision making. In other words, SP as a decision support mechanism should be a continuous, iterative process; not a one-time, episodic exercise (Burt and van der Heijden, 2003; Heinonen and Lauttamäki, 2012; Mahmoud *et al.*, 2009; Sarpong, 2011).

However, despite the very good reasons for understanding SP as a dynamic and continuous process, most of the literature reviewed implicitly characterizes SP as a demanding, one-time exercise frequently led or facilitated by external advisers. Therefore, there is scant evidence of the long term effects or evolution of the process over time. Inter-temporal or dynamic dimensions are mainly ignored. This omission prevents a better understanding of how exactly SP reaches organizational level outcomes.

Outcomes

Improved cognition, learning, strategic decision making, and organizational performance are some of the intended outcomes of SP. However, empirical evidence linking SP to such benefits is seldom. This section revises the proposed individual and organizational outcomes.

Individual cognition. Changes in individual cognition is a primary intended outcome of SP (Chermack, 2004b; van der Heijden, 2005; Schoemaker, 1995; Wright, 2005). SP fosters a constant level of attention with its continuous demand for awareness to the internal and external environment. This, in turn, facilitates better sensing and forces decision makers to contemplate different perspectives. However, little empirical evidence exists to support these claims. The best evidence for the effect of scenarios on individual mental models is provided by Schoemaker (1993) who conducted experiments on MBA students. The results showed how the use of scenarios expanded their thinking as confidence ranges were widened. Schoemaker (1993) argued that scenarios use exploitation of biases in human cognition as mechanisms to achieve its goals. More precisely, scenarios achieve mental changes by reducing biases such as overconfidence, anchoring or availability through exploiting the conjunction fallacy bias, or inclination to believe that a combination of events is more likely than a single one.

In addition to Schoemaker's experiment, only 3 other studies were found to empirically test the effects of SP on individual cognition, although the findings are generally inconclusive. Glick and colleagues (2012) used a sample of 129 individuals involved in SP interventions in 10 different firms. Comparison pre and post-intervention revealed mild support for the process' ability to change some individual mental models; however, the results are inconclusive due to lack of control groups and short time span between the surveys. Zegras and Rayle (2012) used surveys pre and post SP intervention and did not find evidence

for SP's ability to change participants' perception or views. Finally, Sedor (2002) built on contributions from the field of psychology - specifically from Koehler's (1991) argument that tasks requiring a hypothesis to be treated as true is "sufficient to increase confidence in the truth of that hypothesis". Accordingly, by being presented with a scenario, individuals momentarily assume it as true, incorrectly assigning a higher likelihood of such scenario becoming true in detriment of alternative ones. Sedor (2002) investigated the biasing effect of scenario-like presentations by management following disappointing financial results. The evidence shows that scenario-like presentations create more optimistic forecasts in analyst's recommendations. This experiment indicates that instead of correcting them, scenarios may potentially introduce further cognitive biases.

Consequently, despite the wide advocacy of SP prowess on challenging and changing mental frames, the empirical evidence does not support this. Further research is needed to better understand the actual effects of scenarios on individual cognition.

Individual and organizational learning. The literature generally prescribes SP as an intervention that improves individual and organizational learning (Schoemaker 1995; Schwartz 1991; van der Heijden 2004; van der Heijden, Bradfield, Burt, Cairns, and Wright, 2002). According to Aligica (2005) scenarios create knowledge from two perspectives; (1) psychologically through its cognitive contributions meant to confront uncertainty, decompose complexity and de-bias human minds by reducing over-confidence; and (2) from an epistemic point of view, where scenarios increase the stock of knowledge by putting pieces of information together where a new configuration that brings new knowledge about the actors and implications might emerge. Since scenarios come from a rational assessment, they create knowledge which is not factual or empirical but conditional. Similarly, Kivijärvi and colleagues (Kivijärvi, Piirainen, and Tuominen, 2010) see scenarios as elements that enhance organizational knowledge by testing knowledge items against other items. According to

Bodwell and Chermack (2010), SP can help to achieve organizational ambidexterity – simultaneous pursue of explorative and exploitative learning.

However, as it was the case with individual cognition, empirical evidence for the relationship between SP and organizational learning is unclear and further research is needed (Chermack, Lynham, and van der Merwe, 2006). Of the papers analyzed, only Chermack and colleagues (2006) investigated empirically the link between SP and organizational level learning by analyzing the difference in individual responses pre and post SP interventions (3 months span) in a large educational institution in the USA. The results appear to associate SP with increased perception of organizational learning; however, the sample set is composed of only 9 respondents thus diminishing the validity of the results.

Decision making outcomes. Selection of strategies more in line with the (emerging) environment should follow cognitive and learning outcomes. Although better appreciation of the business environment or identification of possible developing trends is important, decisions and actions need to be implemented (van der Heijden, 2004). However, the important link between SP and strategy formulation and implementation is understudied; the existing literature provides inadequate guidance or empirical evidence for how SP aids strategic selection or enables strategic change (Hodgkinson and Wright, 2002; Keough and Shanahan, 2008; Tapinos, 2012; Wilson, 2000).

The early SP literature proposed qualitative and quantitative approaches for strategy selection such as intuition, managerial knowledge, wind tunneling, qualitative correlations, option stock/holder matrix, SWOT methods, key-success-factor-matrix or TOWS matrix for debate stimulation (van der Heijden, 2005; Schoemaker, 1995, 1997; Weihrich, 1993). However, Such tools are generally too simplistic, inadequate, and fraught with a multitude of problems (Goodwin and Wright, 2001). Moreover, they mostly underestimate the complex decision making process in face of many scenarios, different constraints, alternatives and

objectives; thus such tools suffer from lack of realism (Eriksson and Weber, 2008). Consequently, SP has received growing criticism for its underdeveloped strategic evaluations techniques which are unlikely to help in choosing better strategic decisions (Eriksson and Weber, 2008; Goodwin and Wright, 2001; Lempert, Groves, Popper, and Banks, 2006; Tapinos, 2012; Wright, Cairns, and Goodwin, 2009).

Organizational performance. Surprisingly, the relationship between SP and organizational performance has received relatively little attention (Chermack, 2004b; Hodgkinson and Wright, 2002; Keough and Shanahan, 2008; Mietzner and Reger, 2005; Varum and Melo, 2010). Furthermore, increased performance is generally not mentioned as a necessary outcome for SP (Chermack and Lynham 2002), despite the large amount of resources typically devoted to it (Millett, 2003; Mietzner and Reger, 2005). This review only identified two studies empirically investigating the relationship between SP and organizational performance. Phelps, Chan, and Kapsalis (2001) studied two different industries in the UK and found only mild support for improved financial performance resulting from SP. However, the results are tenuous at best due to the combination of uncontrolled variables and a small sample – in addition, worse performance measures were also reported in some non-financial parameters. Visser and Chermack (2009) interviewed top level managers from 9 companies (small and large) in different industries and found some evidence that SP contributes to firm performance. However, in addition to the small sample set, the interview data was subject to self-reported bias and notable differences between the SP processes of the interviewed companies prevent meaningful comparisons.

Consequently, the empirical evidence does not support a positive relationship between SP and firm performance. This is not surprising considering the evidence does not support a positive relationship between SP and its previous intended outcomes – cognition and learning.

Moderation/mediation

Theoretical or empirical studies pointing towards moderators or mediators in SP research are scarce. SP research has focused more on the process and content (Wright *et al.*, 2008) rather than the pre-existing or boundary conditions necessary for its effectiveness. It seems to be an implicit assumption that SP can be used effectively in any context or firm without considerations of the internal capabilities or adequacy of the method for the host institution. However, mainly building from the evidence presented in single case studies, this review has identified several variables with the potential to affect the relationship between SP and its outcomes. Although in many cases the authors did not explicitly discuss or label a variable as moderator or mediator, the context provided supports interpretations of the proposed variables as moderators or mediators. Five moderators are identified; namely (1) organization and industry characteristics; (2) anchoring and understanding; (3) power and politics; (4) the SP team; and (5) structured quantitative techniques. Similarly, one mediator is discussed: emotional responses.

Organization and industry characteristics as moderator. The large amount of resources needed to perform SP is a potential limitation, especially for medium-sized and small enterprises. Scenarios are not cheap or easy to create (van der Heijden, 2005) and the intense level of involvement makes SP an activity for only the most financially secured companies (Wack, 1985a). Besides financial considerations, the method is time consuming (Mietzner and Reger, 2005) and highly demanding on personnel (Millett, 2003) which are further limitations of the method.

Interestingly, much of the broad adoption and popularity of SP hinges on the successful implementation at Shell and its ability to identify environmental shifts (Cornelius *et al.*, 2005; Wack, 1985a, 1985b). However, a careful read of the implementation at Shell

shows the large amounts of capital, human resources, data and analyses behind the process (Wack, 1985a). Further, it took years and much iteration for SP at Shell to have a positive organizational impact. Given the sheer size and idiosyncratic nature of Shell, this brings to question the generalizability of this case to other firms. If anything, this points to unique circumstances possibly constraining the process outside companies with these characteristics (large in size, financially strong, experienced in dealing with uncertainty and with an advanced economics and analytics' team). As noted by Mintzberg (1994), successful SP interventions might be an exception rather than a rule.

Similarly, strong institutional settings and organizational willingness to experiment, absorb and use the knowledge gathered in the process also may affect SP's success (Volkery and Ribeiro, 2009). Unless the institution and its leaders are ready for such challenges, the process is likely to fail. Moreover, Gordon (2011) argued that an organization's level of influence over the potential uncertainties that could shape its environment serves to make the distinction between using visionary (normative) and adaptive scenarios. If the potential level of influence is considerable, the former type of scenarios is recommended. However, if there are many forces over which the organization has no real influence, adaptive scenarios should be used (Gordon, 2011).

Industry characteristics also have the potential to affect SP interventions (Keough and Shanahan, 2008). On their account of a failed intervention, Hodgkinson and Wright (2002) left open the possibility that their intervention might have been premature for an organization embedded in a slow moving industry characterized by incremental change and not used to questioning its core beliefs and processes. Since SP questions long held assumptions and accepts discontinuities, it might be more appropriate for companies embedded in highly dynamic environments whose management is used to discontinuities and revision of assumptions underpinning strategies.

Consequently, the success of SP appears to be moderated by various internal and external factors such as resource availability (human and financial), time, institutional and industry characteristics, willingness to challenge strategies, and ability to influence external uncertainties.

Anchoring and understanding as moderator. Anchoring SP at the highest ranks of the organization (e.g. the upper echelons) is important to achieve organizational buy-in. Consequently, the SP team, stakeholders, and project sponsor are preferably anchored at the higher organizational ranks in order to facilitate SP (Goodwin and Wright, 2001; van der Heijden, 2005; Mobasheri *et al.*, 1989; Schwartz, 1991).

An unclear understanding of the purposes of the scenario intervention is noted as one of the main culprits for unsuccessful SP interventions (Burt and van der Heijden, 2003, 2008). According to van der Heijden (2004), there are four reasons for using SP (sense making, anticipating future events, finding the optimal strategy, and adaptive learning). The author observed most failures when firms tried to generate strategies out of stand-alone scenario interventions, which incidentally tend to produce unsurprising scenarios. Naturally, organizational outcomes are difficult to reach from a standalone interventions involving few actors.

Consequently, a clear understanding from the inception of the purpose along with buy-in and support from high levels within the organizations are regarded as important for the success of SP.

Power and politics as moderator. Broad participation and organizational representation, for instance during scenario building workshops, is recommended in the literature. However, inequalities within the participants in terms of hierarchy and political

weight might influence the deliberations during scenario construction and marginalize some views (Hanssen, Johnstad, and Klausen, 2009). Thus, instead of prompting social and cognitive openness, SP might provoke cognitive closure if powerful individuals exert their influence. For instance, influence of powerful individuals potentially renders SP vulnerable to be used for setting personal or political agendas (Volkery and Ribeiro, 2009), to increase momentum of a topic (Eriksson and Weber, 2008), or to modify the results to make them politically more palatable (Heinonen and Luttamäki, 2012). Similarly, the project sponsor should be open and inclusive, instead of being embedded in close networks or biased in pursuing her/his own agendas (Cairns, Wright, van der Heijden, Bradfield, and Burt, 2006). Personal interest might be served by selecting or presenting scenarios one way or another (Selin, 2006). All these present important dilemmas as actions and allocations of resources might be recommended out of SP.

Consequently, powerful individuals have the potential to exert negative influences on SP which is a key issue seldom discussed in the SP literature.

SP team - composition and positioning as moderator. Keough and Shanahan (2008) identified the SP team composition as vital for the success of the process while at the same time pointing to the lack of guidance in the literature as to how the team members are to be selected or trained. Notably, Hodgkinson and Healey (2008) investigated in depth the SP team's composition and its role in stimulating cognitive outcomes. Leveraging from the field of social psychology and personality, a series of propositions regarding the composition and design of the SP team were articulated with focus on 1) participant's sufficient background knowledge and perspectives to maximize the likelihood of effective group information processing; 2) ensuring adequate blend of personalities to entice cooperative teamwork and minimize conflicts, decision stress and future-focused anxiety, and; 3) avoid political or

logistical factors that might derail the optimal configuration of the teams (Hodgkinson and Healey, 2008)

The critical importance of the core SP team is in full display in the account presented at Shell (Wack, 1985a, 1985b). Despite many obstacles, the SP team at Shell persevered until successful organizational outcomes were reached. However, as noted previously, the success achieved by the Shell SP team should not be generalized to other contexts. This team was very skilled at their positions and trained in dealing with uncertainty (Mintzberg, 1994). Less experienced teams might have reached a different outcome. Given the importance of the core SP team, it is surprising the little academic attention that its optimal composition or characteristics has drawn and this constitutes an area ripe for further studies.

Structured quantitative techniques as moderator. The review revealed a growing trend towards combining SP with more structured quantitative tools better prepared for assessing and selecting strategic options. The structured quantitative dimension is argued as necessary to overcome human limitations in dealing with complex systems such as: (1) focusing on few variables; (2) neglecting time lags; (3) being subject to biases; and (4) using heuristics, focusing on linear causality and overlooking feedback loops (Acar and Druckenmiller, 2006; Jetter and Schweinfort, 2011). The overriding idea in combining SP with quantitative techniques is to reduce the complexity of the decision making. For instance, by using the idea of decomposition – re-composition in decision analysis where the re-composition phase follows a formalized set of axioms thus reducing decision making biases usually employed by managers when faced with such complexity (Goodwin and Wright, 2001; Kowalski, Stagl, Madlener, and Omann, 2009). Some of the techniques proposed to be used in combination with SP are Multi Criteria Decision Analysis (Goodwin and Wright, 2001; Kowalski *et al.*, 2009; Song, Ding, and Knaap, 2006; Stewart, French, and Rios, 2013;

Wright and Goodwin, 2009) or real options thinking (Alessandri, Ford, Lander, Leggio, and Taylor, 2004; Driouchi, Leseure, and Bennett, 2009; Miller and Waller, 2003).

Consequently, in the absence of quantitative techniques more adept at following formalized axioms for strategic selection, SP is ill prepared to select strategic options and rather it is prone to introduce further biases due to the complexity of the decision process. Hence the exploratory essence of the scenarios seems to be well supplemented by structured quantitative techniques, thus likely improving the overall strategic selection capabilities of SP.

Emotional responses as mediator. SP introduces more uncertainty in the decision making process by avoiding prediction. Reaching a decision in face of different perspectives and dilemmas is likely to create anxiety for the decision makers. New information that conflicts with current assumptions forces individuals into unease, anxiety and active rejection of the new painful information (Hodgkinson and Healey, 2011; Karlsson, Loewenstein, and Seppi, 2009).

Within the SP literature, the important role of emotions has not been sufficiently addressed. This review found just a handful of studies exploring the effects that emotions play in the process. MacKay and McKiernan (2010) identified 4 dysfunctional effects of scenarios: (1) creativity layered on fantasy, (2) heightened expectations and confusion, (3) pride and passion, and (4) lack of relation to everyday work. The authors argued these dysfunctional effects might render the SP neutral, distant, or irrelevant at best; and harmful at worst. Heightened expectations and confusion arise from the reevaluation of current reality due to new lenses that lead to stress and frustration. Pride is triggered among senior executives as scenario building activities may challenge their strategy, validity, necessity or durability (MacKay and McKiernan 2010). Emotional responses are also present in the SP study

presented by Hodgkinson and Wright (2002) where it failed because it triggered defensive avoidance strategies by the participants as escape valve to cope with the high levels of decision stress. Similarly, O’Keefe and Wright (2010) described a scenario intervention that failed from the outset as the process raised doubts about already made decisions, potentially jeopardizing the work security of the individuals involved in these prior decisions, many of which were participants of the scenario building process. Thus, instead of openly discussing the firm strategic direction, emotional considerations prevailed. As noted by Wright and colleagues (2008), SP interventions are likely to challenge and question prevailing mindsets thus bruising some egos in the process.

Hence, emotional responses are important in SP as *mediator* to cognitive outcomes and strategic responses. Scenarios might trigger emotional responses such as anxiety, insecurity, pride and passion therefore yielding certain topics, trends, or decisions to be marginalized. This likely (1) hinders cognitive and learning outcomes, and (2) delays or avoids strategic decisions. Similarly, scenarios might also trigger detachment from the process further diminishing its effects. Therefore, emotions triggered during the scenario building process and ensuing scenarios might negate any positive cognitive outcomes of SP and instead reinforce dated views.

UNSOLVED DEBATES AND SUGGESTIONS FOR FURTHER RESEARCH

This paper has examined the current state of the SP literature. Based on a comprehensive review, an integrative framework was created which embodies the different processes, outcomes and variables affecting SP. Importantly, four underdeveloped research areas in particular need of further academic investigation have been identified.

1. Are scenarios effective cognitive devices or rather sources of biases?

An unclear yet vital issue is whether the scenarios, a central building block of SP, are at all effective in challenging views and enhancing individual and corporate perceptions. The evidence found does not support this argument. Rather, scenarios seem to be a constraining mechanism reinforcing potentially dated views and introducing further biases. This is due to its limited variety, novelty and neglect of discontinuities. Scenarios are presenting similar, agreeable, consensual, preferred pictures of the future, with limited treatment of uncertainties or discontinuities (Bacon, 2012; van Notten *et al.*, 2005; O'Brien, 2004). If companies in their approach to scenarios are quantifying the obvious (Wack 1985a), then SP seems unlikely to open mental frames and challenge dated assumptions.

Furthermore, in the event that scenarios are well constructed, novel and interesting, it is not clear either if they are adequate in reducing biases. The empirical evidence is mixed. Some evidence suggests scenarios achieve mental changes by reducing biases such as overconfidence, anchoring or availability (Schoemaker 1993). However, there is also evidence that scenario-like presentations introduce the same biases – e.g. overconfidence or anchoring (Sedor, 2002). Further empirical research is needed to clarify this central issue.

2. The organizational context and influences on scenarios and SP

The review revealed a contradiction in the SP literature. On one hand, it correctly identifies the need for organizations to renew their mental models in face of uncertain and dynamic environments. From this perspective, the method is prescribed as an intervention fitting for updating dated mental models and correct limitations in information processing. On the other hand however, it ignores how difficult it is to change those same mental frames (Bettis and Prahalad, 1995; Corner *et al.*, 1994; Hall, 1984). Most importantly, the SP literature has not yet reflected on the variety of biases and constraints affecting the process due to its

organizational embeddedness. For instance, in addition to strategic mental frames, organizational identity and organizational routines are elements that form the structure of organizational strategic cognition (Narayanan, Zane, and Kemmerer, 2010). Organizational identity is the organizational member's collective understanding of central and relative permanent features of the organization (Albert and Whetten, 1985). Strong organizational identities might result in cognitive inertia (Hodgkinson, 1997; Reger and Palmer, 1996). Organizational routines are repeatable patterns of independent behavior often used to accomplish organizational tasks (Feldman, 2000). Routines are every day part of an organization and they tend to have a constraining effect on individual thinking and judgment (Teece, Pisano, and Shuen, 1997). (Eisenhardt and Zbaracki, 1992).

The SP literature has seldom touched onto the effects of identity or routines over the process. It is not clear how the SP process, embedded within the organization, breaks free from such influences affecting individual and organizational cognition. For example, the first building block for scenario construction, the identification of predetermined elements, will be heavily influenced by the biases introduced during the environmental scanning due to the biased nature of scanning (Barnes, 1984; Beck and Plowman, 2009; Darley and Gross, 1983; Dorner and Schaub, 1994; Kuvaas, 2002). After some analysis, a "predetermined element" might be identified, but such an element is predetermined only to the extent that its relationships are internally consistent and fit current mental frames. As scenarios are built from identified non-paradoxical trends or simple dichotomies, they are unlikely to be useful for exploring situations beyond past known boundaries and contexts, or anticipate rare events (Goodwin and Wright, 2010; Postma and Liebl, 2005).

Only a handful of papers within the SP literature discussed these potential biases and their effects on SP. For instance, Roubelat (2006) argued organizational structures are rarely adequate to challenge old paradigms, much less to propose alternative ones. Consensus and

self-censure will tend to eliminate views that do not fit the current paradigm, especially if members are selected to represent certain parts of the organization. Elkington and Trisoglio (1996) studied the effects of organizational identity at Shell and concluded the scenarios created by the company were affected by features associated with the identity of multinationals at the time – e.g. individualism, hierarchy and lack of egalitarian perspectives. This made Shell miss obvious trends in their environment; for instance in relation to corporate responsibility.

Similarly, the role of emotions as well as power and politics might affect SP. Certain topics, scenarios or decisions might be avoided due to the anxiety the method produces (emotions), or because certain topics might not be in the interest of powerful individuals involved in SP (power & politics). However, with few exceptions, this literature has avoided these key issues and their effects on SP. This represents an important oversight in this literature.

Power as a moderator in SP opens up an interesting debate: the tension between SP being anchored at the higher levels of the organization - which is widely recommended in the literature - and the potential negative influences these individuals might exert into the process due to their powerful positions. The main argument for anchoring the process high in the organization is the need to have SP buy-in at the higher ranks as organizational action is presumed to converge at the top management level (Bettis and Prahalad, 1995; Daft and Weick, 1984; Thomas, Clark, and Gioia, 1993). This facilitates execution at lower levels. Although in line with the “upper echelon” view of the importance of top management teams (TMT) in organizations (Hambrick and Mason, 1984), this line of argument disregards literature pointing towards the possible negative effects of such strong involvement. For example, executive managers tend to focus their attention on topics they deem most relevant while selectively ignoring other topics not thought important (Bogner and Barr, 2000; Daft

and Weick, 1984; Hambrick and Mason, 1984). Furthermore, commitment to status quo is a significant top management orientation (Hambrick, Geletkanycz, and Fredrickson, 1993) which may limit interpretation adequacy and learning capabilities of organizations (Beck and Plowman, 2009), or prevent the opportunity to make sense of a situation by organizational groups outside top management (Maitlis and Sonenshein, 2010). Within the SP literature, the negative effects of an uncooperative CEO on a SP intervention have been documented (Hodgkinson and Wright, 2002). Therefore, contrarily to the established view of senior executives anchoring and involved in SP, there is also evidence such involvement may be detrimental. Presumably, a more cohesive TMT with longer tenure will have stronger mental frames and be more resistant to SP interventions, or exert negative influences on the process as compared to younger, more diverse TMTs potentially more open to being challenged and exploring new alternatives. Better understanding of the TMT compositional characteristics and their effects on SP interventions seems ripe for further investigation.

Closely related to power and TMT influences is the issue of consensus vs. divergence. As pointed out by van der Heijden (2000), scenarios are effective only when the right balance between convergence and divergence of views is achieved. However, a more interesting question is to better understand how this consensus is achieved. If consensus is influenced by power, then it is certainly detrimental to SP. When “groupthink” or consensus dominates, non-conforming views are discouraged or marginalized, which narrows the concerns and capabilities of organizations (Janis and Mann, 1977; Miller, 1993). As the power of the dominant coalition generally maintains particular worldviews, norms or traditions, it is of paramount importance in SP interventions to neutralize these influences. Consequently, further research pointing to mechanisms that balance out this power may be of particular value.

In sum, the SP literature does not sufficiently recognize the embeddedness of this organizational process and the potential constraining effects that organization identity, routines, emotions, and power and politics among others might exert over SP. Further research elaborating on these organizational effects as well as finding ways to prevent these forces seems an important future research area in this literature.

3. SP team: Composition, function and positioning

The SP team has the potential to balance some of the negative organizational influences and is key in SP reaching successful organizational outcomes (Wack, 1985a). However, research around the SP team is scarce and questions around its composition, function and positioning remain unanswered. For instance: should it be a cross-functional lead team? In which part of the organizational should the team be anchored? To whom should they report – e.g. organizational positioning? What are the optimal backgrounds, experiences, and personalities of the members? Or based on which criteria should the SP team select participants for scenario building workshops? – especially if we take in consideration that cultural backgrounds of the scenario building participants have the potential to affect the outcomes of the process (Barbanente, Khakee, and Puglisi, 2002; Johnston, 2001).

Specifically, future research should clarify: 1) what is the purpose of the SP team? If it is only to facilitate SP interventions, then it is unlikely that SP will have positive effects in organizations as facilitation will likely converge into the views and needs of key stakeholders. Rather, the main task or mandate of the SP's team should be to challenge and ask the difficult questions that managers or key stakeholders do not want to hear. However, this is likely to trigger emotional responses or face political pressures which creates the next pressing need for research about the SP team, namely: 2) positioning. It is important to identify mechanisms to shield this team from these social and political influences. Maybe changing the reporting

line from the upper echelon tiers of the organization to the Board of Directors could minimize some of the political influences. Lastly, (3) the internal composition of this team should be further investigated. For instance, what are the implications of different personalities, capabilities and backgrounds on the functioning and effectiveness of this team?

It is surprising that the SP literature has not examined enough some of these questions surrounding a team which has the vital task of challenging the organization. The work by Hodgkinson and Healey (2008) on SP team composition is an important first step in this direction, however more research, for instance grounded in social identity theory (Turner and Oakes, 1986) or human personality (Digman, 1990) seems fruitful.

4. SP learning flows - from the individual into the organization

A largely under-researched area was found in the mechanisms that transcend SP learning from the individual and group level into the larger organization. The literature mainly speaks to the individual or group level – for example, within the people participating in the scenario building sessions. But how this knowledge flows to other individuals within the organizations (both laterally and vertically) is not well understood. It appears that, similar to models for organizational learning or sense making, SP reaches the larger organization through the dissemination of the different scenarios and the sense-giving process of making the implications of such scenarios context-specific for the recipients. Likely, it is only gradually that the learning from SP is transmitted from individual to group and organizational levels. Therefore, it can only be with the aid of time that SP learning transcends into the organization at large.

Yet, oddly most of this literature focusses on externally driven stand-alone interventions. Conceptually, these single interventions resemble what change and intervention theory calls episodic change (Weick and Quinn, 1999). Episodic change occurs when a

change agent deliberately establishes conditions and circumstances that are different from what they are now - e.g., scenarios - and this is accomplished through a series of actions or interventions either singularly or in collaboration with other people - e.g., external consultant, SP team, scenario building workshops (Ford and Ford, 1994). Episodic change follows the freeze-transition-refreeze sequence and although people are highly motivated to learn during the transition stage, it is difficult to unfreeze patterns and relapse to previous patterns is likely (Weick and Quinn, 1999). Furthermore, research on individual change behavior indicates that people exposed to interventions are normally at one of the following stages: pre-contemplation, contemplation, action or maintenance (Prochaska, DiClemente, and Norcross, 1992). These steps follow a spiral-like pattern with successive relapses to previous stages before action is taken. Beer and Eisenstat (1996) offered a good account of the difficulties of achieving lasting organizational change from single interventions. Together, these studies illustrate how difficult it is to achieve individual and organizational change out of episodic interventions. Consequently, self-reported positive effects from single SP interventions do not match well with change theory and other individual or organizational evidence. Likely, stand-alone scenario interventions are destined to fail (van der Heijden, 2004; Korte and Chermack, 2007). Further accounts of single interventions must provide detailed explanations and empirical evidence to substantiate their claims. Researchers should be careful not to equate such normative descriptive story-telling with rigorous research and thus draw conclusions accordingly.

Instead, SP is better conceptualized in line with intervention theory for continuous change which entails constant learning (Weick and Quinn, 1999). An attitude towards continuous learning and adaptation must be institutionalized. In this way, feedback loops can be established. Learning from prior SP processes informs subsequent iterations; change and adaptation could happen, in time. Given the learning benefits attributed to SP, organizational

learning (OL) theory offers a particularly promising conceptual lens for theoretically grounding SP. Yet surprisingly, few studies have empirically explored this possibility (Chermack et al., 2006). By the same token, because SP spans individual, group and organizational level of analysis, it is multilevel in nature. Hence, SP research will greatly benefit from detailed accounts of the evolution of the process over time, the interactions across levels, and the mechanisms that potentially facilitate or preclude SP from reaching organizational outcomes. Multilevel research could add much value in uncovering the mechanisms that link the different levels of analysis within SP from the individual to the organization.

IMPLICATIONS FOR ACADEMIA AND PRACTICE

There are several implications from this research. For academia, it provides the most complete framework to date for understanding SP. The framework gives structure to a literature that has grown mainly from practical accounts focusing in an area or two – e.g. scenario building techniques. Furthermore, links to research discussing the various parts of the framework is provided in the form of tables which should guide future research. By iteratively drawing parallels and leveraging from more established literature streams, this research highlights inconsistencies in the SP literature while simultaneously providing potential venues for further research. Four research streams and debate areas in need of further research have been identified. These are highlighted and summarized in Table 2 which also points to literature streams and theories with the potential to shed light on these knowledge gaps. Consequently, table 2 serves as an agenda for future SP research.

Insert Table 2 about here

For practitioners, this study highlights misunderstood areas and potential problems with SP and its implementation. Despite the wide practitioner-driven endorsement in the literature of the positive cognitive and learning benefits of SP, empirical evidence does not support these claims. Despite solid, detailed single case study accounts that appear to support SP as an effective organizational intervention (Mobasheri *et al.*, 1989; Wack, 1985a), the evidence is too scarce and idiosyncratic thus preventing generalization at this point. Many SP studies use Shell's successful case study as legitimizing mechanism, however, the evidence provided for their own "successful" interventions is unconvincing and generally lacking a methodological approach for data collection to support the findings. Instead, managers and users are advised to be skeptic of these unfounded claims. Undoubtedly, SP is a complicated process potentially hindered by a variety of factors in its quest to improve organizational outcomes. The framework and tables presented in this study are informative to practitioners by pointing to potential complications along with potential sources of information. Additionally, by discussing several moderating and mediating factors, organizations are better prepared to assess the fit of SP to their own organizational context.

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Figure 1
Integrative framework for Scenario Planning

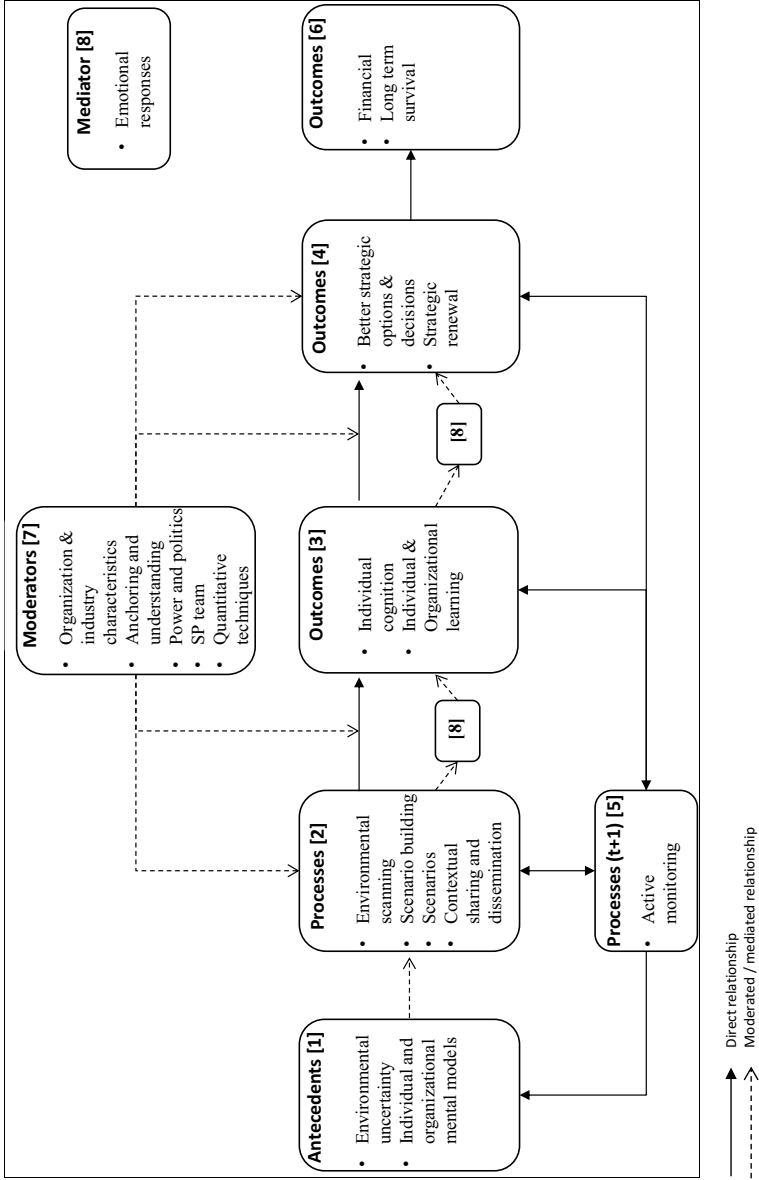


Table 1
Integrative framework for Scenario Planning (SP)

Year	Author	Firm, Industry or Region	Link to Figure 1	Sample and method	Main motivations / Research question	Key findings	Theoretical perspective
2006	Acar and Druckenmiller		[2]	Conceptual	Present SB technique combining dialectical inquiry, scenarios, causal maps and systems dynamics	Dynamic and Interactive analytical capabilities are achieved	System Dynamics
2004	Alessandri, <i>et al.</i>	The National Ignition Facility, USA	7-(3-4)	Conceptual and case study.	Investigate usefulness of combining qualitative approaches such as SP and quantitative options to value capital projects when faced with high uncertainty	As uncertainty increases, managers use more qualitative approaches in the decision process. Combining elements from SM and Finance should improve project assessment and evaluation	Finance. Hybrid DM approach
2005	Aligica		(2-3)	Conceptual	Investigate epistemic basis of scenarios	Scenarios create knowledge from a psychological (cognitive function) and an epistemic (increase stock of knowledge) point of view.	Epistemic
2011	Amer, <i>et al.</i>	Wind Energy in Pakistan	[2]	Conceptual and illustration	Explore new approach creating scenarios with fuzzy cognitive maps (FCM)	FCM combines the benefits of qualitative and quantitative analysis. The approach generates consistent and plausible scenarios	SP Literature
2012	Bacon	Russia	[2]	Literature review	Review literature on scenario-based accounts for "Russia's future"	Analysis of 13 scenario based interventions reveal a rather uniform account of 3 or 4 futures.	SP Literature
2002	Barbante, <i>et al.</i>	Metropolitan Tunis	(7-2)	Case study	Present a case study for scenario building with focus on the political and cultural characteristics of the participants	Social and political differences affected the diversity and participation rate. Despite the problems, remaining participants gradually identified themselves as a group	SP Literature
2010	Biloslavo and Dolinšek	Climate change	[2]	Survey and simulations	Develop a scenario combining the Delphi method, analytical hierarchy process, and dynamic fuzzy cognitive maps	Global warming scenario created, and implications for policy makers discussed	SP Literature

2007	Bishop, <i>et al.</i>		[2]	Literature review	Review the techniques for scenario development	8 main categories identified	SP Literature
2008	Boaventura and Fischmann	Information technology - Brazil	[2]	Case study	Development of a method to check content and consistency of scenarios	Proposed method analyzed the scenarios and identified shortcomings and inconsistencies	SP Literature
2010	Bodwell and Chermack		(2-3)	Conceptual	Propose SP as a tool for promoting organizational ambidexterity	Three capabilities described in the ambidexterity literature are present in scenario planning: sensing, seizing and reconfiguring. The authors claim bringing together two concepts not previously tied	OA
2006	Börjeson, <i>et al.</i>		[2]	Literature review	Present a new scenario typology	3 main categories are proposed	SP Literature
2010	de Brabandere and Iny		[2]	Conceptual and observations	Outline a new approach for scenario creation	9 step methodology that combines creativity with methodical <i>prospective</i> approach. Benefits and drawbacks are discussed	SP Literature
2005	Bradfield, <i>et al.</i>		[2]	Literature review	Address the confusion over the definitions and methods of scenarios	No consensus on definition or framework to which scenarios techniques belong. Three main schools identified-Intuitive Logics, Probabilistic Modified Trends and "La Prospective" school	SP Literature
2010	Bryant and Lempert	Public Policy. USA	[2];(2-4)	Conceptual and case study	Presents a new approach for scenario building - scenario discovery.	Proposed methodology addresses some of the limitations of qualitative scenario approaches. Provides stronger basis for decision analysis	SP Literature
2010	Burt	Firm. International drinks group	[2];(2-3)	Case study	Extend understanding of the art of re-perceiving as proposed by Wack	Social discourse during scenario building help make sense of historical events which were seen but not understood, thus a new reality emerged. Identifying predetermined elements is a critical element of SP, and central to its success.	SP Literature
2011	Burt	Power Industry. UK	[2];(2-3)	Conceptual and case study	Propose integration of SP and systems modelling to identify predetermined elements	Better understanding of the situation emerged from the combination of SP with the rational analysis of systems dynamic. Both methods should be combined in an iterative manner	Systems Modelling

2008	Burt and Chermack		(2-3)	Conceptual	Discuss a wide range of issues concerning SP	SP is a process able to support adaptive organizational learning. Some pitfall of SP are lack of overarching model, implementation and evaluative methods	Individual and OL
2003	Burt and van der Heijden	Small and medium size enterprises, Scotland	7(2-3); 7(3-4)	Conceptual experienced based	Different hurdles in foresight methods are discussed	Tacit assumptions about SP, client "state of mind" and fear of the future are hurdles that originate from a lack of purpose clarity before the process starts.	SP Literature
2008	Burt and van der Heijden	Global Scotch whiskey industry	7(2-3); 7(3-4)	Case study	Propose a framework for understanding the nature, objective and purpose of Foresight	A framework providing guidance on the purpose of Foresight is proposed as a necessary precondition for the success of scenario(Foresight) projects	Appreciative system theory
2006	Cairns, <i>et al.</i>	UK local governments and partner organization	7(2-3); 7(3-4)	2 case studies	Compare two cases of scenario interventions in a cross-governmental agencies setting	The role of the project sponsor must be discussed from the outset as it could derail the project. Power influences are discussed	SP Literature
2011	Chakraborty, <i>et al.</i>	Regional planning.	[2];(2-3)	Case study	Assessing a participatory framework within SP intended for creating awareness and knowledge.	Combining innovative participatory methods and quantitative modelling creates some benefits	SP Literature
2007	Chermack, <i>et al.</i>		[2]	Conceptual and empirical	Examines the "strategic conversation", construct within the SP context	Type 1 (individual) and 2 (interaction) conversation and communication skills increased after SP intervention.	SP Literature
2004	Chermack		(2-3)	Conceptual	Review the potential benefits of SP in aiding decision making	SP has the potential to address 4 key causes of erroneous decisions: Change mental models, reduce bounded rationality, consideration of exogenous and endogenous variables and, reduce information stickiness	Decision making
2005	Chermack		[2];[3]; [4];[6]	Conceptual	Propose a theoretical framework for SP	Model builds from 5 units of analysis: scenarios, learning, mental models, decisions and performance. Hypothesis are proposed	Theory construction
2008	Chermack and Nimon	Technology firm in USA	(2-3)	Pre-test and post-test surveys	Examine the relationship between SP and participants' decision making style	There were some changes in participant's DM styles 3 months after the SP - SP decreased rational DM and increased intuitive DM	Psychology

2003	Chermack and van der Merwe		(2-3)	Conceptual	Draw parallels between SP and constructivist approach to learning and teaching	Constructivist principles such as individual construction of meaning, social influences and social construction of reality can contribute to SP processes.	Constructivism
2006	Chermack, <i>et al.</i>	USA educational institution	(2-3)	Empirical	Quantitatively verify the SP effect over organizational level learning	SP intervention is associated with increased perception of organizational learning. However, reduced sample (9) diminishes results.	Cognition. Human resources literature
2010	Chermack, <i>et al.</i>		[6]	Conceptual	Position SP and organization ambidexterity as tools for better organizational performance	SP and organizational ambidexterity have the potential to enhance firm effectiveness through their ability to enhance team performance.	Teams' performance
2012	Cobb and Thompson	Park planning and management	[2]; (2-3); (3-4)	Case study.	Evaluation of scenario planning process	The scenario planning workshops encouraged explorative and active dialogue. Through such dialogue organization resilience is nurtured and innovations adopted	Systems innovation. Organizational resilience
2005	Cornelius, <i>et al.</i>	Shell	(2-3); 7-(3-4)	Case study. Historical	Present a brief account of the evolution and uses of the Shell scenarios during the last three decades	SP is a good tool for understanding uncertainties but it is not design for selecting investments and allocating capital. Scenarios should be used in combination with real options	SP Literature
2010	Dammers	Territorial Europe	[2]	Conceptual and case study	Discuss new approach for creating scenarios that combines the three well known approaches for scenarios	Combination of strengths of the three different approaches appeared to be fruitful. Especially because of the combination of quantitative and qualitative dimensions.	SP Literature
2006	Dinka and Lundberg	Technology design	(7-2)	Case study	Understand effects of identity and role during technology design via scenario workshops	Both Identity and role have a significant impact on scenario's process and results	Individual identity
2009	Drnouchi, <i>et al.</i>		(7-4)	Illustrative case	Presentation of problem structuring methodology to assess real option decisions under uncertainty	By combining robustness analysis, real options thinking and scenario planning, dynamic flexibility is created in project planning	DM under uncertainty
2010	Durance and Godet		[2]	Conceptual	Revising some important concepts of scenarios and foresight	Scenarios and foresight are not synonymous. Distinction between normative and exploratory scenarios.	SP Literature

1996	Elkington and Trisoglio	Shell	[2]; (7-2); 7-(2-3)	Case Study	Present a case study to demonstrate that Shell ignored trends in the public opinion that were clear, and consequently made wrong decisions	Scenarios constructed at Shell were "hierarchical" or "individualist" which could be multinational at the time.	SP Literature
2008	Eriksson and Weber		(7-2); (3-4)	Conceptual	Achieve conceptual consolidation and review methodological aspects of adaptive foresight	By adopting ideas of adaptive planning, strategic foresight can overcome many of the shortcomings of foresight methods	SP Literature
2010	Evans		(2-3)	Conceptual	Strengthen theoretical foundations of SP by drawing parallels with evolutionary theory	Evolutionary theory is a useful approach for strengthening SP foundations. SP has the potential to induce firm's exploratory learning and variation, or reinforce structural inertia	Evolutionary Theory
2005	Fink, <i>et al.</i>		(2-5);(5-2);(5-1); (4-5);(5-4)	Conceptual	Describe new strategic foresight approach by combining external (market uncertainties) and internal (resource based approach) scenarios	The combined approach is able to create a strategic early warning system	Resource based view
2009	Forge	EU policy	[2]	Conceptual and case study	Present a novel approach that combines a number of methods	It is possible to combine micro and macro level variables by using meso-economics	Meso economics
2010	Freeman and Pattinson		7-(2-3)	6 consultant experiences	Explore different "client" relationships.	Client involvement is necessary. His/her positioning in the firm's network could act as an enabler or barrier to the process	SP Literature
2012	Glick, <i>et al.</i>	10 firms involved in SP projects	(2-3)	Pre-test and post-test surveys	Empirically assess the effects of SP on participant's mental models	Evidence of SP being able to alter some of individual's mental model styles	Cognition
2010	Goodier, <i>et al.</i>	Construction	[2]; (2-3)	Case study	Present scenario building approach that shift focus from organizational to industry level	Process successfully engaged participants and helps understand potential collective issues.	SP Literature
2001	Goodwin and Wright		7-4	Conceptual and hypothetical case	Propose a method for addressing an underdeveloped aspect of SP: the assessment of alternatives across a range of scenarios	The use of multi-attribute value modelling creates a formalized strategic evaluation process within SP. This potentially avoids biases when making decisions	Decision analysis
2010	Goodwin and Wright		[2]	Literature review and past experience	Review of the methods intended for aiding in the anticipation rare-high impact events	Forecasting methods and non-forecasting methods (such as SP) are challenged in anticipating rare events. Firms should have 1)downside protection and 2)provide conditions for challenging thinking	Forecasting. SP Literature

2011	Gordon	South Africa and Tanzania	(1-2); (7-2)	Contrasting case studies	Investigate under which conditions "visionary" scenarios are useful	Proposes limits to when "visionary" and "adaptive" scenarios should be used	SP Literature
2010	von der Grath and Darkow	Logistics industry. Germany	[2]	Case study	Present findings on an extensive Delphi-based scenario generation	Mixed methodology using expert's knowledge, Delphi methodology, quantitative analysis and inclusion of discontinuities for scenario generation	SP Literature
2011	Hanafzadeh, <i>et al.</i>	Investment company. Iran	7-4	Case Study	Integrating scenario planning and a MCDA method	The combination of the two methods created a portfolio that is stable in four different scenarios	Portfolio design
2009	Hanssen, <i>et al.</i>	Regional foresight	(7-2)	Conceptual	Identify and discuss potential dilemmas related to democratic legitimacy of foresight processes	Foresight processes generally lack procedures to ensure compliance with democratic values. Equal participation, accountability and level of transparency are inadequate	Governance
2003	Harries		[4]	Conceptual	Provide a framework for the evaluation of scenario planning as DM tool	Scenario-based DM evaluated from a case based, empirical or theoretical point of view. Difficult to establish if and how scenario-based DM is beneficial	SP Literature
2000	van der Heijden		(2-3)	Conceptual	Discussing the role of scenarios from two different perspectives	Scenarios 1) anticipate future by challenging mental models; and 2) are a social interaction process attempting to find a middle ground between group think and fragmentation	SP Literature
2004	van der Heijden		(7-2); (5-1)	Conceptual	Reflect on the use and value of SP, after many years of use by organizations	Four reasons for using SP, each with different difficulties and likelihood of success are proposed. Firms should be clear from the outset what do they want from SP	SP Literature
2012	Heinonen and Lauttamaki	Climate and energy policy. Finland	[2]; (3-4); 7-2	Case study	Present an example on how Foresight can assist public policy formulation	Generally useful, although some problems are reported with relation to predictability, disconnection to decision making and political influences	SP Literature
2008	Hodgkinson and Healey		[7]	Conceptual	Increase our understanding of the SP team	Various theory - based propositions around SP team are advanced	Personality and Social Psychology

2002	Hodgkinson and Wright	Firm in publishing industry	(2-8-3); (3-8-4)	Conceptual and case study	Report and reflect on the reasons for a failed SP intervention	Psychological defensive mechanisms were triggered by the stress generated from the SP intervention which highlighted threats, but no clear strategic alternatives	Conflict theory of DM
1987	Huss and Houton		[2]	Literature review	Describe 3 SP techniques with & advantages and disadvantages	A firm's choice of SP techniques might partly depend on the level of detail required to make a decision.	SP Literature
1999	Islet, <i>et al.</i>	Pharmaceutical industry. UK	[2]	Case study	Present the results of using judgmental modelling in a scenario workshop with 18 senior managers	Combined methodological approaches are necessary for group decision making. Judgmental modelling aided in the analysis of outcomes.	Judgmental modelling
2011	Jetter and Schweinfurt	Solar energy	[2]; (2-3)	Conceptual and case study	Improve cognitive mapping for SP by combining quantitative analysis and integration of stakeholders' mental models	Fuzzy cognitive mapping has potential to overcome information processing limitations. Different plausible scenarios can be created. Some indication of paradigm shifting	SP Literature
2001	Johnston		[4];[7]	Conceptual	Review the leanings and limitations of foresight studies	Need of better theoretical base, evaluation, linkage to strategy and cultural considerations are important under-developed areas	SP Literature
2012	Kahane		[2]; 7-(2-3)	Conceptual	Present a new scenario planning methodology - Transformative	Some reference to scenario team composition	SP Literature
2008	Keough and Shanahan		[2],[4], [6],[7]	Conceptual	Collapse common elements in different SP methodologies into a generic model	The proposed generic SP model include 5 constructs: Engagement, team composition, SB, decision process and increased performance	SP Literature
2010	Kivjarvi, <i>et al.</i>	University management and manufacturing industry	(2-3)	Theoretical and 2 case studies	Provide a conceptual base for scenario process as a community of knowledge sharing leading to organization innovativeness	Inconclusive evidence of SP as able to promote knowledge creation, sharing, and sustain organizational innovativeness.	Knowledge creation
2007	Korte and Chermack		(2-3)	Conceptual	Investigate scenario planning as a tool to change organization culture	SP invites change in organizational culture by facilitating the reconstruction of shared mental models that govern organizational actions	SP Literature
2009	Kowalski, <i>et al.</i>	Renewable Industry - Austria	[2]; (3-4)	Case study	Analyze the combined use of scenario building and participatory multi-criteria analysis (PMCA)	Assessing scenarios with PMCA is resource intense but the methodology allows for a robust and democratic DM process	Decision analysis

2006	Lempert, <i>et al.</i>	Pollution control	7-(3-4)	Conceptual and an example	Present an approach for finding robust strategies under conditions of deep uncertainty	Decision analysis
2010	van der Lijn	Sudan	[2]	Case study, 6 scenario workshops	Compare 4 scenarios for Sudan in year 2012	SP Literature
2004	MacKay and McKiernan		(7-2)	Conceptual	Increase understanding of the effects of hindsight biases on foresight	Psychology and history
2010	MacKay and McKiernan		[2]; (2-8-3)	Conceptual and observations	Investigate possible dysfunctions and dark sides of creativity and innovation within SP	Organizational Psychology
1987	Maddox, <i>et al.</i>		[2]	Conceptual and short experiments	Review of "imaginary" and its possible applications in scenario planning	Educational research
2009	Mahmud, <i>et al.</i>	Environmental decision making	[2]; (5-1); (5-3)	Conceptual	Propose a structured approach to scenario development in environmental decision making	SP Literature
1988	Mannermaa		(1-2)	Conceptual	Investigate the implications and new perspectives that complexity thinking can bring into "futures research"	Complexity theory
2005	Mietzner and Reger		[2]	Literature review	Discusses differences in scenario approaches	SP Literature
2003	Miller and Waller		(3-4); (4-5); (5-4)	Conceptual	Present an integrated risk management process using SP and real options	Real options and Risk management
1989	Mobasheri, <i>et al.</i>	Electric utilities	(3-4)	Case Study	Present a case study of SP planning implementation at Southern California Edison	SP Literature
					Robust, adaptive DM under uncertainty can be born from combining ideas of SP with decision analysis approach	
					High similarity in the scenarios constructed in different workshops is noted	
					Counter-to-factual analysis can reduce hindsight which results from shallow perceptions of history. This in turn will enhance foresight	
					Four dysfunctions are inferred and four options for dealing with these dysfunctions are proposed.	
					Imaginary techniques combined with rational processes can enhance SP processes.	
					A potential unifying framework with impact in DM requires validation, verisimilitude, confidence and clear communication. Performance criteria should also be present. Should be iterative and dynamic	
					Ideas brought from complexity thinking outline a new concept for "futures research": making the future	
					Some scenario techniques are revised. Strengths and weaknesses discussed	
					The integrated risk management approach promotes coordinated strategic and financial hedging responses to environmental uncertainty	
					The SP process enabled the development of strategies. Scenario-based planning became the standard way of planning after bad experiences with traditional forecasting methods	

2009	Moayer and Bahri		[2]	Conceptual and virtual case study	Investigate new method for generating scenarios - hybrid intelligent scenario generator	Proposed methodology for scenario creation allows coexistence of fuzzy rules and a learning algorithms to learn and correct from experts	Intelligence systems
1996	Moyer	British Airways	[2]; (2-3)	Case study	Present the SP exercise and lessons learned at British Airways	Scenarios caused British Airways to broaden their views	SP Literature
2012	Muskat, <i>et al.</i>	Changes in demography	[2]	Refurbished case study	Investigate mixed methodology approach with a qualitative-quantitative-qualitative sequence for scenario generation	Usage of a quantitative and qualitative scenario generation reduces bias and generate results of high frequency and consistency	SP Literature
2010	O'Keefe and Wright	Manufacturing	7-(3-4); (3-8-4)	Case Study	Present a case study for an unsuccessful SP intervention in an organization	Inertia in DM can be extreme. Even if pressure for change is strong, this will not guarantee a change in strategy if past decisions are at risk of being questioned, thus unsettling some powerful individuals	Conflict theory of DM / Structural inertia
2010	Özkaynak and Rodríguez-Labajos	Projects in Turkey and Spain	[2]	Conceptual and case study	Develop an approach for local-scale scenario building	Paper clarifies conditions under which different interaction methods can be used for local scenario building	SP Literature
2009	Pagani	3G mobile TV in Europe	[2]; (3-4)	Case study	Provide a tool for developing corporate or business strategies	Combination of scenarios with cross impact analysis allows the generation of qualitative and quantitative scenarios that can be used as a tool for decision making	SP Literature
2008	Pagano and Paucar-Caceres		(2-3)	Conceptual	Examination of a framework for systematic elicitation of knowledge from individual level to firm level	Connections between scenario building and causal mapping as elicitation methods are made to the developmental dimension of the Holmic framework for organizational learning	OL
2010	Page, <i>et al.</i>	Tourism, Scotland	[2]; (7-2)	Case study.	Use of SP as a methodology to help understanding the future of tourism	SP, when combined with quantitative tools such as economic modelling, has the potential to identify a range of issues to aid policy makers	SP Literature
2001	Phelps, <i>et al.</i>		[6]	2 Case studies	Explore the effects of SP on firm performance	Some tentative evidence of improved financial performance as a result of SP	SP Literature
2010	Piirainen and Lindqvist	Paper Industry	[2]	Literature review and case study	Introduction of two new methods to create scenarios.	Both methodologies proposed reduce resources in the scenario building phase, but rigor is also reduced	SP Literature

2007	Pina e Cunha and Chia		7-(2-3)	Conceptual	Discuss role of teams in improving organization's peripheral vision	Teams with exploratory purposes, specially of the minimally-structured and immersed type might increase exploration in the periphery	Teams
2005	Postma and Liebl		[2]	Conceptual	Devise alternative scenario building techniques to overcome drawbacks of current methodologies	Causality and consistency in scenario building, could lead to serious drawbacks in the presence of complex and paradoxical trends not thought beforehand. Alternative SB techniques are proposed instead	SP Literature
2011	Ram, <i>et al.</i>	Food Security in Trinidad and Tobago	[2]	Conceptual and case study	Introduce regret as a comparison criteria across different options; and present a new methodology for constructing scenarios faster	The proposed methodology could be deployed quickly, incorporates subjective judgments for multiple objectives, and is able to evaluate options across and within scenarios. Several drawbacks are noted	Decision analysis
2006	Rikkonen, <i>et al.</i>	Public sector Agricultural	[2]; (2-3)	Literature review	Present use of expert's information in strategic planning processes.	Delphi studies promote alternative approaches to strategic thinking by broadening knowledge base	SP Literature
2000	Roubelat		(1-2)	Conceptual	Review SP in light of its capacity to use and create networks	The context of corporate SP is always in motion, shifting. Thus a need for a network structure – rather than single companies – in creating scenarios	SP Literature
2006	Roubelat	Electricite de France.	7-(2-3)	Conceptual and case study	Present a longitudinal case to illustrate interest and traps of the SP methodology	Organizational structures are rarely adapted to question dominant paradigms hence the need to have a SP network outside the corporation to challenge old paradigms	SP Literature
2011	Sarpong		(5-1); (7-2)	Conceptual paper	Investigate scenario thinking as an everyday practice	Academics looking at scenario thinking need to understand daily practices at the firm and how those are enacted in order to understand the organization behavior	Social Theory of Practice
2011	Sarpong and Maclean	Product innovation teams, Software	(2-3); (5-1); (5-4)	Theoretical and case studies (3)	Increase understanding of causal link between scenario thinking and innovation	Scenario thinking does not necessarily lead to innovation. Creative emergence and openness of the practice as mechanisms potentially leading to innovation	Social Theory of Practice
2009	Saunders	Music Industry	[2]	Case study	Suggest a visual technique to collect scenario planning information	The collage technique can overcome some of the problems of verbal communication techniques.	SP Literature

1993	Schoemaker	MBA students.	(2-3)	4 different experiments.	Understanding why the use of scenarios is growing and its psychological effects	scenarios expands people's thinking by reducing biases of the human mind such as overconfidence and anchoring	Psychology
1995	Schoemaker		[2]; (2-3)	Conceptual and 2 case studies	Describe scenario building process and how to use the resulting scenarios	Good scenarios can overcome cognitive biases such as overconfidence and tunnel vision	SP Literature
2002	Sedor	Professional self side analysts	(2-3)	Empirical	Investigate effects on analysts of information presented within a scenario framework	Scenario-like presentations trigger more optimistic forecasts in analysts	Psychology
2006	Selin		7-2; 7-(2-3)	Conceptual	Discuss how scenarios compel people to action and influence decisions from the conceptual focus of trust	Trustworthiness in scenarios should be investigated from the sources, content, methodology, narrative and dissemination	Trust
2005	Smith		(1-2)	Conceptual	Discuss implications of complexity theory forecasting and SP	It is premature to give theory status upon complexity as its mechanisms in firms and social systems are not fully understood. Thus there is no evidence in favor of discounting forecasting or scenario techniques	Complexity theory
2011	Soderholm, <i>et al.</i>	Global. Climate change	[2]	Literature review. 20 studies	Analyze the differences in scenarios presented, especially in relation to governance and institutional issues	Both qualitative and quantitative constructed scenarios have serious limitations.	SP Literature
2006	Song, <i>et al.</i>	Beijing	[2]; 7-(3-4)	Case study	Use SP to sketch Beijing's 2020 urban planning	SP in combination with quantitative techniques can accommodate uncertainty and evaluative framework to aid decision makers	SP Literature
2013	Stewart, <i>et al.</i>	Agricultural policy planning	7-(3-4)	Conceptual and hypothetical example	Review and explore synergies between MCDA and scenario planning	Synergies between SP and quantitative decision modelling can be exploited in addressing complex decision contexts	Decision analysis
1990	Stokke, <i>et al.</i>	Oil and Gas. Norway	(3-4)	Case study	Present a case study for scenario-based decision making	SP can improve R&D strategy development by better understanding the range of strategic alternatives and increasing strategic resilience	SP Literature
2007	Storberg-Walker and Chermack		[2]	Conceptual	Present parallels between SP and the development phase of theory	The SP method could answer what and how questions, plus generating hypothesis. It lacks evaluation criteria	Theory building

2010	Strauss, <i>et al.</i>	Financial institution, South Africa	[2], 7-(3-4)	Conceptual and case study	Introduce a framework combining stochastic modelling and scenarios to analyze risk and uncertainty simultaneously	Complementarities of the two methods in the proposed framework leads to improved decisions	SP Literature
2012	Tapinos		[2]; (1-2); (3-4)	Conceptual paper	Make explicit the relationship between Perceived Environmental Uncertainty and scenario planning	Propositions are developed linking scenario planning to different levels of environmental uncertainty. SP needs to be embedded in firm's strategic processes	Perceived Environmental Uncertainty
2010	Tevis		(1-2); [2]	Conceptual	Questions predominant stance of SP -adaptation. Proposing instead goal-oriented SP	Building from the concept of enactment, a 5 step framework is proposed which emphasizes a goal oriented SP (create future that the firm wants), not an adaptive one	Sociology
2011	Tötzer, <i>et al.</i>	City in Austria	(2-3)	Case Study	Investigate if trans disciplinary processes can support more stable structures in a region	The trans disciplinary process showed some antagonism. In regards to SP, workshops generated knowledge by means of collaborative research. A learning process was initiated.	Trans disciplinary
2010	Varum and Melo		[2]	Literature review	Organize the SP literature	Publications centered on methodologies. Shortage of theoretical underpinnings. Evidence of the use and effects of SP inadequate, as well as its effects on performance	SP Literature
2009	Visser and Chermack	9 firms in several industries	[6]	Interviews	Investigate the relationship between SP and firm performance	No formal assessment on the value of SP. The perception from 7 of the participants indicates some positive effects on firm performance. The study remains interpretative, not empirical	SP Literature
1999	Vlek <i>et al.</i>	Policy for metropolitan traffic. The Netherlands	7-(2-3)	Case study	Test the hypothesis that order of preference in scenarios is affected by the way in which scenarios are evaluated	A formal multi-attribute evaluation of scenarios leads to a different ordering of preference than an intuitive way. The degree of satisfaction is also lower.	Behavioral Decision Making
2009	Volkery and Ribeiro	Public policy making	7-(3-4)	Literature review and case study	Investigate uses, impact and effectiveness of SP in public policy making	Scenario planning is often carried on in an ad hoc and isolated basis, and as indirect decision support. More stable institutional settings are needed to experience with the method	SP Literature
2008	Walton		[2]	Conceptual	Analyze philosophical underpinnings of SP	A generalizable framework for governing and observing SP can be created. No such theoretical foundations can be had for scenarios.	Epistemic and ontological

2000	Wilson		7-(3-4)	Conceptual	Examine the causes of implementation problems after scenarios have been constructed	Scenario projects fail mostly because lack of strategic actions. For scenario planning to be effective, time and practice are necessary	SP Literature
1999	Winch		[2]	Conceptual and short examples	Analyse the benefits of combining scenario building with system dynamics	Scenarios cannot expose the dynamic nature of change. Systems dynamics can aid on better simulating possible futures	System Dynamics
2009	Worthington, <i>et al.</i>		(2-3)	Conceptual	Explore potential of SP as a tool for promoting innovation and corporate entrepreneurship	Scenario/contingency planning allows firms to leverage organizational learning and enhance managerial capabilities.	OL
2000	Wright		(5-1); (5-4)	Conceptual	Draw parallels between SP and quality management	SP is an iterative process that must be continuously improved and corrected as new insights and knowledge is gathered. SP could be seen as a quality approach to strategy	Quality Management
2005	Wright		(2-3)	Conceptual	Propose scenarios as prospective sense making devices	Transformational change is achieved through inductive strategizing at the periphery. Scenario should focus as a device to enhance sense making instead of decision making	Social Constructivism
2009	Wright and Goodwin		(2-3)	Conceptual	Assessing the ability of SP to deal with problems of low predictability	Conventional SP restricts the range of potential scenarios. It might reinforce current views. 4 recommendations to correct this are proposed	Cognition
2008	Wright, <i>et al.</i>	Drinks industry, Scotland	(3-8-4)	Contrasting case studies.	Compare a successful SP intervention with an unsuccessful one as reported by Hodgkinson and Wright (2002)	SP has the potential to overcome inertia but DM dilemma could also accentuate inertia. Pre-interview data can determine whether a firm will be receptive or not to a SP intervention	Inertia in DM / Conflict Theory
2009	Wright, <i>et al.</i>		[2]; 7-(3-4)	Conceptual	Suggest remedy actions to SP pitfalls identified by O'Brien (2004) Additional pitfalls are discussed.	Several recommendations to enhance scenario building are proposed.	SP Literature Decision analysis
2012	Zegras and Rayle	Urban planning, Portugal	(2-3)	Case study. Pre and post intervention surveys	Assess participant's inclination for collaboration and change in perceptions	Modest support for increased collaboration, and no change in participant's perception after the intervention	Theories of collaboration

SM: Strategic Management; DM: Decision Making; OA: Organizational Ambidexterity; OL: Organizational Learning; MCDA: Multi Criteria Decision Analysis

Table 2
Research agenda for Scenario Planning (SP)

Research stream	Opportunities for future research	Leverage from
Scenarios as effective cognitive devices or sources of biases	<ul style="list-style-type: none"> ▪ Explore the quality of scenarios in terms of variety, novelty, and treatment of discontinuities. ▪ What mechanisms influence these characteristics, and how to improve them? ▪ Clarify the effects of well-constructed scenarios over individual cognition 	CP, BDT
The organizational context and influences on scenario and SP	<ul style="list-style-type: none"> ▪ Ground SP in realistic assumptions about cognition, emotions and social interaction. ▪ Explore the mediating role of emotions in SP ▪ Better understanding of the effects of organization routines and identity over SP ▪ Investigate the tension between adequate anchoring, and the effects of power and political games over SP ▪ Explore the effects of Top Management Team characteristics on SP ▪ Uncover mechanisms to neutralize potential negative influence of power and political games 	CP, UE, SIT, NE, OC
SP team; Composition, function and positioning	<ul style="list-style-type: none"> ▪ Study the role and ability of core SP team as potential mechanism to shield SP from organizational influences ▪ Better understanding of it internal composition, positioning and purpose 	SIT, HR, P, PDP, UE
SP learning flows. From the individual into the organization	<ul style="list-style-type: none"> ▪ Better understanding of the transferring mechanisms within and across levels of SP ▪ Ground SP in organizational learning models ▪ Detail case studies with systematic data collection and rigorous data analysis aimed at uncovering SP mechanisms ▪ Longitudinal studies and evolution of SP outcomes over time 	OL, MLT, CIT, P

Legend: CP: Cognitive Psychology; BDT: Behavioral Decision Theory; UE: Upper echelons; SIT: Social Identity Theory; NE: Neuro-Economics; OC: Organization Cognition; HR: Human Resources; P: Psychology; PDP: Power dependence; OL: Organization Learning; MLT: Multi level theory; CIT: Change and Intervention theory

Organizational learning through scenario planning

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ABSTRACT

Integrating insights from organizational learning and scenario planning literatures, this study explores the dynamics of organizational learning through an investigation of the scenario planning process used by a leading global biotechnology company. Our longitudinal case study illustrates how scenario planning activities may operate as a learning system influencing both lateral and hierarchical transmission of learning throughout the organization. Following the learning trajectory from individuals to the organizational level over time, we identify important cognitive and socio-psychological barriers that affect both learning at each level and the transmission of learning between levels. Our study augments extant theory by providing empirical evidence of the multi-level and dynamic nature of organizational learning. We extend theory by conceptualizing strategic scenario planning as a learning system and providing new insights into barriers to organizational learning.

Keywords: Organizational learning; scenario planning; barriers to learning; exploration; exploitation

INTRODUCTION

Scenario planning (SP) intends to help organizations identify how environmental contingencies may necessitate changes to organizational strategies by forcing managers to consider alternative scenarios of future conditions (Hodgkinson & Wright, 2002). This enhances strategic decision making by helping decision makers identify uncertainties, expose 'blind spots' in organizational thinking and direct attention to issues which might otherwise be overlooked (Chermack, Lynham, & Ruona, 2001). Moreover, it creates learning and future memory about how to deal with changes when they eventuate (Schwartz, 1991). Thus, SP provides competitive advantage by enhancing organizational awareness and shortening change response times (Chermack et al., 2001).

Scholars propose that SP can generate such benefits because it (1) facilitates both individual and organizational learning; (2) helps devise better strategic options and aids decision making; (3) anticipates uncertain futures; (4) enhances sense-making; and (5) challenges mental frames, assumptions, prevailing mind-sets, and counter psychological biases (Chermack, 2004; Schoemaker, 1993, 1995; Schwartz, 1991; van der Heijden, 2004, 2005; van der Heijden, Bradfield, Burt, Cairns, & Wright, 2002; Wack, 1985; Wright, 2005).

Scenario planning first originated in the 1960's (Bradfield, Wright, Burt, Cairns, & van der Heijden, 2005) and the field has grown primarily through the development of a large numbers of scenario building methodologies (Varum & Melo, 2010) and anecdotal and self-reported accounts of practitioners' SP interventions (Hodgkinson & Healey, 2008). The practitioner-driven nature of this literature has been more preoccupied with legitimizing and justifying SP than understanding causal mechanisms or grounding SP methods on solid theoretical foundations or empirical evidence (Goodwin & Wright, 2001; Hodgkinson & Healey, 2008). Consequently, theoretical development and empirical research is much needed

to enhance understanding of the ways in which SP approaches can affect organizational outcomes (Burt & Chermack, 2008; Chermack, 2005; Chermack et al., 2001; Harries, 2003).

Given the learning benefits attributed to SP, organizational learning (OL) theory offers a particularly promising conceptual lens for theoretically grounding our knowledge of SP; yet few studies have empirically explored this possibility (Chermack, Lynham, & van der Merwe, 2006). Those that have typically investigate learning through changes to individuals' cognition. These studies have produced inconclusive findings as to whether SP produces changes in individuals' mental models (e.g. Glick, Chermack, Luckel, & Gauck, 2012; Schoemaker, 1993; Zegras & Rayle, 2012) or perceptions of organizational-level learning (Chermack et al., 2006).

By conceptualizing SP as system for generating organizational learning, this study addresses calls for more theoretically grounded and systematic empirical research into SP (Burt & Chermack, 2008; Hodgkinson & Healey, 2008). Specifically, our study is designed to empirically investigate the mechanisms that might enhance or restrict flows of learning (Crossan, Lane, & White, 1999; Crossan, Maurer, & White, 2011). We do so by exploring the dynamics of organizational learning through an investigation of the SP process used by a leading global biotechnology company. Using a participant-observer research design we studied the SP processes used by the company over a three year period to understand how new information flows through the organization, both laterally and hierarchically.

The paper is structured as follows: The conceptual framework for the research derived from the OL and SP literatures follows this introductory section. The next section presents the methodology and data used for the analysis, followed by a discussion of our findings. We close with general conclusions, implications and directions for further research.

SCENARIO PLANNING AS LEARNING SYSTEM

The conceptual framework for this study is developed from two key premises; (a) scenario planning (SP) activities operate as a system using inputs, processes, outputs and feedback (Chermack et al., 2001) and (b) the overriding purpose and explicit focus of SP is to foster learning by enriching how managers think, learn and feel about strategic situations (Georgantzas & Acar, 1995). Thus, SP processes operate as a system for generating organizational learning (OL). OL refers to the processes of communication, knowledge sharing and integration of new knowledge into organizational practices (Graham & Nafukho, 2007). Effective OL enables the sharing of information and knowledge among organizational members to obtain insights about the environment, react to it more effectively and facilitate reflection about actions and consequences. Organizations learn about the effectiveness of past actions and apply that knowledge to guide future activities by drawing inferences from past activities and encoding them into routines for future behavior (Fiol & Lyles, 1985; Levitt & March, 1988; Lipshitz, Popper, & Friedman, 2002) thereby increasing the organization's capacity to take effective action.

Though conceptualized and modelled in a wide variety of ways, there is general consensus that OL results from the learning that individuals' undertake as organizational agents (Argyris & Schon, 1978; Wang & Ahmed, 2003). Individuals construct cognitive maps of the concepts and relationships they use to understand organizational situations (Weick & Bougon, 1986) and translate them into decision rules and action routines which guide organizational behavior (Cyert & March, 1963). The core process of OL is the transfer of learning by individual organizational members into organizational knowledge stocks (Cyert & March, 1963; Flores, Zheng, Rau, & Thomas, 2012). Individual-level learning transmutes into OL when insights are communicated across the organization, consensual validity is achieved, and information is integrated into organizational structures and

procedures to guide the subsequent thinking and behavior of organizational members (Shrivastava, 1983).

To understand how learning progresses from the individual to the organizational level, Crossan and colleagues (1999) developed the 4I framework of OL as a multi-level theoretical model. The 4I framework suggests that processes of *intuiting*, *interpreting*, *integrating* and *institutionalizing* embed learning at individual, group and organizational levels, respectively. Individuals *intuit* insights and possibilities from their personal experiences and, through interpretation, modify their understanding and actions by refining cognitive maps. As such, *interpreting* deals with the conscious efforts to make sense of the intuitions, either within the one-self, or by transmitting those intuitions to others. As learning moves from group to organizational level the focus shifts to the process of *integrating* in order to develop a shared organizational understanding or memory (Weick & Roberts, 1993). Finally, incorporating insights into strategies, systems, structures and procedures *institutionalizes* learning into organizational culture, processes and actions.

These four processes enable both explorative and exploitative learning. Explorative learning is the assimilation of new learning into the organization and involves a feed-forward process of moving learning from the individual to the group level and then to the organizational level. Exploitation is the utilization of learning by organizational members and occurs when knowledge embedded at the organizational level (institutionalized) feeds back into cognitive and behavior changes by individuals or groups within the organization (Crossan et al., 1999). Research has demonstrated the utility of the 4I framework for understanding the dynamics of OL underlying strategic renewal and (un)successful organizational change (Berends & Lammers, 2010; Crossan & Berdrow, 2003) and how such processes may be influenced by factors such as strategic leadership (Vera & Crossan, 2004) or political dynamics (Lawrence, Mauws, Dyck, & Kleysen, 2005).

We adopted the 4I framework for this study because we observed a strong conceptual linkage between the theoretically rigorous 4I OL framework and the more normative SP perspective. Specifically, integrating the two perspectives provides a useful conceptual framework for understanding how SP processes might operate as a learning system. According to the 4I framework, OL begins when “new knowledge enters the organization and individuals use their intuition to make novel connections, perceive new and emergent relationships, and discern possibilities that have not been identified previously” (Crossan et al., 1999: 526). While the 4I framework remains silent on where the *new* information comes from, the SP literature offers useful insights into how this may occur.

One of the first steps in SP is to define the scope of analysis and develop the scenarios, which involves determining the relevant issues, past sources of environmental volatility and uncertainty, trends likely to affect the organization in the future, and the stakeholders likely to affect or be affected by these issues and trends (Schoemaker, 1995). As this process combines knowledge of past tendencies and circumstances with research into emerging and future trends and conditions, it incorporates both exploratory and exploitative learning by scenario developers. This suggests that the process of constructing scenarios could facilitate feed-forward exploratory individual level learning because development of scenarios requires that individuals *intuit* insights about the organization’s potential futures, *interpret* environmental information to refine their mental models of the organization’s environment, and develop relevant and credible scenarios which *integrate* these individual insights into group level (SP team) scenarios to be shared with other organizational members. When the process of scenario development is done collaboratively, such as through scenario workshops (Chermack et al., 2001; Schoemaker, 1995), discussions of issues, trends and uncertainties can also facilitate wider group level learning as diverse group members within

the organization share ideas, engage in collective sense-making, and develop a common understanding (and language) of the future states the scenarios describe.

Additionally, the communication of scenarios to other organizational stakeholders, such as senior strategists and business' line managers, transmits the learning embedded in the scenarios across other organizational groups and up the organizational hierarchy (Wack, 1985). SP may also help *institutionalize* and embed learning at the organizational level (Wright, 2005) if the insights captured in - or generated by - the scenarios lead to adaptation of organizational strategies, goals and mindsets, thereby completing the feed-forward exploratory learning process. Finally, when organizational members adopt and enact the organization's new goals, priorities and strategies to exploit what has been learned, SP has also facilitated exploitative feedback learning. Furthermore, given the uncertainty in long term scenarios, trends need to be tracked and updated to inform which potential scenarios are developing. This refines strategies and informs implementation, further facilitating exploitation. In summary, SP processes can be conceptualized as a learning system by virtue of:

- 1) Introducing new knowledge into the organization;
- 2) Facilitating both explorative learning (developing new knowledge) and exploitative learning (using existing knowledge in new ways);
- 3) Supporting learning at individual, group and organizational levels;
- 4) Enabling flow of learning up the organizational hierarchy from individuals at lower levels via middle managers to corporate level decision makers.
- 5) Institutionalizing new learning into organizational strategies and plans which guide subsequent actions of organizational members.

Conceptualizing SP as a learning system draws attention to the specific SP activities that may facilitate exploratory and exploitative learning by enabling the transmission of

learning between individuals, groups and the organization at large. As a result, we conducted a case study to empirically examine the processes through which SP activities generate OL.

METHODS

Research design

The research was conducted as an in-depth case study in order to leverage the acknowledged strengths of case studies for a) investigating *how* and *why* research questions in contexts that researchers can observe but not control (Yin, 2003: 9); b) understanding social behaviors (Dyer & Wilkins, 1991); and c) enabling meticulously detailed examinations of relationships between events, entities, processes and outcomes (Zikmund, Babin, Carr, & Griffin, 2010). Since the research was conducted to apply, challenge and extend our theory that SP processes may operate as a learning system, the study utilized an extended case method (Burawoy, 1998).

Following the tenets of the extended case method, we first clarified the conceptual framework for the study; our 4I OL theory of scenario planning processes. Next, we selected a case likely to confirm and challenge the theory (Wadham & Warren, 2014), which in this context required a focal organization actively engaged in SP. We chose a Danish multinational enterprise, Novozymes (NZ), operating in the biotechnology industry as our focal case because the company (1) operates in a dynamic and competitive environment with a stated organizational strategy of constant innovation and exploratory learning, (2) has an established SP process which has been in use for some years, and (3) has an explicit learning intention to better understand and improve its SP processes, enabling both research access and organizational commitment. We conducted the case study using an embedded design which combines multiple data sources to capture the interplay of professional activities and logics in their organizational and institutional context (Stake, 1995). Next, we analyzed the

data to determine the extent to which NZ's SP processes operate as a learning system. We then refined and extended our theory about SP as a learning system to accommodate the barriers we identified in the study (Wadham & Warren, 2014).

Data collection

The study collected data through participant observations, field interviews, and archival material, as detailed in Table 1. As the study was broadly framed around the levels and processes of learning derived from the 4I framework (Crossan et al., 1999), we followed (Wickham & Woods, 2005) and charted the research design to a) define the data needed to provide conceptually valid evidence; b) identify potential sources for the data; and c) ensure valid analysis and interpretation of the data by verifying that data was coded in ways consistent with the conceptual definitions derived from the literature.

Insert Table 1 about here

Observation data was collected by the lead author to offer insights into "behavioral patterns, but also the subjective experiences of organizational reality and the ongoing negotiations between members and subgroups over the interpretations and understandings of this reality" (Zilber, 2002: 237). Data was collected between December 2011 and April 2014, during which the lead researcher was granted access to NZ as a participant-observer in the company's SP processes. During this period, the lead author spent approximately 15 hours per week immersed in various meetings and activities related to SP (including various meetings with senior executives, and one annual SP final presentation to the entire executive management team including the CEO, CFO and various executive VP's). This immersion facilitated understanding of the key premises for SP in the company, identification of key

personnel involved in the process, and evaluation of the organizational context in which it was performed. In some weeks, the demands of the SP process required full time participation of the researcher (40+ hours per week); in other weeks the demands of the SP process did not require the researcher to be physically present in the organization. During the entire project period, the lead author was formally embedded and officially identified within the company as a researcher exploring SP processes, ensuring that organizational members knew the researcher's purpose and were engaging with him in a fieldwork relationship (Saunders, Lewis, & Thornhill, 2009). This approach provided access to individuals and highly confidential and commercially sensitive documentation that would be otherwise restricted or unavailable to outsiders. Similarly, it allowed the lead author to develop and utilize knowledge of organizational structures, processes and terminology to participate in discussions, observe actions, and identify the people, processes and documentation that should be examined as part of the research (Brannick & Coghlan, 2007). The disclosed identity as a participant-researcher in the company's SP processes also allowed the lead author to ask questions and observe activities which would otherwise have been inaccessible or 'out of bounds' (Saunders et al., 2009).

Observations were augmented by semi-structured interviews conducted with 22 individuals involved in various SP processes. Interviewees were purposively selected for their knowledge and ability to contribute insights to our theoretical understanding of SP and OL (Bell & Bryman, 2007). An initial sample of 12 informants was recruited for the study based on their involvement in the company's SP processes. This sample was subsequently expanded through snowball sampling (Biernacki & Waldorf, 1981) as interviewees identified additional people involved in the process. The final sample of interviewees included directors and members of the executive leadership team (n=7), managers (n=9) and analysts and support staff (n=6) working in the functional areas of marketing and business development

(n=10), R&D supply operations (n = 6) and business support and finance (n = 6). Interviewee's involvement in SP activities ranged from less than one year to over seven years in total, which provided an additional longitudinal perspective into the evolution of SP processes. The broad pool of informants – functional, hierarchical and with different tenure – provided impressions of the SP processes from diverse perspectives, which reduces potential biases in the data collection (Eisenhardt & Graebner, 2007). Table 2 provides an overview of the 22 interviewees.

Insert Table 2 about here

The interviews were conducted between November 2013 and February 2014 and typically lasted between sixty and ninety minutes, producing over 28 hours of interview data. The interviews were structured around five main topics: (1) the interviewee's personal background and organizational role; (2) involvement in the SP process and knowledge of its operation; (3) outcomes of involvement in SP which indicated learning effects, such as changes in individual cognition or behavior, or strategic actions derived from the SP processes; (4) possible learning barriers or enablers within the SP context; and (5) potential barriers or enablers of learning in the broader organizational context. At the end of each interview, interviewees were invited to raise any additional issues of relevance to the topic that were not touched upon during the interview.

The semi-structured interview design enabled comparisons of interviewee perspectives on the five main topics while simultaneously providing flexibility to probe participants' perspectives and experiences (Bell & Bryman, 2007). All interviews were recorded with interviewee permission and notes were taken as the interview unfolded, and revised within 24 hours of the interview's completion for consistency with the recorded data. In 19 cases we also recorded voice memos after the interview to record the main impressions

and reflections of the interview: in the remaining three instances the insights generated were not novel enough to warrant this extra step.

Interview and observational data were complemented by archival material including proprietary and nonproprietary company documents (e.g., field notes, working documents, company presentations, websites, and analytical models) to validate impressions from observations and interviews. Publicly available data (e.g., analyst reports) and historical data about the company's SP processes during the period 2009 through 2011 were also collected. In total, qualitative and quantitative data covered 5 years of the company's SP processes.

Data analysis using N-Vivo

QSR International's N-Vivo software program was used to facilitate data management and analysis. All data was first imported into N-Vivo to create a case study database (Mainela & Puhakka, 2011). This provided an accurate and easily-updatable database which enabled the integration and comparison of multiple types and sources of data, thereby facilitating a multi-faceted understanding of SP processes and dynamics and reducing the potential biases of relying on any single data type. N-Vivo was then used to support the coding and interpretation of the data by developing hierarchical systems of data categories (nodes) reflecting the concepts to which the data related and coding the data into the relevant categories for subsequent review and interpretation. Since the project focus was theory building and extension, we iterated between existing theory (4I OL theory), data, literature, and emerging theory (Locke, 2001) by combining deductive and inductive coding. Deductive coding was undertaken by developing a codebook of rules derived from the relevant literature (see Table 3 for an illustrative example) to guide the coding process. To ensure the coding was conceptually valid and consistent with the coding rules, a second author independently coded a selection of the interview data and variations in coding between the two authors were

addressed by discussing ambiguous data, clarifying coding rules and modifying the coding scheme (c.f. Nag, Corley, & Gioia, 2007).

Insert Table 3 about here

Inductive coding was used to develop additional data categories and coding rules which reflected and represented emergent themes identified within the data. For example, analysis of interviewee attitudes towards the SP process indicated that attitudes differed depending on the informant's position in the organizational hierarchy. To capture the granularity in the data, nodes were created to enable coding according to the hierarchical level of the informant so that the perspectives of informants from different levels could be examined, compared and contrasted. During data analysis, N-Vivo was also used to explore potential associations between participant attitudes and characteristics by recording the attributes of informants and then using coding matrices to retrieve and review data according to informant attribute. As the analysis progressed, comparing and contrasting different versions of the node system provided an 'audit trail' of the decisions made, the evolution of our understanding, and the evidence on which it was based (Kikooma, 2010). As interpretations were developed and refined the second and third authors adopted the role of 'critical outsiders' to whom the lead author detailed his observations, insights and conclusions. This was done to counter the acknowledged risk that being an organizational insider can lead researchers to probe less, assume too much and thus fail to consider alternative framings of an explanation (Brannick & Coghlan, 2007)

THE CASE STUDY

Novozymes (NZ) is a worldwide market leader in industrial enzymes, which are biological catalysts that increase the rate of chemical reactions. The company has over 6,000 employees globally working in research, production, sales and administration (NZ website accessed August 2014). Their products sell in over 130 countries; 37% sales in Europe, Middle East and Africa; 33% in North America; 19% in Asia Pacific; and 11% in Latin America (Novozymes A/S, 2013). NZ's product portfolio spans a variety of industries, including food, detergents, brewing, bioethanol, biomass conversion, forestry and textiles, among others. NZ has an active learning culture and the company's strategy is predicated on innovation through learning and strong partnering (Novozymes A/S, 2012). NZ's four core cultural values – dare to lead, unlock passion, trust and earn trust, and connect to create - intend to encourage a learning context with highly motivated individuals alert beyond their own tasks. Indeed, employees are specifically requested to “learn from the outside” because the “world is full of ideas” (internal company document). Consequently, NZ's culture can be characterized as a strong learning culture.

Scenario planning at Novozymes

NZ conducts SP as a deliberate and explicit learning process designed to facilitate explorative and exploitative learning. NZs SP process is undertaken every year and takes approximately eight months in total. It is a bottom-up approach which involves several organizational hierarchical layers across different organizational functions culminating in the presentation of the scenario work to the executive management and Board of Directors. Scenarios are developed using information from a range of internal and external sources such as the input given from each business units, external public information, macro trends identified by the core scenario team, and input from executive management.

Stage 1: Information gathering and construction of base case scenario

The first stage of the SP process, which begins in September each year, concludes with the development of the initial base case scenario. The process begins with regional marketing managers from each of NZ's various industry-based business units developing a strategy and forecast of sales and growth potential for the next five years based on price, penetration, industry growth, market share and new products. The forecasts are consolidated by the global marketing manager in consultation with the marketing director. Each industry strategy has input from employees from legal, finance, production, patenting, and R&D with the intention to pressure-test the different strategies. Out of this process, a base scenario for sales growth is created. Scenarios are also informed by anchor budget projections regarding the forecast of costs expected to be disbursed in achieving the anticipated sales – e.g., projections for raw material costs or human capital spending. These processes produce the anchor budget and the medium term planning forecast.

After sign off by executive management, this 5 year forecast becomes the raw data for developing the base case scenario and subsequent scenarios. At this point the process becomes more centralized and a core SP team takes over. The core SP team is formed by three individuals anchored in the three functional areas of finance, marketing and supply operations. The main task of this scenario team is to analyze the base case scenario (5-year forecast) and stress-test its impact on different key parameters for the company such as steel capacity, investments needs, or overall profit margins. The study found that the individual-level learning that occurred through base-case scenario construction and its transmission to Stage 2 was influenced by two factors: (1) searching and scanning routines and (2) individual cognitive biases.

Searching and scanning routines. Interviewees explained that when conducting environmental scans for information used in creating the strategies and forecasts that form the base case scenario, the organization focused their attention on 1) tracking the actions of main competitor's, largely through publicly available information; 2) gaining a granular understanding of the market share in the company's core enzyme business; and 3) ad hoc market intelligence requests. For example, special attention was given to conference calls from competitors and reports of key takeaway from these calls were routinely generated by NZ analysts and subsequently distributed to senior managers and executives. However, the organization did not engage in similar behaviors when scanning for possible competitive actions outside the obvious players, or new technologies. As one NZ analyst explained, this constrained NZs ability to learn about market dynamics:

“...to give an honest opinion, I don't think the information flow and analysis is that good at NZ... to give an example, we do not have clarity on the market share and size in this new market... NZ is mostly focusing internally towards what we are developing. How can we reach the market and so on, but what are the competitors doing? What is the next competitor move? We are not sure....”

In learning terms, NZ's scanning activities determine what information is filtered into the SP process. This filtering process, in turn, shape the content of the SP learning system being fed up the organizational hierarchy. In this way, the searching and scanning routines provide the basis for the development of industry strategies and later scenarios, thus acting as a barrier to the feed-forward process of learning

Individual cognitive biases. During the scanning and scenario construction processes, the individual bias of overconfidence influenced the learning that occurred through SP by affecting perceptions of the competitive environment and NZ's ability to compete successfully in it. For instance, the following statement from a senior manager discussing the

competitive landscape illustrates an overconfident attitude of environmental stability: *“...I see possibility for all competitors, but that will probably go hand in hand with a big expansion in the market..”*. As another director acknowledged, over-confidence in an organization’s knowledge about its environment can undermine learning when it limits the acquisition of new insights: *“... I am not sure if we know enough about competing technologies. We have great knowledge in our core business, but I am not sure if we know enough outside our core areas...”*.

Interviewees also felt that estimations of future conditions were often over-confident, citing examples such as overestimations of future market potential and underestimations of investment costs. Analysis of five years of NZ’s SP presentations and projections show that projections are commonly over-estimated and then adjusted in the following years’ scenarios. As one manager explained, the tendency to over-estimate can also be exacerbated when projections are made over longer time periods:

“The first year budget is typically much more realistic....but as you get further out... what you put into the projection in 2018 or 2019, most likely you will be in another position [within the organization] and will likely be less accountable for those numbers. And there is a long way to 2019, so the further out you go, it is more about being ambitious and seeing all the opportunities.....there is tendency to err on the side of being too optimistic rather than being cautious and conservative”

Hence, overreliance on a stable environment and overconfidence in the organization’s capabilities were reflected in the form of high growth estimates, which may act as a barrier to explorative learning by affecting (biasing) the information that is filtered into the SP system. Moreover, such perceptions may also reduce credibility of the learning outcomes from the scenario process. As one director recalled:

“I remember looking at these projections [from the scenario work] and I see something that goes like shooting to the sky... and I just thought, this sounds ridiculous to even be discussing this... how much uncertainty is out there and when we are discussing such new markets with this long run projections, I think we are wasting our time a little bit...”

The findings illustrate how over-confident estimations of future conditions may hinder forward learning in the organization by generating inaccurate understandings of the business environment and fostering perceptions in some organizational members that the SP process is based on unrealistic premises and thus of limited value.

Stage 2: Scenario selection and refinement

High and low case scenarios are built around the base case. These scenarios factor in different growth factors, specific products, market penetration, impact from the new product pipeline, optimization efforts, macro trends, industry, and regional factors. Other scenarios are considered if recommended by the core SP team or members of the executive management team (typically the CEO or CFO).

This second stage of the SP process takes place in January. The scenarios are developed by the SP team and draft versions are presented to senior decision makers, typically the CEO and CFO. The draft scenarios include quantification of its effects on production needs, investments, and profit and loss items. These senior executives review the scenarios and provide feedback to the SP team as to whether any existing scenarios need to be further elaborated and/or any additional scenarios should be developed. As scenarios are further refined they are reviewed again by the CEO and CFO who may also consult other stakeholders as required. For example, if a scenario on bio-energy was constructed then the vice president for the bio-energy division would be asked to review the scenario and provide input. Final draft versions of the SP findings are ready towards the end of January. At this point the SP team has quantified the likely effects of the selected scenarios on production needs, investments, and profit and loss items. Next, the CEO and CFO are presented once more with these draft versions to discuss and select which are finally to be presented to the executive management team to inform their strategic decision making.

Our study identified several factors may impede the learning process during this stage. Particularly salient are: 1) functional bias of scenarios and 2) power and politics

Functional bias of scenarios. The study found that scenarios themselves acted as a learning barrier by affecting how and which environmental information was communicated through the SP process. As the information is analyzed, interpreted and integrated within the frame of an operationally heavy process, information that could not be driven to fit such frame was excluded. Several interviewees expressed concerns that the financial (mathematical) and operational nature of the SP process frustrated exploratory learning about new environmental developments because, as the director of the SP process acknowledged, scenarios were only included “*if they could materialize in numbers*”. This hinders consideration of new strategic opportunities when the future market size and potential outcomes of investment are difficult to quantify, thus preventing exploratory learning. Analysis of the final SP documentation and presentations given to strategic decision makers provided additional evidence of this learning barrier. Only 6 pages of the 50-page final presentation to Executive Management in 2012 contained scenarios and information about new environmental issues; three of those six pages were in the appendix. These findings indicate that the functional bias of scenarios acts as a learning barrier by filtering out information which cannot be quantified, thereby limiting the information which can be fed forward through the SP process.

Power and politics. Our study showed political power as a potential barrier that prevented individual level insights from being transmitted to the group level and institutionalized throughout the organization. In the eyes of the informants, the SP process was limited by its inability to generate enough explorative learning and adequately challenge

assumptions and strategy. This dissatisfaction triggered several attempts for change, but the lack of bargaining power of these actors prevented the inclusion of new learning possibilities beyond the localized areas where these actors had influence. In some instances, efforts were blocked by powerful individuals by eliminating options and rivals, setting the agenda of the scenario process, or exerting influence over final presentations.

For instance, many informants questioned the financial emphasis of scenarios but these actors lacked the bargaining power to change the SP process. Since the SP team leader was anchored in the production side of the organization, a focus towards production capabilities and risks was deemed natural and value adding. Similarly, transforming scenarios into impact over profit and losses was needed in order to increase confidence in the numbers and long term targets to be communicated externally, and thus deemed necessary from the CFO's perspective.

We found that individuals directly involved in the SP process had learned experientially that the process was operationally heavy and too granular. With the exception of one informant, the rest of the informants directly involved in the SP process described it as extremely operational and acknowledged they had concluded from their involvement with the process that scenario construction in particular could be made more efficient and less time consuming. For example, one director expressed the view that "*the process does not have to be that huge*", while two other directors felt the process could be made more valuable for strategizing by challenging assumptions about organizational strategies and focusing more on strategic perspectives than production capacity. However, participants acknowledged that the SP process' main focus and deliverables had remained essentially unchanged for years despite individuals attempting to adapt SP processes to make the process more exploratory and less detailed; for instance by developing an alternative model "*with more high level estimates and much less detail to make the process more value driven*" (Director).

Furthermore, the study found that power and political dynamics acted as learning barriers by preventing insights about ways to improve SP processes from transitioning from individual to group levels (interpreting) and from group to organizational levels (integrating). Interviewees explained that although several attempts had been made to change the SP process to generate more explorative learning and challenge assumptions and strategy, these attempts had been blocked by managers further up the organizational hierarchy. As one director explained when discussing the history of SP at NZ:

“Historically, the ownership of the process...who is doing what... has been a result of old battles in the organization about having influence because you are sitting on very interesting information. It is also about being promoted; who is having the discussion with executive management; it is a question of influence ...”

Consequently, although learning was generated at the individual level, the lack of bargaining power of the lower and middle managers involved in the SP process prevented the learning from transitioning to the group level and up the organizational hierarchy. The learning was consequently biased in favor of a heavy production orientation of the SP process, which resulted in scenarios and discussions of them being focused on implications for production capacity rather than forward looking strategic considerations.

Additionally, during Stage 2, the power of the CEO/CFO and some members of the executive management team to influence the selection and development of scenarios affect learning by filtering the content of the scenarios and determining which scenarios are transmitted up the organizational hierarchy to senior decision makers. As powerful individuals attach value to particular scenarios and sponsor the forward feeding process in the learning system, it affects the language and cognitive maps adopted by others in the organization (Daft & Weick, 1984). In this way, we find empirical evidence of organizational learning being hampered by power and politics (Lawrence et al., 2005).

Stage 3: Scenario presentation, decision-making and continuous learning

Around mid-February, the final scenarios are presented to NZ's executive management group. This is typically conducted as a one-hour presentation with some discussion of the implications that scenarios could have for production and capacity needs. The scenarios are then presented to the Board of Directors at the Board Meeting held in April or May, thus completing the SP process.

Interviews with senior decision makers revealed that SP enabled them to learn about new environmental conditions, such as the development of new products by competitors, likely growth in particular markets, and political and regulatory influences such as renewable fuel standards. This knowledge is used more for refinement of strategy – e.g. exploitative learning – as it helps executives to determine how the company might need to adapt to future requirements. As one director succinctly explained:

“[Executive-level discussions of scenarios] gave a lot of actions on how to broaden production, where to focus in production, how to, for example, convince customers to go to high activity products to save capacity and production capacity and things like that.”

However, NZ's SP process also facilitated exploratory learning by offering different perspectives of the business environment, and by stimulating discussions about the company's capacity to handle them, as the following quote from a senior director illustrates:

[SP has facilitated] fantastic discussions for example in [a specific product market]. That was really good discussions about how demanding it will be when it happens, and I still think it will happen, because it seems to be happening now....But if it really starts to shoot off this will be incredible demanding for NZ to follow the needs from the industry.

Insights generated from exploratory and exploitative learning were then institutionalized into organizational-level learning through adaptations to capacity planning, investment plans, business strategies and competitive strategies. Yet, a number of factors

were identified at stage 3 which affected the learning outcomes as well as the company's ability to institutionalize learning.

Lack of formal and informal structures to institutionalize learning. The study found that NZ's organizational structure and decision-making culture often acted as barriers to knowledge flows making it difficult to integrate learning into organizational responses. For instance, lack of forums to appropriately disseminate the learning from the SP process, or to absorb and act on new learning as it originated, prevented effective organizational learning. Specifically, the knowledge created from the SP process was rarely distributed to the organization at large beyond the people directly involved in the process. These people, in turn, would typically only utilize the knowledge within their specific functional areas - mainly capacity planning or investment planning. This lack of organized dissemination of the learning outcomes was pointed out by several informants as a major drawback in the process. It also affected morale as most individuals did not see any results or tangible actions from such widespread and demanding SP process, thus further questioning its value. Moreover, the time allocated for discussion of the main SP findings with executive management was criticized for being too short and lacking two-way dialogue to provide new insights. As noted by a director, final presentations of the SP findings to the executive management had the feeling of "*being an information session rather than strategic discussion session*"

The effects of inadequate organizational structures and governance mechanisms are further illustrated by experiences reported by one director when discussing the link between insights and action:

"I recall the case when our research team did an analysis on a competitor entering the market, and we saw [evidence] fairly soon as some of our guys were approached by head hunters about this company looking for talented employees on the production side...So we knew they were moving in....Then we started thinking; how could they actually do this [entering the market] ... and what ended up happening is that they did exactly as we expected

them to do...we should have taken action on the analysis we did. We could have slammed the door on their attempts to enter the market..."

When questioned about the reasons behind the lack of action, the director replied:

"The information was sent to people very high in the organization, but it was never discussed; there was never a request to take actions and investigate this further... If you are sitting further down the organization you need to have somebody to tell top management you need to look at this ... you cannot sit very low in the organization and ask for a meeting with top management. That is not how it works. We actually know quite a lot about this market. We spend a lot of time in this market, so let's be sure we have forums and governance for taking action. I would say we did not have the right forum to have that discussion...of course it is also a people issue. If we had had one VP in the organization say this is really interesting; I want to be sure I understand this, let me be sure I call a meeting with you guys and my boss [sitting in executive management] and then we discuss it, then maybe. Of course this is easy to do, but it never happened; the discussion was never there..."

The organizational structure at NZ, at the time of this research, favored the independence of its many business units as reflected by their strategic processes generally being dislodged from other business units. This bottom up process to strategy converges into the executive management team, who have been traditionally expected to drive decision making. As noted by a director working during several years close to the executive management team:

At times we felt people were expecting the executive team to make decisions for them... we rather wanted them to make the action plans and decisions - we pushed the decision making down in the organization.

Consensus driven decision-making culture. Several interviewees noted that the company's emphasis on consensus-driven decision processes created delays in taking actions and making important decisions. This, in turn, hindered NZ's ability to apply and act on its learning. As one project manager noted:

"From the time there is an idea until the time you can start manning that project, it takes about one year. Just because it needs [to go] through several rounds of approval and decisions, and by that time somebody else might already have executed on that idea... managers cannot make a decision; it needs to go through executives and board [Board of

Directors]. Sometimes even VP's cannot make decisions...I think the way we are structured delays actions”.

In a similar vein, a marketing director labelled decision making and actions as a collective effort: *“maybe we are exaggerating discussion and analysis without somebody pulling the trigger, everybody needs to buy in”*. Similar insights came from a manager located outside the headquarters:

“My impression is that the decision making process [in NZ] is a bit slow because it is consensus driven. Even if you have a point of view or an insight, it probably needs to be bought in by multiple stakeholders. It probably needs a very strong champion to push forward that point of view. If you ask me, it is a slightly over-democratic process”.

Another informant called this the “theatre of decision making” because people at NZ, including top management, are aware that making unilateral decisions is not well regarded in the organization. A senior manager with relatively short tenure further explained:

“...from meetings around the strategy process, or alignment with finance, it is always brought up: who can make the decision on these issues? Who do we need to engage in order to get a decision? And the answer is always like: oh we need to look into it ... my first impression is that people have a hard time in figuring out who has the power to make a decision...”

Our evidence suggests that the consensus-driven culture at NZ affects the learning cycle as the information residing at the individual or group level cannot be easily or timely integrated into the organizational level. In addition, NZ successful past and dominant current market position created further learning barriers by fostering an unperturbed culture devoid of process monitoring and evaluation of performance measures. For instance, a director in finance noted: *“... the money is there and there are no penalties for doing wrong, we are lacking follow up systems”*. Two other interviewees (a director and a senior manager) identified “being content” as a learning barrier, explaining that NZ *“does not have a culture of hard follow up”*. Indeed, one senior manager suggested that *“if you enforce mechanisms to*

revise past decisions and enforce prior plans, then you have a different company". Several directors and managers also noted independently that the lack of follow up mechanisms short-circuited the process of reflective learning from experience as insights from mistakes (or success) cannot be internalized.

DISCUSSION

This study traced the scenario planning (SP) processes at Novozymes (NZ) in order to develop a theory of scenario-based organizational learning (OL). Building on the widely used 4I OL framework (Crossan et al., 1999), we conceptualized SP as a learning system and found that the SP process facilitated exploratory and exploitative learning about the company's competitive environment through individual level learning, transmitted to the group level and up the organizational hierarchy to inform reviews of organizational strategies. We identified three distinct stages through which NZ went in the process of conducting SP; scenario construction, selection, and final presentation including subsequent links to organizational action. The transmission of learnings through each of these stages was influenced by a number of factors that acted as barriers to learning flows: individual cognitive biases, searching and scanning routines, the functional bias of scenarios, power and political dynamics, and the organization's structure and culture of decision making processes. Figure 1 presents a model of scenario planning as a learning system based on our empirical findings:

Insert Figure 1 about here

Our findings that searching and scanning routines skewed information being brought into the learning system and the development of scenarios away from exploratory learning is consistent with prior research showing that scanning processes at all levels of the

organization are likely to be oriented towards known rather than unknown events (e.g., Beck & Plowman, 2009). Likewise, our finding that individual biases such as overconfidence affected the information fed into scenarios is consistent with some of the attributes of learning myopia (Levinthal & March, 1993). Overconfidence leads to reinterpretation of result to make them more favorable, which combined with successful individual's underestimation of future risks may lead to biased overestimation of expected returns (Kahneman & Lovallo, 1993; Lovallo & Kahneman, 2003).

Once the scenarios are constructed, the next stage involves selecting and refining the scenarios to be presented to the executive management team. We found that the functional bias of scenarios affected which information was attended to, and how individuals interpreted new information about the environment and integrated their insights into scenarios to be communicated to other organizational members. This is consistent with extant research demonstrating the problems that biases and heuristics cause on individual judgments (e.g. Bardolet, Fox, & Lovallo, 2011; Camerer & Lovallo, 1999; Durand, 2003; Hodgkinson, Brown, Maule, Glaister, & Pearman, 1999; Tversky & Kahneman, 1974). In the context of SP, individual biases appear to constitute important barriers to feed forward learning processes; particularly in the process of moving learning from individuals via intuiting and interpreting to group and organizational levels. Although theoretically SP should help overcome individual biases by challenging existing frames of mind (Schoemaker, 1995; van der Heijden, 2005) and shifting focus to long run performance, our study suggests that SP may in fact exacerbate biases by perpetuating specific views of the environment.

The evidence points to difficulties in bringing new information into the learning system. This complements the 4I learning framework (Crossan et al., 1999), which remains relatively silent on how new knowledge and insights enter the learning system as well as how individuals learn through cognitive processes. Moreover, it suggests the need for further

research focusing on how to improve or promote individual intuiting of truly new patterns into the context of organizational learning.

Scenario selection and retention is the responsibility of higher level managers, who exercise their power to determine what specific information and knowledge is transmitted up the organizational hierarchy. During this stage, power and political dynamics, in particular, affect the integration of insights into organizational learning and may prevent new insights from being institutionalized into revised organizational strategies. Our finding that power and political dynamics critically influenced how learning insights were transmitted up the organizational hierarchy and institutionalized into decision making processes is consistent with the notion of organizational learning as a political process (e.g. Blackler & McDonald, 2000; Fox, 2000).

These findings provide some empirical support for Lawrence et al.'s, (2005) proposition that the transition of feeding forward learning between groups and the organizational level may be challenged by administrative political processes. Powerful individuals may legitimize specific ideas and transform them into organizational interpretations through their ability to influence the thoughts, feelings, and behaviors of those around them (Lawrence et al., 2005), which can result in decision making processes becoming focused on justifying past actions or the current position, even if change is justified (Das & Teng, 1999). Furthermore, our study shifts the focus from political power to lack of bargaining power by illustrating that political influence and power imbalances influence the transmission of learning upwards in the organizational hierarchy. Without the appropriate bargaining power to question assumptions and the status quo at the higher tiers of the organization, new learning becomes difficult to institutionalize. Thus, we extend knowledge about the barriers to learning flows (e.g. Schilling & Kluge, 2009) by providing empirical support for the proposed effects of power on learning processes, and by demonstrating that

they influence more learning processes than has previously been theorized (Lawrence et al., 2005).

The final stage in the scenario planning process involves presentation of finalized scenarios to executive management which forms the basis for institutionalized learning in the form of strategy development and subsequent links to action. Top executives are taxed with the task of making long-term strategic decisions based on the information that is retained in the final scenarios presented to them in often very short meetings. Our evidence shows that without the adequate corporate level formal and informal structures, absorption of new insights and transformation of learning into institutionalized organizational responses cannot occur. Given human cognitive limitations, the lack of such organizational structures may overload senior management and thus crippling its ability to attend to important environmental queues. Hence, even if these external queues are initially interpreted and integrated at group level, they may never become organizationally embedded through institutionalization.

Paradoxically, the culture at NZ also was identified as a barrier to organizational learning. Even though the organization has a strong culture focused on learning and innovation, it was observed that the preference for democratic, consensual decision making combined with lack of effective monitoring and follow-up systems blocked the ability to effectively learn from prior mistakes. A 'culture of content' resulted in an insufficient impetus to translate cognitive action into process changes, thus preventing the institutionalization of process improvements (Berends & Lammers, 2010; Schilling & Kluge, 2009).

Finally, the organizational structures and decision-making culture at stage three were found to affect the extent to which learning moved up the organizational hierarchy. Specifically, organizational learning flows appear to be influenced by the power and

hierarchical positions of individuals within NZ; from analysts of front liners representing the “individual” level via project managers or directors representing “the group level” to VP’s or executives representing the “organizational level”.

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Our findings advance knowledge about organizational learning (OL) and scenario planning (SP) in a number of important ways. First, by conceptualizing SP as an organizational learning system we contribute to the theoretical grounding of knowledge about scenario planning. Despite a rich normative literature on the virtues and processes associated with SP (Burt & Chermack, 2008; Hodgkinson & Healey, 2008), our study demonstrates the utility of the 4I OL framework (Crossan et al., 1999) as theoretical lens for understanding how SP may operate as a learning system.

Moreover, we extend theory by identifying specific factors that influence the feed-forward transmission of learning up the organizational hierarchy through the SP processes. Specifically, we illustrate how SP process design may condition how new information enters the learning system and the role of various cognitive and structural biases in filtering information as it moves not only *forward* but also *upward* in the organization. Whereas the 4I framework focuses on the mechanisms that enable learning to move forward from individuals to teams and become organizationally embedded, our study highlights the importance of identifying cognitive and socio-psychological barriers to learning that influence both lateral and hierarchical transmission of learning throughout the organization. Taken together, these findings are relevant for practitioners given the widely spread use of SP processes in organizations. Our findings show that the intended learning outcomes of SP activities may never materialize as various barriers might block or bias any potential learning benefits.

The single case nature of our study has the acknowledged limitation that our interpretations and findings might be idiosyncratic to the studied organization (Eisenhardt, 1989). For instance, NZ emphasizes learning and innovation as important parts of its strategy and invests in resources to promote learning, which may have influenced the resources, structures and processes of the SP learning system. Similarly, the company operates in the highly dynamic biotechnology industry, which may have created industry-specific external pressure to keep up with fast-moving environmental conditions that then influenced the organization's engagement in SP and OL. Further research should extend this study by examining firms operating in different industries and with different learning orientations so as to determine whether and how these contextual factors might influence the SP and OL processes our study has described. Such studies could also pave the way for much-needed future studies critically evaluating and comparing SP approaches (Chermack et al., 2001).

Similarly, organizational types or societal variables such as education inclination or labor market structures could also influence learning within an organization (Lam, 2000). Consequently, we encourage future empirical studies to apply the 4I OL model of the SP learning system to a wider range of cases and contexts in order to clarify the boundaries of our theory and identify where and how it can be further refined and extended. Future research could also extend this line of inquiry to include other barriers to learning, such as emotions (Hodgkinson & Healey, 2011; Schilling & Kluge, 2009; Sun & Scott, 2005), and examine how they may also influence learning in SP processes.

Our case study included participant observation which provided the lead author unique access to valuable and detailed company information. Although this approach may raise concerns about ethnographer bias (Dewalt, Dewalt, & Wayland, 1998), this was minimized by charting the research design to identify theoretically relevant data and by collecting different types of data from multiple sources. Integrating data via the N Vivo case

study database for analysis ensured that interpretations could be verified through data triangulation, while coding checks and the second and third authors' role as 'critical outsiders' verified interpretations and conclusions. Notwithstanding, we recommend future ethnographic studies of SP be conducted by embedding multiple researchers or research teams within organizations so as to further minimize the potential for ethnographer bias.

Our study also provide additional support for calls to increase multilevel research on organizational learning to better understand the flow of learning across different organizational levels (Crossan et al., 2011). We specifically advocate further research examining individual-level differences in learning, especially in light of our findings that the power held by people at different levels of the organizational hierarchy may influence the transmission of learning from one level to another. Related, our findings about the influence of hierarchical level on learning through SP motivate us to suggest that future research further clarify learning flows in specific learning processes. Organizational learning theory conceptualizes learning as disseminating from the individual to the group and on to the broader organization (e.g., Crossan et al., 1999). Our study demonstrates that in the context of SP, insights were fed up the organizational hierarchy *rather* than diffused across the broader organizational system. Research into top management teams has established that individuals in upper echelon positions think and act differently to people at other (lower) levels of the organizational hierarchy (Doh, 2003). Hence, examining how individual-level characteristics differ across hierarchical levels may advance understanding of factors that influence learning at the individual level and the transition of learning between levels.

EPILOGUE

A recent change in the company CEO followed by an internal reorganization seems to be addressing some of the identified barriers pertaining to organizational learning. First, formal teams have been put in place to better manage and follow up on the performance of the new product pipelines. Moreover, new personnel have been hired to create a “performance management” initiative which is endorsed by top management and has the necessary resources and empowerment to monitor performance and change reward systems accordingly. These measures aim at changing the “culture of content” at NZ and promote performance focus and revision of past actions. Further, a new corporate strategy center has been created. Among other tasks, this unit is responsible for the construction of scenarios aimed at challenging corporate strategy. This new unit will also be responsible of ensuring top-down integration of knowledge and learning throughout the organization and, as such, act as a feedback mechanism in the learning system by creating faster reaction time between learning and action. The success of these changes however is not certain; for instance, there are “many battles and strong resistance” to implement the desired performance changes and most of the people driving this project have already left the organization.

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Table 1
Data description and quantification

Qualitative data collected for the study	Quantification
Interviews with 22 organizational members involved	More than 28 hours of interviews
Interview's notes recorded while / or immediately after each interview with the aim at highlighting potential new insights and researcher reflections resulting from the interviews	More than 70 pages
19 voice memos were recorder with the researcher's reflections about the interviews conducted. Memos were recorded within 48 hours of the interview.	More than 80 minutes of reflections
Observations taken while actively participating in SP	Direct involvement in 2 SP processes
Casual conversations in the organization about SP processes and the organizational context in general	More than 2 ½ years of observations.
Final documents with the SP findings presented to the Executive Management Team	More than 500 pages
Drafts / working documents previous to final SP findings	More than 1500 pages
Copies of strategy documents detailing industry and market strategies along with diverse scenarios	More than 2000 pages
Emails between members of the core SP team, and between team members and other stakeholders within the organization	More than 100 emails
Models of projected production capacity and projected financial models.	Various proprietary models for capacity, optimization and financial quantification

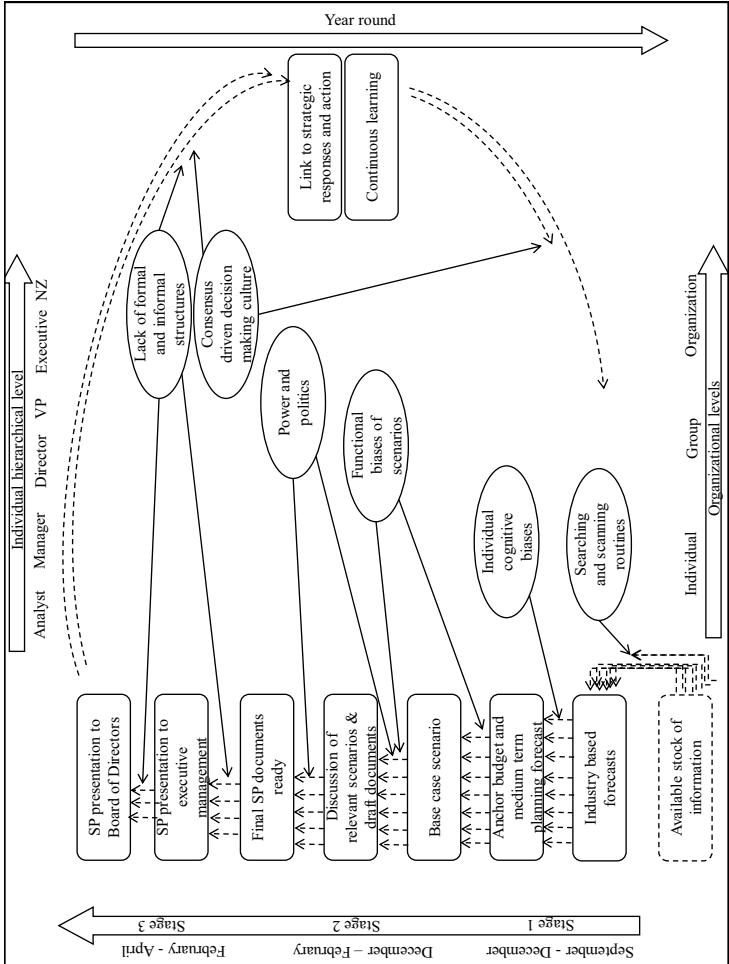
Table 2
 Sample of informants by tenure, functional area and organizational hierarchy

Tenure		Functional area		Organizational Hierarchy	
Years	Number of informants	Area	Number of informants	Hierarchy	Number of informants
0 to 3 years	5	R&D and supply operations	6	Directors and above, including executives	7
3 to 7 years	10	Marketing and Business development	10	Managers	9
7 + years	7	Business support and Finance	6	Analysts and support	6

Table 3
 Example of coding development. From construct definition to evidence

Construct	Definition	Operationalization	Potential data sources	Node name	Node description	Data examples / Quotes
Organizational learning	Process of encoding inferences from history or experiences into routines that guide Behavior (Levitt & March, 1988)	-Organizational learning was considered to occur when two or more informants independently described the same lessons (Bingham & Eisenhardt, 2011) -The result of organizational learning is personified in the existence of operating procedures, routines or scripts (Levitt & March, 1988)	-Semi-structured interviews (Bingham & Eisenhardt, 2011) -Standard Operating Procedures -Field observations -Existence of manuals or checklists	OL	Holds evidence of OL in NZ's SP environment, including: -Interview data in which interviewees discuss changes to organizational routines and processes -Documentary evidence of changes in routines, strategies or processes	-The knowledge from the process was used for capacity, to determine new investments and capacity plans - what products to produce, where and when. (Director) & confirmed by others -The process adds by giving the basis for making decisions. For example on capacity planning. Indication came as to where NZ should build the next factories (VP) & confirmed by others
Individual learning	Systematic change in cognition and/ or behavior informed by past experiences or prior actions (Anand & Khanna, 2000; Argote, 1999; Levitt & March, 1988)	Changes in individuals' cognition (knowledge and understanding) or behavior attributable to past action or experience	-Semi-structured interviews -Observations	Individual learning	Holds evidence of individual learning in NZ's SP environment.	See below
Individual learning – exploitation - internal	Incremental change in individuals' cognition and/ or behavior informed by increased about NZ's internal environment	Evidence of individual incremental learning about NZ's internal environment	-Semi-structured interviews -Observations	Individual learning – exploitation - internal	Holds evidence of individual learning in NZ's SP environment with focus on learning acquired from inside NZ on known themes	"I developed a good understanding for what makes NZ move. Risks factors, upsides for specific industries and markets, knowledge for all industries" (Director)
Individual learning – exploitation - external	Incremental change in individuals' cognition and/ or behavior informed by increased about NZ's external environment	Evidence of individual incremental learning about NZ's internal environment	-Semi-structured interviews -Evidence in SP docs, or information gathered about external influences	Individual learning – exploitation - external	Holds evidence of individual learning in NZ's SP environment with focus on knowledge acquired from outside NZ on known themes	Information collected by an analyst relating to known and routinely tracked competitors – e.g. "we track the news, flow related to large competitors. Some are listed, so we listen to the calls, read the financials..." (Analyst)

Figure 1
 Scenario Planning as a learning system: Barriers to organizational learning across levels and time



Managing ambidexterity:

An analysis of the design, actors and decisions at a market leading bio-tech firm

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ABSTRACT

Organizational ambidexterity – the simultaneous pursuit of exploration and exploitation – has emerged as a powerful concept in explaining long-term organizational success and survival. Despite a rich literature linking ambidexterity to various performance outcomes, relatively little attention has been paid to the specific managerial actions that facilitate the implementation and operation of an ambidextrous strategy. This study explores how a market leading biotechnology firm resolves challenges associated with the simultaneous pursuit of operational efficiency and innovation. Findings provide new insights into the multifaceted aspects of organizational ambidexterity and illustrate how companies dynamically manage the contradictory demands of exploration and exploitation at different organizational levels, and the different actors and decisions that enable organizational ambidexterity.

Key words: Ambidexterity; exploration and exploitation; middle management; scenario planning

INTRODUCTION

One of the most difficult tasks in strategic management is how to balance efficiency and innovation. Managers must choose between designing organizational structures and processes suited for operational routines and standardization, and those facilitating new ideas and innovativeness. This gives rise to the often-cited tension between exploration and exploitation, where organizations must effectively exploit its current capabilities; while at the same time engage in enough exploration of new knowledge and competences to ensure future viability (Levinthal and March, 1993; March, 1991). While exploration and exploitation may seem as potentially incompatible goals with contradictory demands, increasingly businesses find it imperative to balance these demands in the pursuit of superior performance. Exploitation is important for short-term survival yet exploration provides the basis upon which firms develop competitive advantages in the long run. Moreover, exploration has been linked to radical innovations while exploitation is associated with incremental innovation (Gibson and Birkinshaw, 2004); both prerequisites for improving performance.

The key challenge with regards to organizational ambidexterity is that organizational structures and processes designed to promote exploration are distinct from – and often in conflict with – those that promote exploitation. Research has shown that centralization and standardization generally promotes exploitation whereas exploration typically is associated with decentralization and entrepreneurial processes (O'Reilly and Tushman, 2008). This gives rise to a *crowding out* effect where more focus on exploration detracts from the effectiveness of exploitation, or vice versa (Boumgarden, Nickerson, and Zenger, 2012). The result is often suboptimal outcomes when managers try to organize for both exploration and exploitation (Gibson and Birkinshaw, 2004; O'Reilly and Tushman, 2004, 2008). This puts a premium on finding ways in which to resolve this tension in order to pursue an effective ambidextrous strategy.

Research on ambidexterity shows several potential alternatives for how to balance the exploration/exploitation trade-off such as structural separation (Tushman and O'Reilly, 1996), contextual ambidexterity (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004), or temporal separation (Puranam, Singh, and Zollo, 2006; Siggelkow and Levinthal, 2003). Empirical results provide evidence of the nature and role of the various types of ambidexterity in balancing exploration and exploitation as well as its positive effect on firm performance (He and Wong, 2004; Junni, Sarala, Taras, and Tarba, 2013; Kauppila, 2010; Khanagha, Volberda, Sidhu, and Oshri, 2013; O'Reilly and Tushman, 2013; Raisch, 2008).

Despite general agreement among scholars and practitioners that organizational ambidexterity is necessary for business success and firm performance, relatively little is known about the specific managerial actions required to balance exploration and exploitation (Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2013). For instance, while the literature points to the important role of leadership in balancing exploration and exploitation (e.g., Benner and Tushman, 2003; O'Reilly and Tushman, 2004) the actual mechanisms through which management engages with and manages the interface between exploration and exploitation, originating both internally and externally, are largely left unexplored (Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2013). In particular, the different types of ambidexterity imply multilevel coordination processes in order to integrate exploration and exploitation taking part in separate (structurally, functionally and hierarchically) parts of the organization. Specifically, it appears that effective management of ambidexterity requires a distinct capability that may be facilitated by managerial interventions, actions, and/or processes. There is a need for fine grained accounts that delve into the role of managerial capabilities and how decisions are made, who is involved in making them, and how these decisions are implemented (Birkinshaw and Gupta, 2013).

This study investigates the managerial actions and decisions used at a market leading biotech firm in simultaneous pursuit of short-term exploitative efficiency and long-term exploratory innovation while facing market and technological uncertainties. Specifically, this study is designed to address the following questions: (1) How do large firms operating in dynamic and complex environments balance exploration and exploitation organizationally?; (2) what kinds of managerial decisions are involved in managing ambidexterity?; and (3) who makes ambidexterity work in large organizations? The empirical setting is Novozymes (NZ), a market-leading multinational biotechnology firm which is chosen due to its exceptional ability to continuously innovate (both incrementally and radically) while increasing its dominant position in the global enzyme market.

The paper is structured as follows: First the theoretical stage is set by reviewing the ambidexterity literature with particular focus on its grounding in organizational learning theory. An overview of the methodology and data used for the analysis is provided in the next section. The following sections outline the main findings of the study and provide supporting evidence from the in-depth analysis of the managerial actions at NZ to become ambidextrous in the pursuit of innovation and commercial success. The study closes with a discussion of the specific processes and challenges underlying NZ's attempt to balance exploration and exploitation and provides implications for theory and directions for further research.

THEORETICAL BACKGROUND

The organizational learning literature provides a useful distinction between exploration and exploitation and highlights the tensions and incompatibilities between explorative and exploitative learning. According to March (1999), both exploration and exploitation compete for scarce resources, and firms are forced to make tradeoff decisions between them.

Exploration increases variance and fosters adaptation and long term survival; but it increases costs in the short run, has uncertain payoffs, longer term horizons, and lacks feedback loops for assessing adequacy of exploratory efforts. Exploitation, on the other hand, increases firm efficiency and is more tangible but reduces variance thus potentially trapping the company in the long run if its offerings lag market changes. These uneven tradeoffs are usually resolved by leaning towards the faster certainty and payoffs of exploitation, potentially self-destructing the company in the long run (March, 1991).

While several models for organizational learning have been proposed (see Flores, Zheng, Rau, and Thomas, 2012 for a synthesis of the different models and sub processes), the 4I learning framework presented by Crossan, Lane and White, (1999) best represents the tensions between institutionalized learning needed for exploitation and new learning necessary for exploration. The 4I model explicitly considers how information flows as a process from individuals via groups to the organizational level. It also provides insights into the specific processes linking these levels. Moreover, the framework is dynamic by explicitly discussing the interaction between the feed-forward process of moving information from the individual to the group level, and the feed-backward process of institutionalized learning impacting individual and group learning. These feedback processes specifically describe the tension between assimilating new learning (exploration) and using what is already known (exploitation). Crossan and colleagues' (1999) model for organizational learning is heavily influenced by March's (1991; 1999) discussion of the tensions and tradeoffs between exploration and exploitation, which has also fueled the theoretical interest in organizational ambidexterity (Birkinshaw and Gupta, 2013).

Organizational ambidexterity is an organization's ability to pursue explorative and exploitative innovation simultaneously (O'Reilly and Tushman, 2004). This balance is necessary for the long term survival of the organization. While adaptation, innovation and

proactivity are important characteristics of ambidextrous organizations, tight execution for exploiting current assets and generating short term value is also necessary (Birkinshaw and Gibson, 2004).

Ambidexterity research proposes several alternatives to achieving organizational ambidexterity. *Structural separation* refers to the creation of dual, independent structures, each one dedicated exclusively to either exploration or exploitation (Tushman and O'Reilly, 1996). Each subunit has its own structure, people, processes, incentives, and cultures. Behind the concept of structural separation is the notion that tradeoffs between future exploration and current execution cannot be reconciled under the same unit (Gilbert, 2003; Porter, 1996). In contrast, *contextual ambidexterity* suggests the organizational context as facilitator for the individual social behaviors necessary for balancing exploration and exploitation (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004). Under contextual ambidexterity, the role of top management is to create the context necessary for the individuals to behave in ambidextrous ways. Thus, decisions related to exploration and exploitation are made by all the individuals that form the organization as opposed to the top management team alone. While the focus of contextual and structural ambidexterity is on managing the tensions between current execution and future adaptation, *temporal separation* proposes a sequential approach dependent on the current development stage of the firm. For example, Puranam and colleagues (2006) found that organizations in early stages of development, which are typically more exploratory intensive, are negatively affected by the loss of autonomy caused by being integrated with another organization. Consequently, during exploration intensive stages, autonomy tends to outperform coordination. Lastly, research has pointed to role of networks, both internally and externally, as potential mechanisms for organizational ambidexterity (Kauppila, 2010; Tiwana, 2008; Turner, Swart, and Maylor, 2013).

The different types of ambidexterity should be considered as complements rather than alternatives as firms are likely to use more than one form of ambidexterity (Birkinshaw and Gibson, 2004). To this end, while a select few studies have provided evidence of the possible combination of some of these ambidextrous designs (Kauppila, 2010; Raisch, 2008; Taylor and Helfat, 2009), most research has focused on only one of these designs (Andriopoulos and Lewis, 2009; Cao, Gedajlovic, and Zhang, 2009; Jansen, Tempelaar, van den Bosch, and Volberda, 2009; Rothaermel and Alexandre, 2009). Moreover, the majority of these studies build on large empirical surveys, archival data, or comparative case studies focusing more on organizational level constructs thus offering limited insights into the managerial decisions and behaviors underlying ambidextrous organizations (Eisenhardt, Furr, and Bingham, 2010; Rogan and Mors, 2014). Achieving ambidexterity is extremely difficult and the quality of management is paramount in achieving it (Birkinshaw and Gupta, 2013). Consequently, there is need for better understanding of the individual actions that underpin organizational ambidexterity.

In sum, the literatures on organizational learning and ambidexterity offer important insights into the sources of tension between exploration and exploitation. The organizational learning literature provides the theoretical foundation for understanding the conflict between exploration and exploitation. While the ambidexterity literature provides clues as to the possible solutions to this tension, it has focused mainly on organizational level constructs leaving the behaviors and decisions of the individuals managing organizational ambidexterity largely unexplored (Birkinshaw and Gupta, 2013; Eisenhardt *et al.*, 2010; O'Reilly and Tushman, 2013; Raisch, Birkinshaw, Probst, and Tushman, 2009; Rogan and Mors, 2014). In contrast, this study investigates the organizational actors and their decisions that enable ambidexterity. Importantly, because research of individual level actions requires an understanding of the organizational context where these decision occur (Barney and Felin,

2013), this study also investigates the organizational context at NZ – e.g. its ambidextrous design.

METHODOLOGY

Research design

This research was conducted as an in-depth single case study. The single case study approach (Eisenhardt, 1989) is appropriate for answering *how* and *why* research questions; particularly related to social behaviors, contextual details, and investigation of multiple levels of analysis (Dyer and Wilkins, 1991; Eisenhardt, 1989; Yin, 2003). To assure NZ is a suitable organization for research on ambidexterity, prior academic work outlining the characteristics of ambidextrous organizations was revised and contrasted with the ones present at NZ. Because of the research intends to explore the actors and decisions in managing ambidexterity, the research follows participant-observer (Yin, 2003) observation mode. A key strength of participant-observer is the access to groups, meetings and presentations that might be highly confidential and commercially sensitive thus otherwise restricted or unavailable to outsiders (Brannick and Coghlan, 2007; Yin, 2003). Participant observation also allows the researcher to develop and utilize his or her knowledge of organizational structures, processes and terminology to participate in discussions, observe actions, and identify the people, processes and documentation that might be fruitful for the study (Brannick and Coghlan, 2007). Consequently, participant-observer was the selected observation mode as it was expected to leverage best the unrestricted access to the organization and likely allow the author to identify and interact with the actors managing ambidexterity at NZ.

Industry and company selection

Ambidexterity research suggests that the effects of ambidexterity on firm performance are industry specific and likely more prominent in dynamic environments (Simsek, Heavey, Veiga, and Souder, 2009). Recent meta-analysis research validates this assumption and demonstrates the moderating role of industry on the organizational ambidexterity-performance relationship (Junni *et al.*, 2013). Furthermore, organizational ambidexterity also presents a strong link to performance in firms operating in multiple industries (Junni *et al.*, 2013). The focal company of this study is embedded within the highly dynamic biotechnology industry and their product offerings reach several diverse industries, including food, detergents, brewing, bioethanol and biomass conversion, forestry and textiles, among others. Consequently, based on Junni and colleagues' work, it is expected that ambidexterity is not only present, but necessary in a company like NZ. Further analysis grounded on the work of Sarkees and Hlland (2009) corroborates this expectation.

According to Sarkees and Hlland (2009), ambidextrous organizations show positive effects on 4 different dimensions of performance: revenue, profits, product innovation and customer satisfaction. This is important as an organization that excels in one or two metrics might do so by trading off other performance areas. NZs' market share in the enzyme business is 48% globally (Novozymes A/S, 2013a). Long term organic sales growth and earnings growth are approximately 7% and 13%, respectively. Product innovation ranges from continuous marginal adjustments to radical innovations. The company has introduced more than 75 new products/concepts over the last 10 years and it strives to introduce 6 to 8 new products each year (Novozymes A/S, 2014a). In 2012 and 2013 Procter and Gamble named NZ as one of its 15 top performing partners out of more than 82,000 suppliers and agencies (P&G corporate press, 2013). NZ has received this award on 6 other occasions demonstrating strong customer satisfaction. Furthermore, in August 2014, NZ was named outstanding global corporate innovator winner (along with an American company -

Starbucks) by the product development and management association (PDMA, 2014). Undoubtedly, NZ shows positive results in the 4 different dimensions as proposed by Sarkees and Hlland (2009).

Furthermore, by its own admission, NZ simultaneously pursues exploration and exploitation as catalyst for long term performance: “NZ drives innovation, expands opportunities and improves productivity to achieve sustainable long-term earnings growth” (Novozymes A/S, 2013a). Accordingly, NZ can be classified as an ambidextrous organization and the selection of the organization meets the criteria for revelatory single case study design (Yin, 2003: 42).

Data collection

A variety of qualitative and quantitative data was collected between December 2011 and February 2015. During this period, the researcher was actively involved and had responsibilities and deliveries in various processes carried out in the global headquarters of NZ. Hence, the mode of observation can be described as participant-observer (Yin, 2003). Data collected included observations, field notes, working documents, presentations, analytical models, internal memos, annual reports, public available information and various interviews with NZ employees.

As the study was broadly framed around exploration and exploitation, it followed Woods (2005) and charted the research design to a) define the data needed to provide conceptually valid evidence; b) identify potential sources for the data; and c) enhance validity of data analysis and interpretation by ensuring that data was coded in ways consistent with the conceptual definitions derived from the literature.

Data was mainly collected in relation to the researcher’s participation in two scenario planning processes at the organization. At NZ, scenario planning is a bottom up approach

which runs for about 8 months a year, every year. It is integrated into the corporate strategy in the sense that it builds from the diverse industry strategies set out for a 5-year horizon. The process starts at the regional levels and gradually becomes more centralized with the executive management team and Board of Directors as main stakeholders. It touches employees from several functional areas such as sales, marketing, supply chain operations, production and finance. Analysts, managers, directors, VPs and executives participate directly or indirectly in the process. Being actively involved in a process that touches upon many different hierarchical levels and functional areas offers a unique possibility to better understand the managerial decisions and actions for achieving ambidexterity at NZ.

In addition to the scenario processes, the researcher actively participated in a 3 month project designed to develop market positioning and penetration strategies in a developing country. This allowed for a closer view and understanding of the processes and strategies used by the company to penetrate markets and exploit its capabilities. To complement the active involvement in these processes and projects, the researcher also participated in various other corporate activities, such as team meetings, conferences, knowledge sharing sessions, social events, etc. In all, these numerous interactions facilitated a deeper understanding of the organizational context and underlying strategic processes at NZ.

Interviews

25 people throughout the organization were interviewed. Most of these informants were directly involved in the scenario planning process. In the initial interview list, 12 informants were identified as key contributors due to their strategic involvement and responsibilities in current or prior scenario processes. However, as the interviews unfolded, new leads were suggested by the informants as potential sources of information – leading to chain referral or snowball sampling (Biernacki and Waldorf, 1981). These new leads were contacted and

subsequently added to the interview pool. In total, 17 individuals were directly or indirectly involved in the corporate scenario process at NZ. The other 8 informants were a mix of scientists, innovation focused employees, or personnel involved with the R&D side of the organization. These individuals were contacted with the expectation to get further insights into their exploratory behaviors and the processes through which they contributed to ambidexterity at NZ.

The final pool of informants included several functional areas. Some were competitor intelligence analysts located outside the headquarters. Others were managers with a scientific background anchored in the R&D functional area. Marketing, finance and supply operations were also represented. The broad pool of informants – functionally, hierarchically and geographically – allowed the researcher to gather impressions of the phenomenon of interest from diverse perspectives, which reduces potential biases in the data collection (Eisenhardt and Graebner, 2007). Importantly for the specific purpose of this study, the broad sample of informants allows for better understanding of the general context of NZ, for instance, in relation to structures to support ambidexterity, and behaviors and social interaction of the individuals making ambidexterity work.

The final sample of interviewees included directors, VPs, and members of the executive leadership team (n=7), managers (n=11) and analysts and support staff (n=7). The informants belong to the functional areas of marketing and business development (n=10), R&D and supply operations (n = 8) and business support and finance (n = 7). Table 1 presents a list of the 25 informants, their seniority level, functional area and tenure. In an effort to extend the confidentiality offered to the participants, these three categories were intentionally made broad.

Insert Table 1 about here

The interviews were conducted between November 2013 and June 2014. These were open ended but based on a common set of questions and typically lasted 60-90 minutes. All interviews were recorded with the permission of the informants. This produced more than 30 hours of interview data. At the end of the interviews, all informants were given the opportunity to add any impressions that they deemed important but were not touched upon during the interview. Notes were taken as each interview unfolded and these notes were revised within 24 hours for consistency with the recorded data. The interview protocol moved from general questions into more specific ones. Questions were as general as asking the informants to give their impressions of what it is like to be working for the company or to name the main competitors and customers. These general questions looked for information on the contextual and social environment of the organization. Other questions were more specific, such as asking informants to describe their daily routines. For instance, the people involved in the corporate scenario process were asked to describe their roles in the process, the conversations during the process, who made the decisions, and so on.

Data analysis

One of the potential limitations of the participant observation method is the large amount of data at the researcher's disposal and the subsequent need to select, prioritize and analyze such a large dataset. Given the amount and diversity of data gathered, it was managed and analyzed using QSR International's N-Vivo software program for analyzing qualitative data. N-Vivo was used to develop nodes (hierarchical systems of data categories) reflecting the concepts to which the data related and subsequently coded into. These data categories supported subsequent review, analysis and interpretation of the data.

Since the researcher was aware of the main theoretical concepts in the ambidexterity literature, the analysis iterated between existing theory, data, and emerging theory (Locke, 2001). Consequently, the coding was deductive when evidence supported for instance

exploratory and exploitative concepts. However, inductive coding was also used as theory emerged from the data, for example in relation to particular managerial actions for balancing exploration and exploitation.

To assure the quality of the research and findings, particular attention was given to coding reliability. Specifically, checks for coding stability were performed. To ensure the data was coded in ways which were conceptually valid and consistent with the coding rules, two independent researchers undertook the coding and analysis. Specifically, one researcher coded a random selection of the interview data. Variations in coding between the two coders were addressed through discussion of ambiguous data or coding rules and modification of the coding scheme (c.f. Nag, Corley, and Gioia, 2007). A second independent researcher took the role of ‘critical outsider’ to whom the author detailed observations, insights, main conclusions in the study, and the evidence on which they were based. This was done in order to counter acknowledged risk with participant observation such as failing to consider alternative framings of an explanation (Brannick and Coghlan, 2007) and assuming advocacy roles or becoming supporter of the organization or group under study (Yin, 2003). The findings are presented in the next section.

FINDINGS

Simultaneous exploration and exploitation at Novozymes

NZ has been in business for more than 90 years - initially as part of the Novo Group, and subsequently as a stand-alone company since 2000. The company is today a worldwide market leader in industrial enzymes – biological catalysts that increase the rate of chemical reactions creating diverse efficiencies. Much of its strategy has innovation at its core:

“NZ is an innovation-driven company. More than 20% of our global workforce works in R&D, and annually we spend around 14% of revenue on R&D. The focus is to ensure

continuous development of our existing product portfolio while expanding the use of our technology by developing new concepts for new applications. Furthermore, we devote a significant part of our resources to long-term radical innovation in order to ensure our long-term growth” (Novozymes A/S, 2014a)

However, tight execution and productivity improvements are also very much part of the company’s core strategy:

“...the R&D and Supply Operations departments continuously strive to find ways to improve production strains, increase product efficacy and optimize production processes. These improvements allow NZ to deliver better and more sustainable innovation to customers faster. At the same time, the company is cost-conscious, enhancing its ability to deliver earnings growth” (Novozymes A/S, 2013a)

Evidently, NZ’s strategy is focused on attending simultaneously to the needs for exploration and exploitation in pursuit of long term success. The recent opening of two new platforms looking into future growth opportunities are further evidence of the innovative efforts at NZ. The first technology platform, BioAg, intends to supply biological solutions for farmers worldwide. It is a different technology to enzymatic solutions as it is based on *“microbials, plant extracts and beneficial insects that allow farmers to improve crop health and productivity, and complement or replace traditional fertilizers and chemicals”* (Novozymes A/S, 2014b). The second platform, Biomass conversion, is based on the company’s core enzymatic technology and *“turns plant and animal materials into high-quality fuels, electricity or renewable chemicals”* (Novozymes A/S, 2014b).

These two platforms complement the large pipeline of current products at NZ and provide further growth platforms for the short and long term. As noted by their Board of Directors (BoD), these two growth platforms *“could transform Novozymes’ future business”* (Novozymes A/S, 2013a). These two new platforms are pushing boundaries in different ways. Although BioAg leverages existing R&D and technology capabilities, it is a different biological business to their core enzyme capabilities and thus could be labeled as fully

explorative efforts. Biomass conversion, on the other hand, is about production *scalability* and cost *efficiencies* of core enzymatic technology within the biomass industry. The company has been trying for the last few years to reach commercial profitability through constant improvement of its technology applied to this industry. Therefore, it is closer in nature to incremental innovation – e.g. *exploitation* of current capabilities. As stated by the company’s CEO in its 2013 annual report:

“Both BioAg and biomass conversion have the potential to become big. Those are big bets for NZ. They are very different in nature, for Biomass conversion we would say the technologies are roughly ready to be deployed. Now it is a question of deployment and getting the financing for the plants that are going to produce second generation bioethanol and cellulosic ethanol.. BioAg is a different history. It is about understanding the science. The companies who first understand the science of it, of how these products work, they will earn the licenses to develop the next generation, the next wave of products. So, biomass conversion is about deployment [exploitation] where BioAg is about investing on the science part of it [exploration]...”

As the above examples illustrate, NZ excels at simultaneously exploring new possibilities and exploiting current capabilities. To NZ, these are not conflictive but rather complementary and necessary goals for long term success. To better understand the dynamics and mechanisms that make these potentially contradictory objectives coexist, I next examine the organizational processes, structures and actors that make NZ ambidextrous.

Ambidextrous design at NZ

Various ambidextrous designs were simultaneously observed. These designs, routines and processes were built to support the contradictory demands of exploration and exploitation needed for long term success. Importantly, the designs changed over time in consideration of external or internal forces. The dynamic design continuously supports concurrent explorative or exploitative needs.

Contextual ambidexterity. According to contextual ambidexterity, the organizational context acts as facilitator for the individual sociological behaviors necessary for balancing exploration and exploitation. As noted by Birkinshaw and Gibson (2004: 49) “in a business unit that is ambidextrous, the systems and structures are more flexible, allowing employees to use their own judgment as to how they divide their time between adaptation (exploration) and alignment (exploitation) oriented activities”.

At NZ, leadership, cooperation, personal connections and alertness are greatly encouraged throughout the organization. For example, NZ’s culture is sustained by four core values (Novozymes A/S, 2014c): (1) Dare to lead (internally and externally; take initiatives; never settle); (2) Unlock passion (inspire others; focus on opportunities; do not fear mistakes; learn from them); (3) Develop a circle of trust (empower others; take care of others); and (4) Connect to create (learn from the outside; challenge conventions). These core values are given to employees when they join the company and yearly performance reviews include an assessment of the extent to which individuals “live” these core values in their daily life at NZ. The impression is that employees at NZ are cooperative, alert, willing to learn, and highly motivated. These impressions were largely confirmed during the interviews as the majority of the informants revealed high motivation, stimulating tasks and continuous learning as some of the main behavioral traits of the daily life within the organization.

Hence, NZ has managed to create a culture and context that stimulates continuous individual learning and attention. Additionally, the interviews revealed that individual’s motivations and interests are generally aligned with the corporate vision and ambitions. Research on identification and identity has shown the positive effects of individual identification in terms of increased effort, participation, beneficial decision making and intrinsic motivation (Ashforth, Harrison, and Corley, 2008). Consequently, NZ’s core values and motivational alignment enables highly motivated individuals and a learning culture. The

context and individual behaviors at NZ hold many similarities with the contextual attributes observed by (Birkinshaw and Gibson, 2004) in ambidextrous organizations.

Structural ambidexterity refers to the exclusive dedication of a sub-unit to either exploration or exploitation, which is supported by its physical (separated) location, people, culture, incentives or processes. Yet, there must be enough connectivity to create synergies and cost control among the different units. At NZ, innovation is mainly driven by the R&D side of the organization which receives a steady stream of funding for experimentation. According to official documents, 14% of revenues are allocated to explorative activities (Novozymes A/S, 2014a). About 2/3 of it goes to new exploration, and 1/3 is used to improve or optimize current products or technologies (Finance Manager). NZ's R&D unit has more than 1000 employees located at eight global sites on 4 continents, each site representing a certain set of skills and competencies. One of these sites is located in the central complex that forms the headquarters of the organization. In this complex, the R&D unit is located in a different building than for example human resources, accounting, corporate finance or executive management, who are all centralized in the same building and viewed as a support and coordination unit. Production is housed elsewhere in separate locations.

While the design and separation of functional units is evident, the internal connectivity is tangible. In accordance with prior research (Tushman and O'Reilly, 1996), the connectivity at NZ between R&D and the rest of the organization becomes stronger at the higher levels of the organization. For instance, business units' strategies have R&D representation in addition to marketing, sales and finance. The R&D unit is fully integrated at the executive level, which assures the creation of synergies. However, evidence of connectivity is also observed along the life of the exploratory projects for new products or technologies and horizontally at the individual level in general.

Internal exploration of new products follows a three step process: new lead, discovery and development. As the exploration efforts move forward, the connection with other parts of the organization increases, for example with sales and marketing for estimating potential market sizes and defining product development at the later stages. New lead and discovery is typically about the technology and is mainly driven by R&D scientists.

Similarly, more casual connectivity among individuals in different sub-units, though not very common, is possible and to a certain extent encouraged. For instance, in 2012 the finance team, which is an exploitative unit focused on control and support, had a global meeting and convened in Chicago for a week. One of the reasons for the chosen location was to learn the basics of a new technology and interact for a day with one of the subsidiaries for the BioAg platform which is located at driving distance from Chicago. Such initiatives are aimed at creating awareness and a loose structure of internal networks.

Another example of connectivity among different units is the access that employees have to internal training courses with the intention to increase awareness and understanding of the different technologies, applications and platforms across NZ. These training sessions need to be approved by the immediate manager, typically take from one to three days and are driven by senior scientists or marketing directors. In the sessions, participants are presented with a basic understanding of the operations, opportunities and challenges of business units that otherwise would be difficult to obtain during the course of daily operations. Consequently, the link between the R&D, other business platforms, and the rest of the organization exists, and it goes beyond synergies at top management level, albeit somewhat loosely particularly at lower organizational levels.

The structural ambidexterity is supported by markedly different cultures, behaviors and incentives as highlighted by some informants. For instance, a manager shared the large variation in the “type of people” that forms the R&D organization:

“...they [R&D employees] are hard core specialists, different between each other but very open minded, with the ability to think outside of the box. Contrarily, in finance for instance, everybody is aligned; they all look and act the same”.

Furthermore, individual creativity is highly encouraged on the R&D side of the organization as NZ in general allows certain levels of autonomy in the individual pursuit of exploration.

“...all scientists to have 10% of their work time allocated to pursue personal ideas (science managers 30% and science directors 50%). NZ’s organizational structure and working methods have been designed to create the optimal environment for innovation” (Novozymes A/S, 2014a)

The evidence points to structural separation (Tushman and O’Reilly, 1996) also being an integral part of NZ’s strategy to achieve ambidexterity. Different subunits attend almost exclusively to exploitative or explorative needs. However, the reach of the interconnections and synergies extends beyond the higher tiers into almost all levels of the organization, albeit often in a relatively loose and unstructured fashion. These weak connections are more the decision of group leaders and the interaction with their subordinates. Thus, middle managers actively engage in promoting and reinforcing ambidextrous behaviors within dedicated units. This highlights the critical role of middle managers in the pursuit of ambidexterity.

Managing organizational ambidexterity

The case evidence points to several actions for managing organizational ambidexterity. ***The dynamic nature of ambidexterity*** is evident by the company’s constant pursuit of strategic refinement to better manage its explorative and exploitative efforts. For instance, while discussing recent competitive moves that directly affected NZ’s ability to exploit its knowledge base and technologic offerings, a VP shared:

“...we realized that the main driver for the deal between these companies [a long-tenured customer and a competitor] was the need to finance the cost of the plant... we discussed [internally, among the executive team] whether we should change our strategy or not. At first we decided to not change the strategy... But [subsequently] we modified that slightly [the strategy]... but yes, events like that certainly lead us to rethink the strategy and the strategy was modified somewhat last year... ”

Thus continuous refinement to its ambidexterity design (reach of collaborative contracts in this case) is a vital managerial action to achieve continuous ambidexterity. However, variations on strategies and designs not only respond to competitive actions but also to market conditions. The changes in strategy support the maturity cycle of the particular industry. For instance, in the 2013 letter from the BoD (Novozymes A/S, 2013a) changes in go-to-market strategies are discussed as follows:

“Depending on the industry in which the enzymes or microorganisms are used, different go-to-market strategies are used. In some industries and regions, bio-solutions arriving on the market are so new, and at times revolutionary, that they require operational changes and investment for some customers. Therefore, the go-to-market strategies focus more on education, technology de-risking and adoption. In other industries, such as Household Care, customers are well established and looking for new ways to expand the market and make their value chain and products more sustainable. Here, biotechnology has already been adopted, and NZ’ go-to-market strategy is focused on increasing penetration and showing customers how they may benefit from using more biotechnology”

The life cycle of the organization also affects how ambidexterity is managed. During the interviews, many informants referred to the “Steen culture” in clear reference to the leadership style of Steen Risgaard, the former company CEO who was highly innovative and transformational. Undoubtedly, this highly explorative style shaped NZ’s first years after the demerger in 2000. However, some informants described past exploration efforts as fantastic ideas that many times did not materialize commercially. Other mentioned that the company tends to stay too long in projects outside the core enzyme business that are not profitable and therefore should be exited faster. Therefore, a perceived weakness in past exploratory efforts relates to disconnection from market realities and needs. Yet, this is the essence of

exploratory efforts: the increase in variance and seeding of new possibilities. As noted by a VP, the company's strategy rests as much in executing as it is in seeding for the future: "*you need to continue investing for the future, some money you waste, but in some instances you succeed*"

Nevertheless, in 2013 the company changed CEO and underwent a complete reorganization aimed at better supporting its long term ambitions. Among the changes, the introduction of a project that prioritizes the new products' pipeline in 2013 signals a direct effort to create a more efficient R&D process in order to increase the speed to market as well as to generate more significant innovation. Additionally, attention is given to prioritization on the pipeline and resources to determine faster when projects should be moved forward or terminated. Similarly, a new unit (performance management team) has been created with the intention to establish the mechanisms and processes necessary to introduce and support a "performance culture". The strategy formation has also changed from being driven mainly independently by each business unit to becoming centralized at the organizational level. A new corporate strategy unit has been created to support these efforts. Consequently, as the life cycle of the company changes, the management and focus of their explorative and exploitative efforts changes as well. The evidence points to a company evolving from a largely explorative entity to one that although still explorative, is increasingly preoccupied with achieving various long term targets – including financial. The following paragraph taken from the "Letter from the BoD" in the company's 2013 financial report (Novozymes A/S, 2013a) highlights this change:

"[At the beginning of 2013] The organization adopted a new structure to sharpen focus on the customers. Internal processes and procedures were reviewed and new R&D application units and novel growth platforms were created, all to help achieve NZ' long-term targets"

The evidence adds another layer to the complexity of managing ambidexterity. Continuous support to simultaneous pursuit of exploration and exploitations necessitates constant nurturing and revisions of the process, strategies, structures and networks built to support the ambidextrous organization.

Integrating mechanism. It appears that a mechanism to efficiently integrate the exploratory and exploitative learning residing at different sub-units and levels within the organization, and transform these into subsequent action is needed in order to manage the complex organizational structures at an operational level. Ambidextrous designs include distributive and integrative aspects (Smith and Tushman, 2005). At NZ, an integrative managerial process that touches many different organizational units (sales, marketing, R&D, finance, production), geographical regions and seniority levels (from analysts to executive management and the BoD) is scenario planning. The connectivity created by the scenario planning process is noteworthy. This is how the project manager of the scenario process for the enzyme business division (roughly 90% of total NZ's sales) describes the process:

“... it [the scenario process] started in the autumn when the IS [Industry Strategies – business unit strategy] were made. At the same time, optimization efforts [production] were planned for the next 2 or 3 years, so we had some knowledge about new strains and stuff like that. These were completely separated processes timed up with the fixation of the AB [Anchored Budget]. So the ISs were done before the AB. Raw material development was also done before the AB. The AB and the MTP [Medium Term Planning] was the starting point of the scenario work. Out of the IS's there came the MTP. Further, the complete R&D portfolio was also timed up against the AB process. All R&D bodies were reviewed and the NPV (net present values) values were updated against the AB process because the R&D NPV's and portfolio NPV's needed to be aligned to the AB.... So there were all these sort of different things being aligned to be the AB and MTP movement. The MTP came out of the ISs and there was this decision process with upper management around the MTPs... there were actually all the production recipes also done up against the AB. So in the AB all production recipes were calculated down and you had a pretty good base line of how the production economy was. So there was also a production economy alignment. So you kind of had all the major processes at NZ being aligned up against the AB. Of course all the cap cost budgets and things like that were also aligned against that. So you have all these major processes being aligned up against the AB [starting point of scenario work] at the calibration point...”

The broad reach of the scenario planning process at NZ allowed integration of exploratory and exploitative learning residing throughout the organization. For instance, the exploration residing at the structurally separated R&D unit was captured through R&D participation in the different business unit's strategies and via the product pipeline feeding into the scenario work. Knowledge from different networks within an industry was also represented and captured at the business unit level. Incremental, exploitative efforts using prior knowledge comes from production and supply chain operations in the form of more efficient product receipts, optimization from older strains, or introduction of better strains and formulation in the production and cost mix. On the Bio business division (the remaining 10% of the business), albeit some differences in regards to smaller scale and larger time frame (up to 15 years), the scenario process also acts as a coordinating and prioritization mechanism. As shared by a manger:

"... the scenario work will consolidate different projects which will be discussed by the portfolio board. They will prioritize projects, where to focus the resource that we have available. After that portfolio discussion they will approve or reject new projects and allocate people [scientist] available according to their decisions..."

Throughout the interviews, informants pointed to constant innovation, optimization of fermentation capacity and production scalability as some of the competitive strengths of NZ. Constant and radical innovation is mainly about future growth opportunities. Optimizations of fermentation capacity and production scalability are current competitive advantages that allow NZ to exploit their past explorative efforts. Having a clear picture of potential bottlenecks to their core production competence and clear decision points on where and when to invest are valuable insights for execution and production. As shared by a director, in the past, NZ has been caught off guard in responding to unforeseen market developments. This historical background has increased the organizational attentiveness toward current and future market dynamics affecting production in order to exploit efficiently.

Hence, in addition to coordinating and integrating knowledge around the organization, the scenario process serves as a mechanism to create awareness and highlight the main topics in need of discussion at the executive level, analyze it, and transform this knowledge into fine-tuned action points around the core exploitative capabilities:

“You started the scenario work simply by breaking down all production numbers, so you had the cost structure, the capacity structure of the production number using the knowledge about the optimization portfolio to say ok how will production cost evolve during the coming years?, how the production capacity will evolve for the different products during the years.. so we transferred coming products into capacity and profitability expectations based on the goals of the project and knowledge, based on how we have done this in the past and stuff. That was all consolidated in our scenario model... anyhow, that was done, and out of that you got capacity [utilization], investment [needs], capacity cost, forecasts, but of course it was done on fermentation forecast, then you had to do separate exercises on some of the other items. And all these gave a good basis for discussion, and I think this base case scenario [there were many other scenarios] is which gave the most value...” (Senior Director)

In sum, the scenario process at NZ mainly acted as a mechanism for coordinating, integrating, and discussing exploratory and exploitative learning as well as turning it into actions for exploitation and optimal leverage of its competitive advantages. These are rather counterintuitive findings as the scenario process was expected to have mainly an explorative function. Figure 1 illustrates the matrix results from the data coding in relation to the leaning generated from the scenario planning process. As shown, across the different functional areas the general impression is that the scenario process is inadequate in generating exploratory leaning while more adept in generating exploitative learning.

Insert Figure 1 about here

Interestingly, following a recent reorganization, this scenario process has also changed. As noted by a senior manager, *“the new scenario process is less about production and more about allocation of resources”*. Furthermore, this new process is executed in close

collaboration with the newly developed corporate strategy team. This adds further evidence to the dynamism at NZ in their processes for managing ambidexterity.

Actions of senior management (executives) in supporting ambidexterity. One of the most important traits observed in senior managers at NZ was the creation of contradictions – e.g. contradictory goals. For instance, for senior managers the goals of the organization were not exclusively focused on market share gains or increased profits (exploitation) or on radical change or innovations alone (exploration). Through various mechanisms, for instance external market guidance, senior managers were preoccupied with promoting simultaneous attention to both ends of the ambidexterity spectrum in support of very aggressive long term targets in various areas. For instance, they have recently guided the market with 5 year sales growth of 8-10% organic, above their current 7% historical growth (Novozymes A/S, 2015). Additionally, the company plans to deliver 10 transformative innovations and save 100 million ton CO₂ by 2020 among other targets. As noted by the company’s CEO, “*Over the next five years we aim to reach, educate, catalyze, deliver, save and enable to make a lasting difference*” (Novozymes A/S, 2015).

Internally, senior management aligns and reinforces behaviors through a variety of actions. For instance, employees are constantly reminded (e.g. through videos on the intranet) that long term objectives can only be achieved if NZ executes on all fronts, both in terms of performance and execution of current capabilities, and in exploring, finding and delivering the radical solutions and new growth platforms necessary to reach higher growth rates as compared to historical trends. To further align the interests of the individuals and the organizations, a recent profit sharing program has been implemented throughout the organization.

The creation of Blue Marble – an alternative scenario planning process [now discontinued] - is another example of senior management fostering and supporting contradictions. Blue Marble was an initiative driven by the sustainability department of the organization with heavy support of the R&D department and facilitated by external consultants. It had executive support and funding. The aim of the project was “*to look for radical innovation that could change the revenue stream*” (R&D Director). This scenario process contradicted in many ways the formal process - for instance, in relation to the purpose (find radical innovation), organizational anchors (sustainability and R&D) or integration (lack of) into the strategic cycle of the company. Consequently, it constitutes a good example of the constant inclination at the senior level to nurture paradoxical framing (Smith and Tushman, 2005); thus recognizing and embracing contradictory demands for long term success.

Another observation at senior level in managing ambidexterity is the use of the established scenario process as ambition setting mechanism (e.g. to push for further exploitation). Some informants felt the scenario planning exercise, in addition to inform on production capacity and investment needs, served as mechanism to push for higher sales growth. To confirm these impressions, analysis of documents and presentations from prior years’ scenario processes were compared against (1) realized figures and (2) the following years’ scenario presentation to assess any biases in the numbers. The findings confirm the impression of the informants and suggest an inclination to have too positive a forecast in the base case scenario. In many instances, informants revealed that it was not uncommon to have the sales figures that formed the base case scenario being revised several times [upwards] until management was satisfied with the figures in the forecast. At lower levels of the organizations, this top management behavior was understood as ambition setting.

In addition to enabling and promoting an organizational mindset of contradictions, and challenging the organization, top management was tasked with creating the appropriate

learning context (e.g. through the 4 core pillars) and the allocation of resources (e.g. decision to fund individual projects or growth platforms).

Actions of middle management in supporting ambidexterity. Managing ambidexterity goes beyond decisions at the higher levels of the organization. At NZ, middle management was also found to be actively engaged in activities that promote ambidexterity. For instance, a conference held in 2012 for the global business finance team – driven by two finance directors and supported by a finance VP - had sessions at an American university with key speakers that emphasized looking at the big picture, and thinking outside the box – exploring new possibilities. The intention was to promote exploratory behaviors in a functional area where routinized day to day tasks creates a clear exploitative and operational atmosphere. This encouragement of explorative possibilities creates behaviors where individuals explore routinely for novel, more efficient ways to carry out their tasks. As a finance director pointed out: *“I recall the time when outside expertise was asked for to bring new insights into how to make this process [the scenario process] more geared towards challenging the internal assumptions that we work under, there was a need to explore more”*. Analogous efforts to insert a more explorative focus to the scenario process were noted during the interviews with members involved in the scenario process.

However, despite the organization’s predisposition to providing individual autonomy for exploratory efforts, and the department manager’s promotion of ambidextrous behaviors, active blocking of these individual exploratory behaviors was observed during the scenario planning process. In some instances, explorative attempts were blocked through persuasion as noted by a director:

“...people are trying from time to time [to introduce changes to the scenario process] but we are persuaded to continue ...it is requested, it is a deliverable we have, so we do it...”.

In other cases, the proposed changes intended to bring new exploratory learning were adapted to serve other exploitative purposes, as noted by another director:

“...in one instance, building from my background, I built a different model to drive decision making, with more high level estimates, much less detail, to make the process more value driven...but the main process did not change, it was simply adopted into something else...”

Analysis of draft documents of the scenario process against the final document presented to executive management revealed that some material containing explorative information were dismissed or relegated to the appendixes [by middle managers] in favor of information that supported execution (exploitation). Hence, evidence reveals the active role of middle managers in promoting ambidexterity and exploratory behaviors. However, selecting which of the ambidextrous proposals or behaviors are allowed to move upwards from the individual collaborator to the higher managerial decision level is also a key behavior of middle managers at NZ.

Networks for exploration and exploitation. The network perspective to ambidexterity, especially at the individual level, is relatively new (Mom, van den Bosch, and Volberda, 2009; Rogan and Mors, 2014). A striking observation in this case study was the extensive use of networks in managing ambidexterity. These networks are internal and external and manifested at all levels, from the individual up to the organizational level. For instance, exploration of new ideas not only comes internally from the many scientists employed, but also from the outside through the extensive net of collaborative agreements that NZ has developed. A manager shared some of the external ties used for exploration:

“To complement internal exploration, the company engages in different activities to explore externally. For instance, the company regularly applies for external EU funding and engages in research in areas of common interest. The company will also fund external exploration in capabilities or technologies too far away from its core expertise, for instance by cooperation with universities or funding of PhD research...”

In line with prior work highlighting the importance for R&D-intensive organizations in establishing close links with universities to open up the boundaries of exploration and technological transfer (e.g. Lam, 2003; Murray, 2002), the evidence points to NZ also using such external collaboration. However, the collaborative network for achieving ambidexterity at NZ is more complex. Some of these collaboration networks are internal. For example, the company's Radical Innovation Catalysts (RIC):

“RIC is a cross-functional group collaboration for idea qualification involving 40 people across functions over a period of one year. The focus is on ideas outside current strategic focus with radical innovation potential. The RIC team is responsible for getting business project ideas qualified before entering the front-end phase of the project management system” (Novozymes A/S, 2014a)

Cross-functional interfacing and job rotations are additional internal mechanisms used to facilitate transfer of internal knowledge and in some instances to cross-fertilize (Taylor and Helfat, 2009) and create synergies between new and established units. For instance, it is typical that employees from established areas within the organization are sent to new businesses with the intention to share knowledge.

At the individual level, an illustration of the predisposition of NZ's employees to explore through networks is the time when the author was contacted by an NZ employee outside the organizational setting - through a university route - because this individual had “stumbled over” the research efforts in general terms and wanted to learn more about it. It was an explorative effort to learn from the outside, without realizing the anchoring of the author at the company. Both individuals were anchored at different organizational units and had not interacted before. After a few emails, a communication and collaborative channel was established. Following casual (e.g. lunch) conversations to learn about each other's activities, the researcher was referred to additional people (in very different organizational areas) that might be of interest in common explorative efforts. This eventually resulted in a larger

network and options for collaboration and exploration of ideas. On another occasion, an informal chat with a manager resulted in this manager becoming interested and connected to part of the researcher's external network with the intention to explore possibilities and share knowledge. These behaviors are rather common and encouraged among NZ employees, who can be considered expert networkers that create a broad, informal network base to explore ideas and share knowledge and experiences.

At the organizational level, some networks are weak or bridging ties (Granovetter, 1973) which increase the exploratory power of the organization through access to larger exploratory pools in areas of interest at the periphery of the company. For instance, crowdsourcing with partners and collaborative crowd foresight - to explore business implications of early stage technologies - are channels established to pursue possible exploratory venues. Moreover, the company is present and active in as many online forums as possible where it can share and gain first-hand access to potential ideas or disruptive technologies. In this way, NZ actively engages in open source collaboration. One such open collaboration is the so-called "hacker-spaces", as explained by an innovation manager:

"...there are plenty of 'people out there' who are bursting with good ideas on new technologies and applications. They want to develop and realize these ideas in collaborative, knowledge-sharing and open source ecosystems"

The design of these weak ties has also changed over time, as explained by a senior science manager:

"We have moved from financial sponsoring to active engagement. These are new and exciting times for us where we explore open source collaboration... For us it is a paradigm shift because we are not aiming at creating and securing IP (Intellectual Property) here – it is exactly the opposite"

Evidence of strong external networks and collaborative agreements are also visible at NZ. Beyond exploring, these strong external ties intend to increase the adoption or success

rate of NZ exploration activities by aligning exploration with market needs. Since NZ's innovations are at the forefront of technology, many of its partnerships intend to create a market as much as a product. As noted by March (1991), one of the potential limitations of exploration (innovation, experimentation or discovery) is the uncertainty of their returns. For NZ, having close relationships with their long term customers assures that exploration occurs in areas that might be of common interest.

"We like to work with partnerships, so we align the pipeline to partners with compelling targets, where there is value for both NZ and the customer, and where there are technical possibilities and a chance to meet out common goals for the project within a reasonable timeframe" (executive VP for R&D, interview in Novozymes A/S, 2013b)

This potentially increases the likelihood for creating a market and customer's adoption (reduced uncertainty). At the same time, partners share the risks of exploration (financial costs, technological capabilities). The uncertainty of the potential winning technology also motivates changes in the structure of its partnership. NZ strategy is now one of impactful innovation through partnering along the entire value chain, which is markedly different to the previous strategy where *"NZ wanted to be the independent enzyme developer and provider that will be willing to sell enzymes to everyone"* (VP). The following statement from the CEO reflects on the new strategy at NZ:

"It is not enough to develop better performing, lower cost enzymes; it is also about bringing our internal research to our partner collaborations in order to develop a process that performs. We recognize that it will take many different feedstock and production processes for cellulosic ethanol to reach its full potential. Therefore, we have developed a broad partnership strategy in order to enable as many technologies as possible. This has allowed us greater insight into the cellulosic conversion work currently underway across the globe..." (CEO on intranet video, accessed August 2014):

In addition to partnerships with customers, joint ventures and investments in other companies (partial or complete takeovers) also form part of the exploratory activities used by the organization. Furthermore, the company actively tries to educate and influence public

opinion and government perception in areas in which it is exploring. By working with academia, NGOs and intergovernmental organizations, the aim is to “*encourage a balanced public debate and ensure that policy is scientifically based*” (R&D VP). This strategy further increases the likelihood of potential markets and future exploitation of its explorative efforts.

In their 2013 financial report, NZ explains the exploratory efforts in the last year aimed at expanding its portfolio of opportunities via joint ventures, partnerships and influence on governmental agendas:

“ In 2013, NZ focused its efforts on finding new opportunities by seeking closer working relationships with customers and expanding its reach through new partnerships, such as The BioAg Alliance with Monsanto [partnership in BioAg], M&G Chemicals [partnership that looks at producing bioplastics – plastics derived from renewable biomass sources] and Raízen [production of cellulosic ethanol in Brazil]. NZ has also set a long-term target to champion the inclusion of biofuels as a High Impact Opportunity in the U.N.-led Sustainable Energy-for-All initiative. The aim is to identify needs and provide biosolutions in new industries and to nurture NZ’ four key growth platforms: Biomass Conversion, BioAg, Animal Health & Nutrition and Biopharma. The company consistently seeks to turn opportunities into significant business that can sustain growth and returns over time”.

Hence, at the organizational level, we find evidence of a rich network of internal and external relationships and partnerships that underpins the basis for achieving organizational ambidexterity (Turner *et al.*, 2013). Consistent with Tiwana (2008), the evidence points to a complex and dedicated network of weak ties that bridge areas of knowledge outside the core competences of the organization. Given the highly uncertain nature of its business due to many competing technologies, this greater capacity to generate ideas and variance is not only a casual outcome but very much a well-defined strategy. To complement this exploration, strong ties with long-term customers and other contractual agreements assure exploitation of past collaborative efforts, and potential markets (future exploitation, uncertainty reduction) for current exploration. At the individual level, the evidence builds on recent work pointing to the important relationship between an individual’s network and its composition (e.g. formal or informal) in promoting ambidextrous behaviors (Rogan and Mors, 2014).

DISCUSSION AND CONSLUSION

This study has examined in detail how a large multinational firm operating in a complex and dynamic environment successfully balances exploration and exploitation. The findings indicate that NZ follows a complex yet deliberate strategy to achieve organizational ambidexterity. While prior work on ambidexterity has focused mainly on one type of design (e.g., contextual or structural), the study evidence supports the notion that many of these designs coexist at any given time. First, NZ continuously promotes an ambidextrous culture which is embraced on a daily basis by the individuals forming the organization. This approach is consistent with the contextual approach to ambidexterity (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004) or human capital mechanism for achieving organizational ambidexterity (Turner *et al.*, 2013). Second, a structural approach (Benner and Tushman, 2003; O'Reilly and Tushman, 2004) is also evident as for instance the R&D unit is dislodged from most of the exploitative tasks which fall under the production, finance or marketing units. Despite this separation of tasks, there are enough loose connections to allow the benefits of synergies, which extend beyond the connections at the top management level. Third, the findings also point to the dynamism and constant refinement needed in managing ambidexterity. The different structures, culture, processes and networks that support ambidexterity at NZ oscillate to assure continuous support in the face of changes in the competitive landscape and market conditions. The refinement in the design also supports differences in the life cycles of the various business units of the organization, as much as the life cycle of the organization itself. Figure 2 illustrates the role of dynamic organizational design in managing ambidexterity at NZ. The figure shows some examples of how parts of the design have changed over time, and the intended objectives of the changes.

Insert Figure 2 about here

Furthermore, the multilevel nature of organizational ambidexterity is evident from this case study. Consistent with organizational learning theory (Crossan *et al.*, 1999), ambidexterity is rooted in individual behaviors and attention to specific tasks and information. As exploration and exploitation behaviors move horizontally (across functional areas) and vertically (up the organizational hierarchy), structures and processes must be put in place to ensure ambidextrous outcomes. Our study illustrates how scenario planning processes may act as a mechanism for the integration of exploration and exploitation behaviors across functional and hierarchical levels.

Coordinating this dynamism and complexity in the ambidexterity design requires both adequate processes and active management. As pointed out by Birkinshaw and Gupta (2013), ambidexterity is achieved through good managerial capabilities, and this study uncovers some of those managerial decisions. The evidence points to several players actively engaged in managing ambidexterity through a variety of mechanisms and actions. The senior management team (executives) creates and modifies the adequate organizational context. For instance, through the core NZ values which allow individual behaviors to become ambidextrous (Birkinshaw and Gibson, 2004), by managing organizational synergies (O'Reilly and Tushman, 2004) or by introducing a performance culture to sharpen exploration and exploitation efforts. Goal setting was also observed from the executive management, with emphasis on sales growth and execution.

Most importantly, through ambitious external guidance on combined exploratory and exploitative organizational goals, senior management's chief role in managing ambidexterity is one of creating and accepting contradictions as an organizational mental frame. Internally, these contradictions are constantly reinforced (e.g. via internal webcasts) and the work force is motivated and aligned towards achieving those contradictory goals (e.g. organizational wide profit sharing plans with exploratory and exploitative targets on it). Additional evidence

of senior manager's inclination to contradictions is the temporary coexistence of two different scenario planning processes. Taken together, these findings support prior research theorizing on the role of contradictions in managing ambidexterity (Smith and Tushman, 2005) and provides insights into some of the mechanisms and actions used by senior managers in promoting these contradictions and ambidextrous mindsets.

Though the organizational context heavily encourages ambidextrous behaviors, the findings also point towards the encouragement and subsequent management of these behaviors from individuals at key positions within middle management. For instance, many of the exploratory initiatives brought forward by employees actively involved at different times with the scenario process were blocked as it did not fit the exploitative inclination of the process at hand. Taylor and Helfat (2009) brought attention to the important role of middle managers in the context of ambidexterity and the replacement of a company's core business with a new one. The evidence presented in this study extends these findings by pointing to the key role of middle managers in managing the dilemma of which ambidextrous behaviors are allowed to move up to the next level. Consequently, contrarily to arguments that place the decisions between alignment and adaptability on front liners (Birkinshaw and Gibson, 2004), we find it to be a continuous effort where ambidexterity is encouraged, but selectively nurtured, managed or blocked by middle managers. Hence, the evidence brings attention to the pivotal role of middle managers in actively promoting ambidexterity and exploratory behaviors, while at the same time selecting which proposals are allowed to move upwards in light of the needs of a specific unit, process or goal. Figure 3 shows the main actors that make ambidexterity happen along with their main responsibilities and decisions.

Insert Figure 3 about here

Raisch and colleagues (2009) identified the question of whether ambidexterity manifests at the individual or organizational level as one of the key areas in need of further research. In this case study, the findings indicate that ambidexterity is reflected at both the individual and organizational level because of the dynamism and flexibility in the structures to support continuously ambidexterity along with the managerial decision to shift, rearrange or control structures and behaviors.

The organization and individuals at NZ are ambidextrous because the individual behaviors and organizational designs are constantly managed and nurtured. For instance, ambidextrous behaviors can be easily discouraged and frustrated by organizational routines as reflected by the impressions of the participants of the scenario process. Managerial actions (blocking exploratory behaviors) can accentuate the discomfort with the process, but other managerial actions, such as promotions and rotations, alleviate these negative attitudes. Importantly, in the process the individuals instill enough exploration of new ideas and variation so that eventually the process changes to continue supporting organizational ambidexterity in line with its contemporary needs. Redesign of contracts, partnerships, networks, and so on is what rejuvenates the ambidextrous design at NZ. Without the managerial actions, ambidextrous behaviors and design today might become a source of organizational inertia tomorrow.

Together, these findings may explain the reported differences in the organizational ambidexterity-performance relationship found at different levels of analysis. Junni and colleagues (2013) found evidence that the relationship becomes stronger as the level of analysis increases from lower to more aggregate levels. Our case study highlights how NZ extracts organizational benefits from ambidexterity in terms of innovation and efficiency, which translates into strong corporate performance and innovation. However, at the individual/group level it may be harder to detect a direct relationship between ambidexterity

and performance. As noted, most individuals and groups reported frustration or even resentment in relation to balancing exploration and exploitation. Individuals (and groups) are typically assessed against objective, short-term measures of performance which tend to be based on efficiency (exploitation) rather than innovation (exploration). Moreover, as evidenced in the case, exploratory efforts are often blocked from reaching higher managerial levels. Together, these forces make the link between individual/group level of ambidexterity and (organizational) performance less clear. To what extent individual/group level ambidexterity is associated with individual/group level outcomes is research question ripe for future exploration.

Another interesting finding pertains to the role of networks in achieving ambidexterity. At the organizational level, NZ deploys a complex network of internal and external ties for explorative and exploitative purposes. Some of these ties are strong and involve collaborative agreements, contracts and partnerships which intend to reduce market uncertainty, risk, and increase future exploitation of current explorative efforts. Other network relationships are of the weak type (Granovetter, 1973), and are in place to explore, increase the peripheral vision of the organization and create variance in the exposure to new ideas, potential applications or technologies. Partnering through the value chain is a deliberate strategy. The goal is to have enough weak ties for new technology or product exploration at the front end, while also having enough strong ties for market development and penetration to allow explorative efforts to become exploited.

At the individual level, the evidence brings attention to the strong inclination of NZ's employees in creating an internal and external network of informal ties as basis for potential future collaboration. These findings shed new light on the behaviors that support ambidexterity at the individual level and build on recent work looking at the relation between individual networks and ambidexterity (Mom *et al.*, 2009; Rogan and Mors, 2014). For

instance, Rogan and Mors found that senior manager's (partners in their context) informal ties within the internal organizational network have a positive relationship to ambidexterity. Interaction effects show this relationship becoming significantly associated with ambidexterity only in the presence of informal external ties. The behaviors of individuals at NZ are consistent with these findings. Importantly, the case evidence also extends Rogan and Mors' work by showing how these behaviors are not only specific to senior managers (executives or partners) but rather exists across various hierarchical levels of the organization.

IMPLICATIONS FOR FUTURE RESEARCH AND STUDY LIMITATIONS

The findings of this study have several implications for future research. First, it contributes to organizational ambidexterity literature in particular by looking at the actors and decisions involved in managing ambidexterity, within the context where these decisions occur. In regards to the design of ambidexterity at NZ, this research addresses one of the central tensions in ambidexterity research, namely, the static versus dynamic perspective on ambidexterity (Raisch *et al.*, 2009). The case evidence indicates that ambidexterity is a highly dynamic phenomenon. Most of the configurations and mechanisms used for ambidexterity at NZ have changed during the last years, including the culture, networks, partnerships, strategies and reallocation of resources. Consequently, the research extend the simulations presented by Siggelkow and Levinthal (2003) and the empirical work on differentiated units' design by Westerman and associates (Westerman, McFarlan, and Iansiti, 2006) to suggest that continuous ambidexterity necessitates dynamic alignments and refinements given the needs of exploration and exploitation might be different over time. Further research may continue this line of inquiry and refine the findings by looking more closely at the different dynamics identified in this study, such as changes in the individual behaviors under contextual ambidexterity, or changes in the network structure needed to support ambidexterity.

The ability of an organization to renew capabilities and reallocate assets to meet new market opportunities is one of the key features of organizational ambidexterity. This translates into management making difficult choices pertaining to the often conflicting demands of exploration and exploitation. Yet, these choices are embedded within existing organizational structures and processes that span multiple organizational levels and functions. While an ambidextrous strategy necessitates simultaneous attention to exploration and exploitation, such simultaneity may not be required throughout the entire organization as certain functional subparts may pursue exploration more effectively while others drive operational efficiency (e.g. structural ambidexterity). By the same token, the roles of top versus middle management and beyond may differ markedly in terms of exploration and exploitation; however, this crucial point is often left unexplored within the context of ambidexterity research. Hence, as shown from the case evidence, the individual behaviors involved in managing ambidexterity might differ across hierarchical and seniority levels. Further investigation into these individual differences is a fruitful area to increase our understanding of the individual behaviors (e.g. micro foundations) that support ambidextrous organizations.

This study also contributes to the literature on scenario planning by providing a theoretical basis for understanding the strategic role of scenario planning. While the scenario planning literature has traditionally been mostly anecdotal and prescriptive (Burt and Chermack, 2008; Hodgkinson and Healey, 2008), this study illustrates how scenario planning can be understood as a mechanism for balancing exploration and exploitation. Contrarily to the expectation that scenario planning aids mainly in the acquisition of explorative learning, the findings suggest it mainly plays a role in fine tuning exploitative efforts. In light of the novelty of these results, further empirical research is encouraged to follow the steps of this research to extend and clarify the conditions under which scenario planning processes may act as a facilitator or inhibitor of organizational ambidexterity.

Conducting the study as a single case study has the acknowledged limitation that the interpretations and findings might be idiosyncratic to the case company and thus cannot be generalized to other organizations (Eisenhardt, 1989). For instance, NZ has enjoyed long periods of success and has at its disposal vast resources which might facilitate the deployment of different structures and strategies to explore and achieve ambidexterity. Similarly, NZ's industry is highly dynamic and uncertain given the competing technologies; consequently, this might put extra pressure on achieving ambidexterity as compared to organizations embedded in different industries. Additionally, the observations were carried out while the author was mainly embedded within the headquarters of the focal organization. Although great effort was put into interviewing individuals located away from the headquarters, most of the time was spent at the headquarters. It is possible that the behaviors of the individuals working in central offices are not reflective of the rest of the organizational behaviors. Future research should strive to validate the findings in other organizational and industry contexts.

Despite different measures taken to minimize limitations of the participant observation method used in this study, this method is susceptible to different biases (Dewalt, Dewalt, and Wayland, 1998; Yin, 2003). At the same time, given the nature and complexity of ambidexterity as it unfolds within an organization, further ethnographic research is highly encouraged. Future studies may seek to delve further into the intricacies of ambidexterity at individual and organizational levels by employing a mixed method design that combines the strengths of participant observations with large scale survey collecting information from employees across all levels of the organization. Additionally, comparison across multiple case studies over time may reveal interesting patterns of similarities and differences in terms of adoption and adaptation of ambidextrous strategies.

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Table 1
 Sample of informants by tenure, functional area and organizational hierarchy

Tenure		Functional area		Organizational hierarchy	
Years	Number of informants	Area	Number of informants	Hierarchy	Number of informants
0 to 3 years	6	R&D and supply operations	8	Directors and above, including executives	7
3 to 7 years	11	Marketing and Business development	10	Managers	11
7 + years	8	Business support and Finance	7	Analysts and support	7

Figure 1
 Informant's perceptions of the learning generated by scenario planning at NZ

Organizational learning genera		participants:Functional area = Bsns support and Fin....	participants:Functional area = R&D, patents and pro...	participants:Functional area = Marketing and Bsns deve....
1. Organizational learning exploration - SP	24	15	13	
2. Inadequate	22	9	10	
3. Adequate	2	6	3	
4. Organizational learning exploitation - SP	16	21	8	
5. Inadequate	1	0	2	
6. Adequate	15	21	6	

Figure 2

Dynamic ambidexterity: Organizational design, changes in time, and intended outcomes

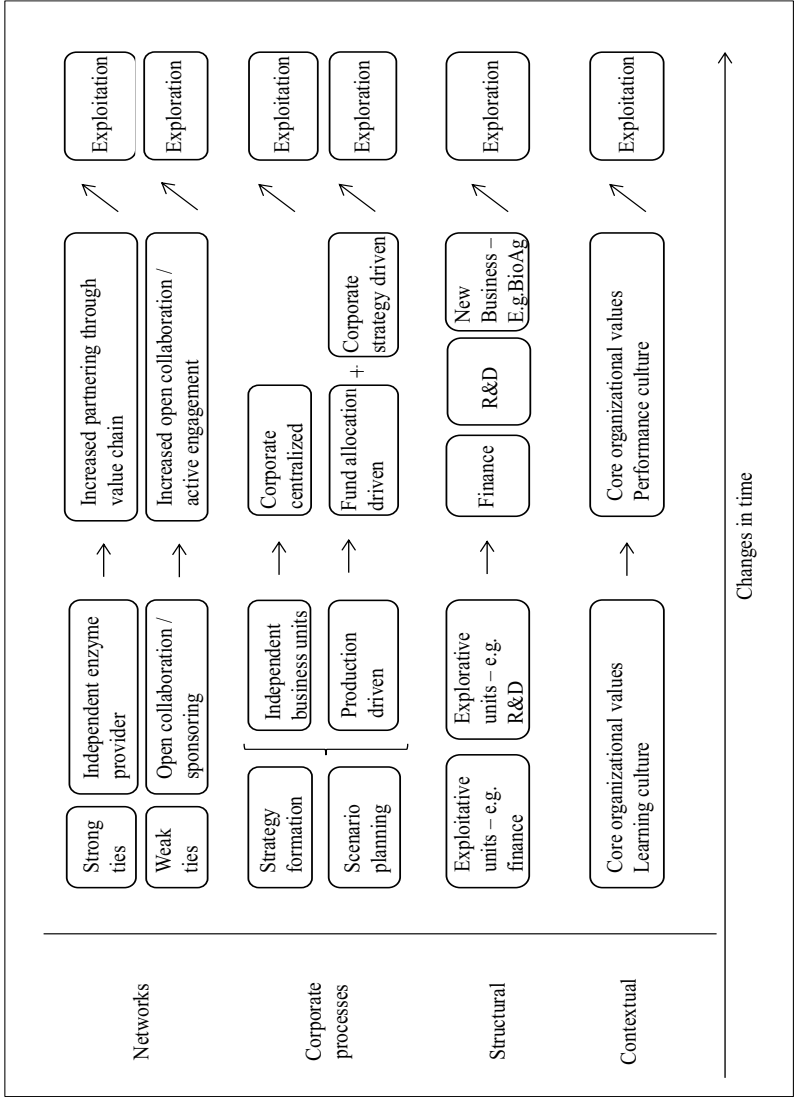
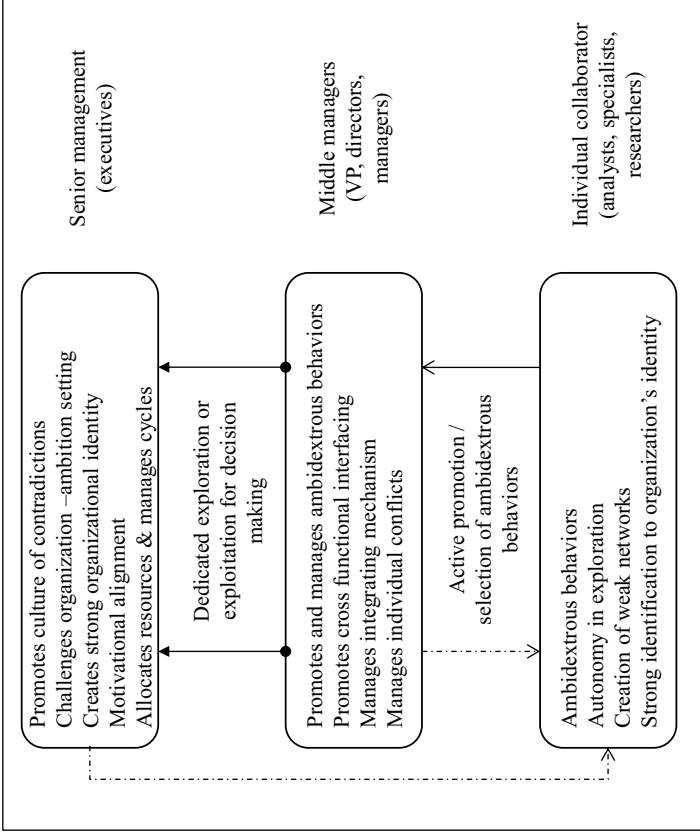


Figure 3
Managing ambidexterity: Actors and decisions



**Overcoming barriers to organizational learning: Integrating behavioral strategy
into the 4I organizational learning framework**

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ABSTRACT

Integrating behavioral strategy into the 4I organizational learning framework, we develop a theoretical model for overcoming the key barriers to organizational learning. We identify five barriers that constrain the dynamic flow of learning and examine two mechanisms for dealing with these barriers. Specifically, we analyze how particular cognitive and social psychological barriers interfere with the feed-forward and feedback processes in the learning system and propose *intervening* and *instigating* as new mechanisms that help break mental frames and promote continuous learning and innovation. The resulting theoretical model extends the 4I organizational learning framework to account for behavioral mechanisms that restrict and enhance the stocks and flows of learning. Moreover, we advance learning theory and practice by providing insights into how organizations may manage the tension between continuity and change (exploitation and exploration).

Keywords: Organizational learning; behavioral strategy; exploration and exploitation

INTRODUCTION

Organizational learning is critical for innovation and competitive advantage as it facilitates strategic adaptation and renewal (Argote, 1999; Crossan & Berdrow, 2003; Crossan, Lane, & White, 1999). The process of organizational learning is complex and involves dynamic processes through which the stock of learning flows between individuals, groups and the organization at large. Our understanding of these learning processes has been greatly advanced by the seminal work by Crossan and colleagues (1999), which identified intuiting, interpreting, integrating, and institutionalizing as the (4I) processes that allow learning to move forward or backward between individual, group and organizational levels. The utility of this theory of organizational learning (OL) has resulted in a number of theoretical extensions and empirical studies (Berends & Lammers, 2010; Crossan & Berdrow, 2003; Holmqvist, 2004; Lawrence, Mauws, Dyck, & Kleysen, 2005; Schilling & Kluge, 2009; Vera & Crossan, 2004).

For instance, Crossan and Berdrow (2003) utilized the 4I framework to empirically investigate strategic renewal at Canada Post Corporation and highlighted the challenge of moving learning across the organization as well as managing the tension between exploration and exploitation. Vera and Crossan (2004) augmented the 4I framework by highlighting the critical role of leadership style and described how behaviors and practices of leaders may influence organizational learning. In a further extension of this framework, Lawrence et al. (2005) linked intuition to discipline, interpretation to influence, integration to force, and institutionalization to domination, and provided important insights into the role of power and politics in organizational learning. More recently, Berends and Lammers (2010) focused on discontinuities in organizational learning as a function of embeddedness in social and temporal structures. In their longitudinal case study of implementation of knowledge management

in an international bank, these discontinuities were found to disrupt and fragment learning flows as well as limit institutionalization of learning.

Yet, although many of these studies highlight potential challenges to learning at various stages or places in the learning system, relatively little theory development systematically investigates the learning barriers and mechanisms for overcoming these. Building explicitly on the 4I framework, a recent review of the OL literature (Schilling & Kluge, 2009) provided a long list of barriers to learning but fell short of integrating these into OL theory (Crossan, Maurer, & White, 2011). The effect of such barriers on the flows of learning forward and backward through the learning system, and in particular how to neutralize them, remains unexplored. Moreover, the often-cited tension between exploration and exploitation continues to haunt organizations and OL theory is largely silent on how to reconcile these seemingly opposing forces. As noted by Crossan and colleagues (1999: 535) and reiterated by Crossan and colleagues (2011), understanding the mechanisms that enhance or restrict the stocks and flows of learning and addressing how organizations deal with the tension between exploration and exploitation represent two areas in particular need of improvement in order to advance a theory of OL.

This paper contributes to the further development toward a comprehensive theory of OL by integrating insights from behavioral strategy (Powell, Lovallo, & Fox, 2011) pertaining to cognitive decision biases and socio-psychological organizational behavior into the 4I framework of OL. The 4I framework provides a cogent and dynamic way of analyzing the OL processes, which simultaneously pays attention to multiple levels of analysis and the flows of learning (feed-forward and feed-backwards) between these levels. This framework points to four key processes of organizational learning; intuiting, interpreting, integrating, and institutionalizing. The tension between new ideas and actions (exploration) and what has already been learned (exploitation) is captured by the feed-forward and feedback processes in the learning system. We identify five specific behavioral and social

processes that constrain the acquisition and transfer of learning and examine how they influence the forward and backward learning flows. We also propose two new mechanisms for dealing with these barriers in order to open up learning flows.

First, drawing on cognitive and social psychology pertaining to the role of human biases, information processing limitations, and emotional responses (Bargh, 1989; Damasio, 1994; Dörner & Schaub, 1994; Fiske & Taylor, 1984; Hogarth, 1987; Kahneman, Slovic, & Tversky, 1982; Taylor & Fiske, 1978; Tversky & Kahneman, 1974) we introduce *intervening* as a mechanism for cognitive frame-breaking and reduction of ego defenses at the individual and group level. Prior research has discussed the role of interventions to facilitate change and routine breaking. For instance, the need for conflict (Beech, MacIntosh, MacLean, Shepherd, & Stokes, 2002), changes in top executives (Crossan & Berdrow, 2003) and managerial interventions such as crisis creation (Kim, 1998) have been identified as potential routes to creating organizational learning. However, these interventions have not been systematically integrated into OL theory. We identify and discuss three processes underlying the *intervening* mechanism and their effects on reducing learning barriers; (1) forcing discrepancies; (2) challenging of expert knowledge capacity; and (3) promoting dialogue and critical self-reflexivity.

Second, building on insights from the power and dependence perspective (Emerson, 1962), *instigating* represents the mechanism for ensuring learning is transmitted from individual to group and organizational levels. Consistent with Emerson's (1962) original focus on power in social relations, we argue that *instigating* is the mechanism that alters the power dynamics within the social context of organizational learning by empowering organizational actors who hold key resources; i.e. new information or capabilities. By changing the power dynamics, a strong barrier (power and politics) at the group and organizational level is neutralized and new individual or group learning is allowed to

flow into the organization. In this way, *instigating* serves to shift power dynamics and alleviates barriers of power and politics thus facilitating dissemination of learning throughout the organization.

While the 4I framework deals with organizational learning through the iterative processes of intuiting, interpreting, integrating, and institutionalizing, little attention is paid to how individuals access new (external) information in order to renew or invigorate the learning process. The theoretical model we advance allows for new information to enter the learning system at the individual level and subsequently move upwards to the organizational level. Furthermore, by identifying specific barriers to feed-forward and feedback learning processes – and designing mechanisms for overcoming these – we provide a more nuanced framework for understanding organizational learning as it unfolds over time across levels in practice. This helps advance OL theory by explicitly addressing the sources of tension between exploration and exploitation and how companies may deal with these (Crossan et al., 1999).

We begin with a short review of the 4I OL framework (Crossan et al., 1999) upon which we build our theoretical model, and examine how information flows into the model. Next, we turn to identification of the barriers to learning flows. Finally, we explore two mechanisms designed to alleviate the obstructions to learning and discuss contributions to theory and practice.

THE 4I ORGANIZATIONAL LEARNING FRAMEWORK

Pattern recognition: Bringing in new information

Organizational learning is a multilevel, dynamic process that naturally begins with individuals. Crossan and colleagues (1999) placed the responsibility for recognizing differences and similarities of patterns at the subconscious level of two types of individuals: experts and entrepreneurs. Expert intuition entails the recognition of known patterns building from previous experiences. Building from countless similar

situations, the expert recognizes a pattern and acts immediately. Conversely, entrepreneurial intuition identifies potential novel connections within the patterns which were not previously identified. Consequently, entrepreneurial intuition has a forward looking orientation (creativity, change, exploration) while expert intuition is backward looking (past knowledge, exploitation). Intuition is the beginning of learning and within the 4I framework this process is called *intuiting* (Crossan et al., 1999).

An important aspect in relation to *intuiting*, largely left unexplained, is precisely how new information enters the OL system. According to Crossan et al. (1999: 526), “intuition is the beginning of new learning” and it is the responsibility of the ‘entrepreneurs’ within the organization and their entrepreneurial intuition to “make novel connections, perceive new and emergent relationships, and discern possibilities that have not been identified previously”. Yet, while some individuals may possess such entrepreneurial and creative characteristics, they are more likely the exception rather than the norm (Kahneman & Klein, 2009). Moreover, intuition in most individuals is imperfect for two key reasons: the frequent use of easy to apply heuristics triggers biased judgments (Kahneman & Klein, 2009; Simon, 1987), and limitations of individual information processing abilities leads to use of schematic, automatic information processing (Walsh, 1995; Louis & Sutton, 1991). Paradoxically, both heuristics and schematic information processing are not necessarily negative (e.g. can economize mental resources) but may lead to crippling errors when acquiring information and making judgments of it (Tversky & Kahneman, 1974; Walsh, 1995). As noted by (Kahneman & Klein, 2009) when referring to intuition, “there is no subjective marker that distinguishes correct intuitions from intuitions that are produced by highly imperfect heuristics”.

A theory of OL must be grounded in realistic assumptions about human cognition and acknowledge the difficulty in recognizing relevant new external stimuli and bringing it into the learning system. Cognitive filters leads to new information to the learning system being filtered out and/or

difficult to recognize and absorb. The human tendency to use heuristics in their intuition and judgments biases the information in the learning system. We suggest that *intuiting* as the beginning of the learning system should be anchored in behavioral assumptions about human cognitive limitations and mechanisms for overcoming these limitations be developed in order to ensure continuous learning.

Cognitive mapping: Moving learning from individual to social context

For learning to move from the individual to the group level, ideas and knowledge must first be internalized and made explicit and transferable. This process of *interpreting* starts at the individual level as people try to make sense of and refine their ideas and embed them in the proper cognitive context before attempting to relay them to others at the group level. Whereas *intuiting* operates at the subconscious level, *interpreting* deals with the conscious efforts to make sense of the intuitions, either within the one-self, or by transmitting those intuitions into others. Crossan and colleagues (1999) stressed the importance of language for interpreting and transmitting ideas or insights to others (feed-forward). Cognitive maps are used as interpretive mechanisms to help develop individual and group understanding of intuition in relation to specific knowledge domains (Huff, 1990). Yet, the feed-forward process from *intuiting* to *interpreting* is fraught with challenges that may affect its effectiveness and these barriers are under-examined.

As learning moves from one individual to groups of individuals, the same human limitation in terms of information processing filters and tendencies to use heuristics are likely to affect *interpreting* as well. Information that moves through the scanning filters needs to be interpreted and given meaning through the process of sense-making or encoding, and this is a critical point of entry for cognitive biases (Duhaime & Schwenk, 1985; Schwenk, 1984). Moreover, emotions are likely to play an important role in individual interpretation of information as people actively attempt to shield

themselves from information that causes psychological discomfort (Karlsson, Loewenstein, & Seppi, 2009). This is because new information that conflicts with prior assumptions or beliefs forces individuals into unease, anxiety and active rejection of the new painful information (Hodgkinson & Healey, 2011). At the same time, power and politics arguably influence individual's motivation and ability to process information and interpret and share intuitive insights (Lawrence et al., 2005). Consequently, as learning is moving from the individual into the social group context, prior experiences and cognitive filters of a larger number of actors come into play, in addition to emotions and individual interests in the form of power and politics.

Shared understanding: Integrating learning organizationally

As learning moves from group to organizational level the focus shifts to the process of *integrating*. The goal of *integrating* is to develop a shared organizational understanding or “collective mind” (Weick & Roberts, 1993) of a phenomenon or an idea. Crossan et al. (1999) point to language, dialogue and storytelling as pivotal processes through which cognitive maps can be translated into group-level and ultimately organizationally shared understanding. While individuals learn by interpreting information and stimuli via filters based on their individual cognitions, values and experiences (Hogarth, 1987; Hodgkinson, 2003; Walsh, 1995), groups learn through interaction and collaboration on problem-solving. Research suggests that the process of feeding forward learning between groups and beyond may be challenged by administrative and political processes (Lawrence et al., 2005) as well as emotions at both individual and group level (Huy, 2011; Sanchez-Burks & Huy, 2009). While the 4I framework acknowledges the difficulties in moving learning from the individual into the group, better theory development about the barriers in the process of creating a shared understanding and specially, the means to overcome these is needed.

Given the power and politics inherent in organizational life (Das & Teng, 1999; Eisenhardt & Zbaracki, 1992), integration of learning via shared understanding may be seriously hampered by political agendas and power asymmetries among different groups (Miller, 1994; Lawrence et al., 2005). For instance, if the ideas of a group conflict with decisions made previously by others, this might be perceived as criticism (Weick, 1995). Moreover, different ‘thought worlds’ or ‘collectives’ who have a shared understanding in a domain may render integration difficult. For instance, different departments within an organization might find extreme difficulties in sharing ideas with other groups as the different sides may see other’s central issues as meaningless or incomprehensive (Dougherty, 1992).

In addition, emotions may propel individuals to use specific language or metaphors in their dialogues and conversations which will unintentionally bias group interpretation and integration of knowledge (Barsade, 2002; Smith, Seger, & Mackie, 2007). Group-focus emotions (e.g. in-group support and out-group confrontation) are felt privately by individuals and are linked to social identity (Smith et al., 2007). Social identities in groups are influenced by two underlying psychological processes: self-categorization and self-enhancement. Self-categorization minimizes in-group differences, and maximizes differences with other groups (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Self-enhancement relates to the human need of maintaining a positive image of the self in relation to others, thus comparisons among group members are made in ways that favor the in-group (Hogg, Terry, & White, 1995).

Within a group learning context, this is relevant as individual views that might be perceived as violating group norms might be self-marginalized and concealed thus effectively becoming a learning barrier for the organization. Between group emotions might also be a learning barrier. For instance, groups might decide to not share learning experiences with other groups within the organization if this will put them at a disadvantageous position or get insufficient recognition for their insights (Sun &

Scott, 2005). Thus, *integrating* within the 4I framework must address the effects of dominant groups, power and emotional responses within and between groups; all of which might bias or block the learning process.

Embedded learning: Institutionalizing into organizational routines

The final process in the 4I framework as articulated by Crossan and her colleagues (1999: 525) is the *institutionalizing* or embedding of learning into organizational routines (or memory) reflected in strategy, structure, procedures, and systems. *Institutionalizing* is what differentiates individual or group learning from organizational learning. As such, group level understanding of business practices are rolled out organization-wide in an effort to capitalize or exploit current knowledge in the future. Firms seek to design systems that enable such institutionalization for instance by building knowledge management systems to formalize information storing and retrieval (Nielsen & Michailova, 2007). Similarly, explicit procedures to ensure embeddedness of organizational routines can be established, for example in formalized strategic planning process, or in the use of control systems for measuring and monitoring organizational functions (Simons, 1994). The feed-forward process of developing such routines and ensure their institutionalization may, however, be constrained by several factors such as time or resources (Beer & Eisenstat, 2000; Sun & Scott, 2005). Moreover, the process of feeding backward institutionalized learning into the *intuiting*, *interpreting* or *integrating* processes is relatively under-investigated as are the potential barriers that may obstruct this learning flow. It is unclear, for example, how learning that is institutionalized avoids leading to organizational inertia.

An organizational cognitive structure is formed by three elements; identity, strategic frames and organizational routines (Narayanan, Zane & Kemmerer, 2010). Similar to the cognitive filters at the individual level, the organizational cognitive structure may hamper organizational learning. Once

shared strategic frames or dominant logic (Bettis & Prahalad, 1995) have been established, nonconforming points of views are likely to be discouraged or marginalized, which constraints organizational attention and capabilities (Janis & Mann, 1977). For instance, Miller (1994) reported how knowledge and suggestions residing within some groups at General Motors regarding small car manufacturing or pollution controls were rejected as this information went against entrenched beliefs within the dominant coalition of the company. Similarly, because organizational identity implies rules for exclusion, some practices, business initiatives or newly proposed avenues for improvement might not be allowed within the logic of the organizational identity (Narayanan et al., 2010).

Additionally, an organization's past success also reduces organizational attentiveness and incentives for looking for alternative ways of doing things (Levinthal & March, 1981). Research has shown how past success leads to institutional inertia, decline of information processing and scanning (Lant & Hewlin, 2002; Miller, 1994). In this way, existing organizational cognitive structures and past performance are likely to influence learning flows.

To summarize, the 4I framework is based on four main premises (Crossan et al., 2009); (1) organizational learning spans individual, group, and organization levels and is about moving stocks of learning forward or backward between these levels; (2) four broad categories of social and psychological processes – *intuiting*, *interpreting*, *integrating*, and *institutionalizing* (4Is) – provide the link between these levels; (3) organizational learning is associated with the tension between simultaneously exploring new knowledge and exploiting existing knowledge; and (4) cognition plays a pivotal role in the learning system as it affects actions and is affected by actions. -

As the discussion above illustrates, the framework proposed by Crossan et al. (1999) provides a strong foundation for understanding the basic processes of OL. Yet, as individual learning feeds forward in the OL system, there are numerous barriers that may hinder this process. Similarly,

institutionalized learning might prevent an organization's ability to renew itself by intuiting, interpreting and integrating new insights and thus the barriers in the feedback process must be identified and dealt with. In the following sections we examine the barriers to OL flows in more detail and propose two new enabling mechanisms – *intervening* and *instigating* designed specifically to overcome these. Figure 1 shows our conceptual model of adaptive organizational learning.

Insert Figure 1 about here

BARRIERS TO ORGANIZATIONAL LEARNING

Organizational learning is a dynamic process as evident by the continuous interplay between the feed-forward process of acquiring new learning and the feedback process of exploiting institutionalized learning (Crossan et al., 1999). With an inherent positive focus on dynamic multilevel learning advancement, OL theory has neglected to pay adequate attention to potential barriers to learning at each level and process. To be sure, the challenges of learning and its movement forward or backward have been acknowledged in the literature and specific elements of these, such as power and politics, analyzed in more detail (e.g., Crossan et al., 1999; 2011; Lawrence et al., 2005). Yet, despite recent attempts (e.g., Schilling & Kluge, 2009), little effort has focused on examining the sources of these barriers and integrating them systematically into OL theory (Crossan et al., 2011). This is a critical omission in our understanding of the tenets of OL theory as these barriers may at any point in the process hinder learning from being acquired or advancing in the learning system.

Our investigation of barriers to learning builds on behavioral strategy (Powell et al., 2011) to recognize that it is the psychological and social processes of individuals, embedded in groups and organizations that potentially obstruct learning flows. Specifically, “behavioral strategy merges

cognitive psychology with strategic management theory and practice” (Powell et al., 2011: 1371) and thus encompasses both individual level cognitive bases for human behavior as well as group and organizational level social processes. Building on these insights, we identify 5 behavioral factors which act as barriers to learning flows in organizations.

Individual cognitive limitations and biases [B1]

We begin at the individual level where information (new or experiential) is captured through *intuiting*. This *intuiting* process allows the individual to perceive certain patterns in diverse and disparate data, often in an unconscious way. Different people are likely to perceive such patterns differently. Intuition is shaped by individual personality as much as by an individual’s prior experiences (Behling & Eckel, 1991). The view of intuition being determined by personality traits builds on the work of Carl Jung who classified human personalities in four dichotomies, sensing-intuition being one of them (Jung, 1923). Jung defined ‘sensing’ individuals as having a preference for measurable facts while ‘intuitive’ individuals prefer hunches, inspiration and insights. Furthermore, research has provided support for two types of intuitive judgments; the analytical, and the intuitive or creative (Simon, 1987). As noted by Simon (1987: 58), “The primary evidence behind this dichotomy is that the two hemispheres [left and right in the human brain] exhibit a division of labor: in right handed people, the right hemisphere plays a special role in the recognition of visual patterns, and the left hemisphere in analytical processes and the use of language”. Intuitive judgments, however, are also grounded in knowledge and prior experiences. Bernard described intuitive judgment as having its source in “...psychological conditions or factors, or in the physical and social environment, mostly impressed upon us unconsciously or without conscious effort on our part. They also consist of the mass of facts, patterns, concepts, techniques, abstractions, and generally what we call formal knowledge or beliefs, which are impressed

upon our minds more or less by conscious efforts and study. This second source of non-logical [intuitive] mental processes greatly increases with directed experience, study and education...” (Bernard, 1938: 302, quoted in Simon, 1987: 58). Consequently, though intuition has a physiological dimension in the form of an inclination to intuitive thinking (e.g. experts and entrepreneurs as discussed in Crossan et al., 1999), much of this intuition is shaped by prior experiences, beliefs or contexts, all of which might be important sources of cognitive biases that may block new information from being acquired or from being moved forward in the learning system.

Intuiting is shaped by prior experiences, beliefs, contexts and cognitive orientation. In combination, these create a mental template or knowledge structure (Fiske & Taylor, 1984) which also affects *interpreting*. The concept of mental template lies at the center of theory driven information processing (Walsh, 1995). Information processing modes in individual cognition are seen as a continuum between controlled and automatic processes (Bargh, 1989). The controlled process is characterized by being effortful and active where information guides individual responses. Meanwhile, automatic processes are unintentional, autonomous and influenced by prior knowledge and perceptions (Bargh, 1989). The balance between these two processes varies depending on the task at hand (Hodgkinson, 2003). Given individual’s limited information processing capabilities and inclination to create economic tendencies (Hogarth, 1987), information processing in organizations is typically characterized by the dominance of automatic processing (Louis & Sutton, 1991). Importantly, while automatic information processing economizes mental resources and allows individuals to process a great deal of information, its overreliance can also limit the individual’s understanding of the environment by giving way to some problematic actions such as stereotype thinking, inaccurate filling of gaps, refusal to abandon cherished hypotheses, and inability to produce creative problem solving (Hodgkinson, 2003).

Interpretation processes are also subject to biases because individuals are selective rather than comprehensive in how they perceive information, and see what is expected to see and consistent with previous held beliefs or experiences (Hogarth, 1987). These simplified representations of reality (mental templates) become encoded within the mind of the individual, acting as filters through which information is processed (Hodgkinson, 2003). Knowledge structures, core beliefs, causal maps and schemas are some of the cognitive filters used by individuals (Walsh, 1995) which give meaning to environmental changes and in turn are linked to organizational action (Nadkarni & Narayanan, 2007). Therefore, the way individuals act is driven by how they interpret the world, which might be a biased or distorted interpretation.

Extant research points to some of the cognitive biases and information processing limitations of individuals within organizational settings, such as categorization of environmental factors in automatic and stereotypical ways (Barr, Stimpert, & Huff, 1992; Louis & Sutton, 1991; Porac & Thomas, 1990; Prahalad & Bettis, 1986), reliance on obsolete cognitive maps (Hodgkinson, 1997; Hodgkinson & Maule, 2002; Reger & Palmer, 1996; Schwenk, 1995), along with the problems that heuristics cause on managerial judgments (Bardolet, Fox, & Lovallo, 2011; Camerer & Lovallo, 1999; Durand, 2003; Hodgkinson, Brown, Maule, Glaister, & Pearman, 1999; Kahneman et al., 1982; March & Shapira, 1987; Tversky & Kahneman, 1974). Consequently, *interpreting* is a critical process where cognitive biases may influence learning flows.

Intuiting and *interpreting* are potentially hampered by these cognitive biases affecting individuals. To begin with, the cognitive filters (e.g. mental frames) used to acquire and interpret information might be dated in changing environments. Given the tendency towards automatic information processing, *intuiting* and *interpreting* are severely diminished, or at best biased towards known information. Although 'entrepreneurs' might have an inclination to see some of the novel pieces

of information and make some new connections, they are also inhibited by their own experiences and beliefs. However, even if new information is brought in by ‘entrepreneurial intuition’, this information still needs to be shared and interpreted by other individuals that do not necessarily show entrepreneurial inclinations. In fact, research has shown that ideas brought forward by innovators are usually resisted and their innovative initiatives blocked by other organizational members (Kirton, 1976, 1984).

In sum, (1) individual mental models will determine which information will receive attention, and people are expected to focus their attention on cues that are recognized or offer support to current mental models while other important information pointing to changing environments might be ignored (Kiesler & Sproull, 1982); (2) even if perceived by the process of intuiting, information will subsequently be interpreted under the lenses of the current mental models (Dutton & Jackson, 1987); and (3) dated mental model will hamper transfer of information and action as potential solutions will be analyzed and constrained to the ones that fit the current metal models (Bateman & Zeithaml, 1989; Duhaime & Schwenk, 1985). Thus, we propose:

P1: Individual cognitive limitations and biases may obstruct the feed-forward learning processes of intuiting and interpreting.

Emotions [B2]

The strategic management literature has mostly ignored affective and emotional aspects of human beings, mainly portraying decision making as a series of sequential, analytical and dispassionate activities (Hodgkinson & Healey, 2011). However, individuals are not only exposed to biases and cognitive limitations; emotions also play an important role in individual-level thinking and behavior (e.g. Damasio, 1994). Research shows that people actively attempt to shield themselves from

information that causes psychological discomfort (Karlsson et al., 2009). In this way, new information that conflicts with current assumptions forces individuals into unease, anxiety and active rejection of the new painful information (Hodgkinson & Healey, 2011). Further, reaching a decision in face of different perspectives and dilemmas is likely to create anxiety for the decision maker. Therefore, people tend to avoid active engagement through various responses (fast categorization, procrastination, excessive information seeking or hyper vigilance, and reaching a contrived solution) in order to eliminate the stress and discomfort of cognitive dissonance (Janis & Mann, 1977) created by the uncertainty (McKenzie, Woolf, Winkelen, & Morgan, 2009). Hence, emotions may act as a barrier to individual learning by actively blocking or ignoring cues where disconfirming information might reside. In this way, emotions affect individual ability to *intuit* novel patterns or rationalize away uncorroborating information during the process of *interpreting*.

While the influence of emotions on cognition and behavior is well established, the link between emotions and higher level outcomes, such as group and organizational learning and renewal, is less apparent. Emotions have been linked to organizational change (e.g. Huy, 1999, 2002), but the processes through which emotions impact the flow of learning from individuals to groups and beyond are poorly understood. As learning moves forward through *interpreting*, emotions may influence how information is being attended to. Learning can provoke emotional responses such as defensiveness, anxiety, fear or retrenchment as much as excitement or motivation towards new possibilities (Vince, 2001). However, as learning moves from the individual into group, the focus of these emotions is the social context and interaction of its members, much in line with the essence of behavioral strategy (Powell et al., 2011).

As interpretation involves cognitive efforts to attach meaning to the patterns recognized in the earlier stage with the purpose of communicating this to others, collective emotions might surface during the *interpreting* stage. Evidence from social psychology shows that emotions spread among

individuals within a group, creating clusters of shared emotions (Barsade & Gibson, 1998; Brief & Weiss, 2002). Collective emotions are important as these can precipitate either action or inaction (Huy, 2002; Sy, Côté, & Saavedra, 2005). Moreover, in an organizational context, emotions may run high in times of crises (e.g., downsizing) or radical change but the emotions are likely to differ among individuals (Barsade, 2002; Sanchez-Burks & Huy, 2009). As a result, the influence of such contextually bound emotions may lead to information being interpreted differently. To the extent that emotions are causing certain information to be perceived positively or negatively at the expense of other information, it biases the learning process, thus providing a potential barrier to forward learning flows.

Extant research has provided powerful evidence of group-level (collective) emotions and its impact on collective behavior (e.g., Smith et al., 2007). Grounded in social identity theory (Turner & Oakes, 1986), affiliation and strong identification with a social group may elicit collective, group-focus emotions. Consistent with multilevel theory (Klein & Kozlowski, 2000), employees within a social group (e.g., team, department, or firm) likely experience emotions that are more similar to other individuals within that social group compared to individuals outside that group (e.g., members of another team, department, or firm). Organizational identity research points to the shared beliefs and culture of an organization that makes up its 'character' and often evoke collective emotional responses to situations when the organization faces events that may impact the welfare and identity of the organization. Such group-level social identities are shaped by self-categorization (Turner et al., 1987) as individuals think and act as embodiments of the relevant in-group; thus minimizing in-group differences while maximizing inter-group differences. Valuing social group identity can elicit positive emotions while devaluing it may arouse negative emotions (Mackie, Devos & Smith, 2000). To this end, Huy (2011) showed how social identities among a group of middle managers facilitated aroused

emotions that led them to support or covertly dismiss a particular strategic initiative even when their immediate personal interests were not involved. Thus, collective emotions play an important role in group behavior towards other groups or the organization at large (Barsade, 2002; Mackie et al., 2000).

The emergence and impact of group-emotions may play a critical role in how learning is translated and integrated into a shared understanding at the group and organizational level. For instance, Vince (2001) showed how organizations might exhibit severe disruptions to the learning process as emotional responses such as envy, mistrust, or personal dislike were tangible across different organizational groups. These group emotions blocked effective communication across units creating an inefficient learning context dominated by mistrust. Ultimately, communication was avoided and separateness was not only justified but also protected. Naturally, *integrating* learning in such contexts is all but impossible. Hence, emotions, either individual or collective, may act as powerful barriers to organizational learning, especially in the *intuiting*, *interpreting* and *integrating* learning processes:

P2: Individual and/or collective emotions may obstruct the feed-forward learning processes of intuiting, interpreting and integrating.

Power and politics [B3]

The important role that power and politics play in organizations has long been recognized. For instance, Pfeffer (1981) provided an overview of the different forms of power in organizations and asserted that a critical source of power is the access to and control of critical resources. Organizations are political systems (Eisenhardt & Zbaracki, 1992) where individuals have an inclination to self-preservation and consensus building, and where the most powerful group usually determines the final decisions (Das & Teng, 1999). In the OL literature, Lawrence and colleagues (2005) referred to power

and politics as the ‘social energy’ necessary for promoting learning processes. Recognizing the complex role of power and politics, Lawrence et al. (2005:188) stated that “...power and politics are not a dysfunctional aspect that needs to be remedied but, rather, are an intrinsic part of the process that should be appreciated and understood...” We argue that power and politics may impede learning as powerful individuals will tend to allow learning to move upwards in the feed-forward process of learning only if it is beneficial to their political agendas and careers. As a result, new learning that goes against their interests will be blocked and the learning process will be biased.

Extant research recognizes the importance of power and politics for organizational learning (Blackler & McDonald, 2000; Coopey & Burgoyne, 2000; Fox, 2000; Lawrence et al., 2005). For instance, Lawrence and colleagues (2005) explicitly built on the 4I framework and argued for specific types of power being more salient during the different processes of OL. Specifically, *intuiting* is linked with discipline, *interpreting* with influence, *integrating* with force, and *institutionalizing* with domination. These different types of power will influence the learning flow of the organization by deciding which learning flows are restricted or allowed to move on, depending on the political interests of different organizational actors. Lawrence and colleagues differentiated between episodic and systematic forms of power. Episodic forms, such as influence and domination, are sufficient for moving or restricting learning during *interpreting* and *integrating* – e.g. by timing the opportune moments for exerting these forms of power. Conversely, systematic forms of power - for instance by laying out manufacturing plants or designing information systems - are necessary for continuously supporting patterns of practice that will affect the OL processes of *institutionalizing* and *intuiting*. Consequently, organizational learning is affected by different forms of power, some of which are timed and episodic, while others are built into systems and routines and thus exert their purposes without the constant vigilance of the interested actor(s).

Additionally, the influences of the upper echelons of the organization will interfere with organizational learning by directing which cues to attend to. Incomplete and inaccurate scanning can be the product of top management team (TMT) focus as their attention is with topics they deem most relevant while others get selectively ignored (Bogner & Barr, 2000; Daft & Weick, 1984; Hambrick & Mason, 1984). In other words, TMT attention focus and causal logics act as organizational filters for noticing and responding to environmental changes (Nadkarni & Barr, 2008). The power of TMT members combined with lack of influential skills of lower level employees might prevent the opportunity to make sense of a situation by other organizational groups (Maitlis & Sonenshein, 2010). Consequently, *interpreting* will be biased towards the interests of these powerful individuals.

Similarly, as shown by Siggelkow and Rivkin (2006) the OL process of *integrating* can be affected by political or personal interests. The authors investigated if decentralized exploration at lower levels combined with higher level coordination will foster organizational exploration (feed-forward learning). It was expected this combination would be fruitful to organizational exploration given the proximity of lower level managers to environmental realities and better positioning to see new alternatives as compared with the upper echelons. Instead, the authors found organizational exploration suffered as lower level manager followed their own interests and blocked exploration in areas that did not fit their own goals or interests (Siggelkow & Rivkin, 2006). Proposals against their interests were screened out or concealed from senior management. Therefore, more exploration at lower levels can actually decrease firm level exploration, illustrating how politics and power may be harmful to the *integrating* process of feeding forward exploratory learning. Moreover, *institutionalizing* is also greatly affected by power and politics as the views of powerful individuals or coalitions will have great impact on which (and how) particular learning becomes organizational routines. Hence:

P3: Power and politics may obstruct the feed-forward learning processes of interpreting, integrating and institutionalizing.

Organizational cognitive structure [B4]

The previous three barriers block learning from feeding forward in the learning system. We now turn to two factors that may obstruct the feedback learning process after learning has been institutionalized. The first barrier is organizational cognitive structure which refers to relatively stable patterns and characteristics of organization behavior. Organizational identity, strategic frames and organizational routines are the elements that form the structure of strategic cognition in organizations (Narayanan et al., 2010). Crossan and colleagues (1999) identified the potential inhibiting effects of institutionalized learning on exploratory learning; “This [to allow intuitive insights and actions to surface and be pursued] is extremely difficult because the language and logic that form the collective mindset of the organization and the resulting investment in assets present a formidable fortress of physical and cognitive barriers to change”. However, they referred mainly to “systems, structures and routines” (Crossan et al., 1999: 530) as representations of institutionalized organizational learning. Building on organizational behavior and strategic cognition, we offer a more nuanced account of institutionalized learning and the potential constraining effects on new learning.

Organizational identity is the organization member’s collective understanding of central and relative permanent features of the organization (Albert & Whetten, 1985). Since identity implies rules for exclusion, some practices, business initiatives or newly proposed avenues for improvement might not be allowed within the logic of the organizational identity (Narayanan et al., 2010). Consequently, a shared identity provides an anchor for organizational meaning construction (Maitlis & Sonenshein, 2010) and strong organizational identities might result in cognitive inertia (Hodgkinson, 1997; Reger &

Palmer, 1996). As noted by Gagliardi (1986), learning is usually restricted by the organization's efforts to preserve its identity.

Similar to how individual mental frames affect individual learning, organizations also possess strategic mental frames which can constrain their ability to learn. Organizational level frames or dominant logic (Bettis & Prahalad, 1995) take time and energy to construct, but once consensus is achieved, there is substantial inertia in changing that frame. Dated strategic frames are usually reused automatically to interpret current issues or information cues, whether adequate or not (Corner, Kinicki, & Keats, 1994). Consequently, once a dominant logic or collective mental frame is established, it creates blind spots by providing a framework that dictates the organization's orientation towards change and innovation. This, in turn, increases the chances for incorporating a related or similar strategy in the future (Hutzschenreuter & Kleindienst, 2006), while ignoring changes in the environmental conditions until those changes are so significant and far-reaching that the organizations' adaptation is seriously undermined. In this way, when 'groupthink' (Janis & Mann, 1977) or consensus becomes institutionalized, non-conforming views are discouraged or marginalized thus hampering learning.

Organizational routines are repeatable patterns of independent behavior often used to accomplish organizational tasks (Feldman, 2000). Routines involve information processing but economize on cognition as prevailing strategic frames dominate cognitive processes (Narayanan et al., 2010). Because organizational routines favor standard operating procedures over systematical analysis of alternatives (Eisenhardt & Zbaracki, 1992), such routines tend to have a constraining effect on individual thinking and learning (Crossan et al., 1999; Teece, Pisano, & Shuen, 1997). Strategic planning is an example of institutionalized learning that often fails to generate new learning or actions (Mintzberg, 1978, 1994). Instead, it may lead to strategies that are resistant to change (Janis & Mann,

1977). Hence, using routinized processes to exploit prior learning may act as a barrier to explorative organizational learning. Consequently, an organization's identity, its strategic mental frames and routines are important factors that might block organizational learning:

P4: Organizational cognitive structure may obstruct the feedback learning processes of intuiting, interpreting, and integrating.

Past performance [B5]

Interpretation of an issue is path dependently influenced by prior experience with the issue at hand (Martins & Kambil, 1999). Past successful performance can be detrimental to organizational learning, because it creates 'psychological slack' in managers leading them to overestimate their capabilities and create overconfidence in the probability of future success (Milliken & Lant, 1991). Therefore, firms with a history of success may lack the motivation to pursue different strategies. According to Miller (1993), firms that have experienced success in the past are more inclined to become one-dimensional by focusing for instance on a single goal, strategy or world view. Successful past strategies or actions can also create slack resources. This subsequently may hinder an organization's ability to adapt to external environments because slack creates a buffer between the organization and environmental changes. Since environmental changes are often seen as temporarily or unimportant, the company does not react to them but rather prefers to wait them out (Meyer, 1982; Milliken & Lant, 1991). Consequently, past success reduces incentives to look for alternative ways of doing things, thus leading to status quo or organizational inertia (Levinthal & March, 1981). Information cues or signals that will suggest the need for change will be ignored, information gathering will suffer (Miller, 1994) and learning will be transformed into 'superstitious learning' where any future good performance will be

attributed to any factor management feels inclined to (Levitt & March, 1988). As a result, there is an inclination in successful organizations to not change what has worked in the past; to exploit rather than explore (Levitt & March, 1988; March, 1991).

Hence, past organizational success may hinder *intuiting* for instance by ignoring potential sources of information to better understand the reasons behind environmental changes. *Interpreting* and *integrating* will also be affected by past performance as the new information, if acquired, will be interpreted under the current successful dominant logic. Thus, information that contradicts the current strategy will be rationalized as a temporarily fluke that can be waited out. In contrast, bad performance is generally supportive of organizational learning and strategic renewal as there is incentive to revise the reasons for the failing current strategy (Boeker, 1989; Huff, Huff, & Thomas, 1992). Thus:

P5: Past (positive) performance may obstruct the feedback learning processes of intuiting, interpreting, and integrating.

Insert Table 1 about here

Table 1 summarizes the barriers and their impact on learning flows across organizational levels. In developing these barriers to learning we recognize that organizational learning does not follow a natural, uninterrupted flow from the individual to the organization at large; there are many obstacles that learning flows might encounter as it moves forward and backward and the barriers we identify are not exhaustive (Berthoin-Antal, Lenhardt, & Rosenbrock, 2003; Crossan & Berdrow, 2003). For instance, Lam (2007) highlights the importance of an individual's (e.g. a scientist) career structure in understanding his or her motivation in firm level R&D collaborative projects with external partners. Lack of alignment might disturb the learning flow thus preventing the organization from fully

benefiting from the external collaboration. However, rather than presenting a long list of potential barriers we have focused on 5 socio-psychological barriers that in our opinion deserve particular academic attention. The 5 barriers have been placed along the learning process where we believe their effects are most predominant; however, given the complexity and dynamism of organizational learning along with the many feedback loops it entails (Crossan et al., 1999, 2011), these barriers may also affect other sub-processes of the OL system.

The first three barriers leverage behavioral strategy (Powell et al., 2011) to recognize that organizational learning is mainly a social interaction process predicated on human behaviors in a social context. These three barriers (individual cognitive limitations and biases, emotions, and power and politics) affect primarily the feed-forward process of OL. Learning starts at the individual level, and our first two learning barriers [B1] and [B2] recognize the limitations of humans in recognizing – *intuiting* - new patterns among the many information cues available, and correctly make sense – *interpreting* – of such information. Cognitive limitations and biases [B1] is rooted in past experiences and automatic information processing and is operating unconsciously. Emotions [B2], on the other hand, represent a conscious process of actively avoiding or hiding information, which also affects *integrating* of understanding throughout the organization. Power and politics [B3] is an important barrier that gets more tangible as learning moves from the individual into the group and the organization, and finally becomes organizationally embedded via *institutionalizing*.

The last two barriers, organizational cognitive structure [B4] and past performance [B5] are present in the feedback process of OL. These two barriers represent the effects of institutionalized learning on new learning – the tension between exploitation and exploration (March, 1991). In line with Crossan and colleagues (1999), routines and structures affect new learning; however, organizational cognitive structures [B4] are expanded to include identity and strategic frames as further

barriers to new learning. Past performance [B5] represents the path dependency of organizational success, which may act as deterrent to exploratory learning due to the slack resources it has created, and the lack of motivation to change individual and organizational habits and strategies that have worked well in the past.

OVERCOMING BARRIERS TO LEARNING: INTERVENING AND INSTIGATING

Identifying barriers to learning is important only to the extent that such barriers can be integrated meaningfully into a theory of OL and – perhaps more importantly – mechanisms be designed to overcome these barriers. As noted earlier, the extant literature has remained curiously silent on how specific barriers to learning flows may be surmounted. This section develops two specific processes through which firms may seek to avoid or lessen the potential negative effects of the behavioral and social barriers identified above.

Intervening

Enticing shift in information processing mode. Our starting point is the early stages of the learning system where individuals' effort at recognizing patterns via *intuiting* and posterior *interpreting* is obstructed by cognitive limitations and biases [B1] as well as emotions [B2]. To reduce these barriers we introduce the process of *intervening*. According to information processing theory (Bargh, 1989; Fiske & Taylor, 1984; Taylor & Fiske, 1978), there are two main information processing modes in humans; one being automatic, effortless and influenced by prior knowledge – top down or theory driven; the other being controlled – bottom up or reflective. Most organizational tasks are performed under automatic processing (Louis & Sutton, 1991), which economizes mental resources but might

hinder learning. *Intervening* acts as mechanism for switching cognitive gears from automatic to conscious information-processing; top down shifting in information processing mode.

By engaging in conscious information-processing, individuals are more likely to notice new patterns in the environment and interpret them away from engrained mental schemas and past experiences regularly used as interpretation filters. However, switching to a conscious mode implies the inclination or motivation to learn. Yet learning, especially if the new learning goes against preconceptions, might create anxiety and activate ego defense mechanisms (Brown & Starkey, 2000). By the same token, noticing a threat can block learning. If a threat is perceived, managers rely on fewer sources of information (Smart & Vertinsky, 1984) and emphasize cues consistent with current, known frames. Such behavior, in turn, will propel organizations to cling to known routines thereby causing rigidity in strategic responses (Staw, Sandelands, & Dutton, 1981). Hence, even if individuals do notice discrepant information, they are likely to make sense of (*interpreting*) it by reverting back to automatic information processing when changing to a conscious process is necessary. As noted by Luis and Sutton (1991: 71); “cognitive errors occur and problems result not because people rely on cognitive structures and engage in automatic processing. Rather, errors occur because people fail to recognize the presence of conditions in which they should switch cognitive gears into active thinking”.

Louis and Sutton (1991:60) identified three conditions under which individuals are likely to become consciously engaged. First, experiencing a novel or unusual situation – “something that stands out of the ordinary” – is likely to engage the individual into a conscious processing mode. Second, switching is provoked by discrepancy – “an unexpected failure, a troublesome situation, a significant difference between expectations and reality”. Third, a deliberate initiative is usually a response to an external or internal request – “trying something new”, or when people are “explicitly questioned”.

Intervening is the process of enticing individuals to actively shift cognitive gears from an automatic mode to a conscious mode by creating novel situations, forcing discrepancies, or provoking deliberate initiatives. In doing so, individuals are more likely to perceive discrepant information or novel information (*intuiting*) and process it (*interpreting*) free of filters characteristic of automatic information processing.

Challenging expert knowledge adequacy. In addition to promoting cognitive gear shifting, *intervening* challenges expert knowledge adequacy. As argued earlier, expert intuiting is valid in stable environments with clear rules yet not adequate for changing business environments. As the organizational circumstances change, mental frames need to be updated accordingly. Recent research on schema emergence identified deconstruction of existing schemas as a key step in the formation of new schemas (Bingham & Kahl, 2013). By challenging potentially dated individual and organizational mental frames new configurations and relationships of the business environment emerge. New connections can be made and information cues might be interpreted differently. The overall effect of deconstruction is thus the broadening of relationships and categories (Bingham & Kahl, 2013). By challenging current frames or schemas, biases such as overconfidence or extreme commitment to current strategies might be reduced. Since individual mental frames affect *intuiting* and *interpreting*, challenging these frames enhances organizational learning.

Promoting dialogue and critical self-reflexivity. Strategic adaptation requires the critical self-assessment of an organization's core premises, which is captured by its identity (Hurst, Rush, & White, 1989). However, such self-assessment is stalled by inclinations to maintain individual and collective self-esteem by not questioning prevailing self-concepts. Ego defenses protect self-concepts and learning is not a motivation as it might entail anxiety provoking identity change. Information that

threatens individual or collective identity is often marginalized, ignored or even concealed. Therefore, organizational learning must prepare individuals to challenge the group or organization's identity. Thus, the understanding and mitigation of ego defenses through the promotion of dialogue and critical self-reflexivity enables organizational learning (Brown & Starkey, 2000). This can be facilitated in an organization with a culture of dialogue as this helps people share their anxieties in an environment where it is acceptable to express doubts. In this way, doubts become a catalyst for learning. In a culture that promotes dialogue, reflexivity and learning, questioning beliefs and updating mental frames is more likely; thus improving the learning processes of *interpreting* and *integrating*.

In sum, the process of *intervening* mainly counters individual cognitive limitations and biases [B1] and emotions [B2] associated with the feed-forward learning processes of *intuiting*, *interpreting* and *integrating*. It does so by (1) enticing cognitive gear shifting towards a controlled mode in relation to information processing, (2) challenging expert knowledge capacity, and (3) promoting dialogue and critical self-reflexivity:

P6: Intervening helps alleviate the negative effects of [B1] individual cognitive limitations and biases and [B2] emotions on the feed-forward learning processes of intuiting, interpreting and integrating by (1) enticing shifting towards controlled information processing mode, (2) challenging expert knowledge adequacy, and (3) promoting dialogue and critical self-reflexivity.

Instigating

Intervening has limited capacity to move learning forward to the organization level because power and politics [3B] act as a powerful barrier to learning. We agree with Lawrence and colleagues (2005) that

power and politics are “an intrinsic part of the [learning] process that should be appreciated and understood..”. To this notion, we add that it must also be managed in order to facilitate organizational learning. If power and politics are not addressed, powerful individuals may allow learning to move upwards only if beneficial to their careers or political interests. Ultimately, organizational learning becomes a truncated or biased exercise. *Instigating* addresses this learning barrier and thus allows learning to move from the individual level to the group and the organization at large. Consequently, *instigating* is directed mainly at the processes of *integrating* and *institutionalizing* within the 4I learning framework.

Theoretically, *instigating* builds on sociology. Specifically, we draw from Emerson’s (1962) seminal paper on power dependence relations. Emerson’s bargaining power and dependence perspective has been generalized to the organizational level (Pfeffer & Salancik, 1978) and applied to inter-organization learning (Harrigan & Newman, 1990; Holmqvist, 2004). In line with the essence of bargaining power and dependence (Emerson, 1962), we apply power dependence relations to the social setting inside the organization. In bringing the level of analysis within the organization, we also remain true to our overall intention to insert human behavior and social dynamics (behavioral strategy) into a framework for organizational learning.

According to Emerson (1962: 32), power to control or influence the other resides in control over the things the other party value; that is: “power resides implicitly in the other’s dependency”. By recognizing the reciprocity in social relations in general and specifically inside an organization, a power – dependence relationship among organizational actors hinges on the dependency of the actors over the resources possessed by other actors, and in the actors’ ability to shift those power relations through *balancing operations*. Emerson (1962:34) defined balancing operations as “structural changes in power-dependence relations which tend to reduce power advantage”. Emerson identified four types

of balancing operations which are dominant in social relations. Specifically, a power structure can be altered by 1) motivational withdrawal of the weak party, (2) extension of power network by cultivation of alternative social relations, (3) giving status to highly valued members, and (4) coalition or group formation. In the first balancing operation, weaker actors will move away from social relationships which are unbalanced to their disadvantage. In the second, the extension of a power network reduces the power of stronger actors. In the third balancing operation, giving status to highly valued members increases this member's power to control formerly more powerful members. The last balancing operation increases the power of weak actors through collective actions.

For the purposes of altering the power balance of parties that might block information within the context of organizational learning, we focus on the third balancing operation – giving status and formal authority to valued members. In our learning context, valued members are the ones with a powerful resource: new information, insights, or knowledge. Such new information or learning might upset powerful individuals which hold authority and power and, given the unbalanced power structure of organizational life, learning will be blocked from moving forward. Consistent with the first of Emerson's (1962) balancing operation, the (less powerful) members with the valuable information will eventually withdraw their motivational investment from the group or organization; for instance by losing interest in pursuing further exploratory learning. Instead, these members might comply with the status quo or become frustrated and eventually leave the organization. Under these conditions of social interaction, exploration of new possibilities that go against the status quo or interest of powerful individuals is severely reduced, challenging the learning processes of *integrating* and *institutionalizing*.

Instigating is a power balancing mechanism where formal authority is given to an individual or organizational group with the mandate to explore and challenge strategic frames and organizational identity – i.e. to instigate or activate exploration at the organizational level. An individual or group

alone cannot explore on behalf of an organization; however, this individual or group has the formal authority to serve as a central repository of new learning and initiatives; i.e. knowledge brokers (Hargadon, 2002). This formal authority (e.g. by the board of directors creating a team dedicated to exploration) or status (e.g. making the leader of such team a VP) is consistent with balancing operation three in Emerson's (1962) framework. Furthermore, this individual or group has the mandate to put forward initiatives, connect with the necessary parties wherever they may reside within or outside the organization, and follow up on initiatives while challenging current strategy or identity. Consequently, an organizational actor with a valuable resource – exploratory learning – is given the formal authority and power to counterbalance powerful individuals who might oppose new initiatives. Importantly, this actor (or group of actors) does not belong or report to a specific part of the organization but is acting independently as instigator of initiatives:

P7: Instigating helps alleviate the negative effects of [B3] power and politics mainly on the feed-forward learning processes of integrating and institutionalizing by balancing power by giving status and formal authority to valued knowledge brokers.

Intervening and *instigating* are in line with the spirit of continuous change as opposed to episodic change (Weick & Quinn, 1999). Both *intervening* and *instigating* are institutionalized processes for exploration and attention to the future. Episodic interventions, such as changes in top executives, contain most of the mechanisms argued for, such as switching to conscious information processing, change in mental frames, and power to execute. Consequently, these interventions might create organizational learning (Crossan & Berdrow, 2003). However, in the absence of a continuous process, a new equilibrium will be reached and inertia will set forth once again (Weick & Quinn,

1999). Consequently, an episodic intervention is not the type of intervention that will institutionalize exploratory learning. By acting in a continuous fashion, *intervening* and *instigating* in time reduce the potentially constraining effects on the feedback process of OL. For instance, despite ongoing success and good performance, inattention to the external environment does not become common practice. Similarly, strategic frames and organizational identity can be challenged at any time in order to support constant learning. Thus, with time, we expect *intervening* and *instigating* to overcome [B4] and [B5] learning barriers in the feedback process of learning as well:

P8: Over time, intervening and instigating will combine to alleviate the negative effects of [B4] organizational cognitive structures and [B5] past performance on the feedback learning processes.

Table 2 presents the main mechanisms and effects of *intervening* and *instigating*.

Insert Table 2 about here

CONCLUSION

In this paper we have integrated behavioral strategy (Powell et al., 2011) into the 4I organizational learning (OL) framework (Crossan et al., 1999) in order to investigate how individual cognitive decision biases and socio-psychological organizational processes may influence the flow of learning within organizations. We began with the premise that organizational learning starts at the individual level – and thus is hampered by individual limitations such as human biases, information processing limitations, and emotional responses. Next, we emphasized that learning is mainly a social interaction process, and as such potentially hindered by various socio-psychological obstacles. Taking this view allowed us to incorporate assumptions about human limitations and social behaviors that might present

powerful barriers to learning flows as learning moves from the individual to the groups and beyond. As such, this study presents the first attempt to systematically integrate behavioral barriers into the 4I learning framework (Crossan et al., 2009).

The first three barriers affect the feed-forward process of OL. Our study investigates how individual cognitive limitations and biases, as well as emotions, affect primarily the sub processes of *intuiting* and *interpreting*. Specifically, information entering the learning system is severely influenced by individual heuristics, schematic and automatic information processing. Automated and schematic information processing acts as a filter to allow only certain types of environmental cues to be attended to and thus brought into the learning system and moved forward to the group level. For instance, scanning, one of the first steps in organizational learning (Daft & Weick, 1984; Flores, Zheng, Rau, & Thomas, 2012; Walsh & Ungson, 1991) can be detrimental for changing perceptions because of individual information processing limitations and biases. As noted by Dörner and Schaub (1994), most information collection mistakes are due to preformed images of reality as people are not prepared to look at the whole range of information but only at what is considered important from the point of view of their preconceived image of reality. For instance, dissonance theory (Festinger, 1957) stresses the individual preference for confirming rather than dissonant information to previous decisions, experiences or beliefs. Therefore, individuals are selective (biased) rather than comprehensive in how they perceive information (Hogarth, 1987).

By the same token, emotional responses play a crucial role in making sense of environmental information and sharing it with others within the organization. For instance, as people actively attempt to shield themselves from information that causes psychological discomfort (Karlsson et al., 2009), individuals might actively block or ignore cues where important, yet disconfirming information might reside. By shrinking the “pool” of information, *intuiting* is affected. Similarly, individuals might

rationalize away un-corroborating information, if, for example new information contradicts the rationale for prior decisions made. Under such a scenario, personal feelings towards “pet projects” may affect the process of *interpreting*. Moreover, emotional responses are also present at group level (Barsade, 2002; Mackie et al., 2000). Emotional responses in groups may lead a group to support or covertly dismiss a particular strategic initiative even when personal interests are not involved (Huy, 2011). Consequently, emotions also affect the process of *integrating*.

Power and politics affect *interpreting*, *integrating* and *institutionalizing*. In line with Lawrence and colleagues (2005) we acknowledge the pivotal role of power and politics in organizational learning. However, our view towards this potential barrier is more negative as learning flows are likely to be allowed forward in the organization only if it is beneficial to the political interests (e.g. promotions, removing rivals) of powerful individuals or groups along the learning system. This may bias or block organizational learning. Our study also highlighted potential leaning barriers on the feedback process of OL, for instance in relation to organizational identity, and inattention to learning due to successful past performance and build-up of slack resources. Hence, by integrating an important leaning model (4I) with realistic assumptions of human and social interaction, we present a more complete and realistic account of the difficult journey of organizational learning. In absence of these assumptions, learning models are interesting theoretical desk exercises, but difficult to integrate with real life to guide management practitioners.

Yet, integrating learning theory with behavioral assumptions is important only to the extent mechanisms to correct these limitations are investigated. Consequently, we have proposed two new processes – *intervening* and *instigating* - for dealing with the five barriers to organizational learning. Drawing on insights from information processing and social psychology, we introduced three main mechanisms through which *intervening* enables learning at the individual level to enter the learning

system; (1) enticing shifting towards controlled information processing mode; (2) challenging of expert knowledge capacity; and (3) promoting dialogue and critical self-reflexivity. Through these mechanisms, intervening helps advance organizational learning by overcoming the barriers of individual cognitive limitations and biases, as well as emotions.

Instigating is designed to address the learning barrier of power and politics in particular. Drawing on Emerson's (1967) concept of power dependence relations in social contexts, *instigating* is a process that alters the balance of power within the organization by giving formal authority to individuals or groups with a valuable resource – new information or capabilities. This shifting of power neutralizes powerful individuals or coalitions who might be inclined to block new learning and possibilities due to their preference for status quo and exploitation of learning. In this way, *instigating* reduces the potential feed forward barrier of power and politics associated mainly with *integrating* and *institutionalizing*.

In combination, *intervening* and *instigating* allow new learning to enter the organization at the individual level, and subsequently flow forward to groups and the organization at large. By extending the original 4I framework to encompass these two new processes, we address the challenges that individual limitations and social interaction exert over organizational learning. The resulting theoretical model advances learning theory and practice by providing insights into how organizations may manage the tension between exploitation of learning and exploration of new possibilities. According to March (1991) both exploration and exploitation compete for scarce resources, and firms are forced to make tradeoffs decisions between them. The differences in payoffs, time horizons and uncertainties are usually resolved by leaning towards the payoff certainty and faster feedback of exploitation, thus driving out exploration. While the literature on ambidexterity emphasizes the critical role of strategy, structure and leadership in balancing exploration and exploitation (e.g., Benner & Tushman, 2003;

O'Reilly & Tushman, 2004), the underlying behavioral mechanisms driving the choice between exploration and exploitation are largely ignored (Birkinshaw & Gupta, 2013; O'Reilly & Tushman, 2013). By integrating behavioral strategy into the 4I OL framework and identifying five learning barriers rooted in individual cognitive limitations and social behaviors, we have given a behavioral account of why exploration might be driven out in many organizations. In addition, we have suggested two new processes which may help balance the interface between exploration and exploitation. As such, our explicit focus on barriers and enablers to learning flows contribute to OL theory by exposing the critical role of individual cognition and behavior in social settings that drive organizational learning.

IMPLICATION FOR MANAGEMENT PRACTICE

The utility of OL theory rests on its ability to provide management with practical guidelines for enhancing learning flows and managing the tension between exploitation and exploration. Our theory extension raises a key question concerning the implementation of the two enabling processes of *intervening* and *instigating*. To this end, we suggest scenario planning (SP) activities may act as catalyst for increasing individual and organizational awareness of barriers to learning flows and ways to overcome these.

SP is a highly participative approach that uses multiple plausible futures (scenarios) to challenge individual and organizational mental frames (Schoemaker, 1993; van der Heijden, 2005; Wack, 1985). In doing so, SP activities compel organizational actors to engage in conscious information processing in order to relax their conventional frames of reference. Specifically, scenarios achieve mental changes by reducing biases such as overconfidence, anchoring or availability through

exploiting the conjunction fallacy bias, or inclination to believe that a combination of events is more likely than a single one. In this way, scenarios exploit biases in human cognition as mechanisms to help individuals learn through a deeper appreciation of the factors that could shape the future (Schoemaker, 1995). Essentially, SP works under the assumption that the future will not be constant or similar to the current business environment; therefore scenarios are designed to question the deepest assumptions about an organization's strategy and identity. Hence, SP can be an organizational aid for both drawing attention to behavioral barriers to learning flows and *intervening* to overcome these.

Although potentially effective, SP is not without its limitations. For instance, its effects in disabling emotional barriers to learning are not clear. Building scenarios can be viewed as playing experimental yet sophisticated games; and playing games may create 'transitional objects' that serve to diminish and control anxiety (Winnicott, 1974). For instance, Wack's (1985) detailed account of an SP intervention showed how fear created by the scenarios served as a powerful device for learning. On the other hand Hodgkinson & Wright (2002) presented a scenario intervention where the stress and anxiety generated by the different scenarios interrupted the learning process. Consequently, given the limited and mixed empirical evidence, the role of SP activities in organizational learning is poorly understood and in need of further research.

We have also brought attention to the role of *instigating* as a key process to allow exploratory learning to move to the group and organizational level. We argued that *instigating* generates the necessary shifts in power to counterbalance the learning barrier of power and politics created by powerful individuals blocking feed forward learning. Within the SP context, *intervening* will challenge long held assumptions and strategies which might bruise some egos along the way. This puts a premium on the composition, design and reporting structure of the SP team in order to ensure its effectiveness. The literature traditionally argues that the scenario team should be anchored at the

executive level (Goodwin & Wright, 2001; van der Heijden, 2005). Yet, if some of the learning from the scenario team challenges the views of powerful individuals at the top, this learning may be blocked or its importance relegated. This suggests that a direct reporting line to the board of directors might be a better way to generate the necessary balance in power. Given the potential importance of the scenarios for moving learning forward from individuals to the group and organization at large, the scenario team must have the necessary autonomy and power to challenge mind-sets and change cognitive frames. Future research should investigate how scenario team composition and power may influence learning flows (Hodgkinson & Healey, 2008).

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Figure 1
Intervening and Instigating for Adaptive Organizational Learning

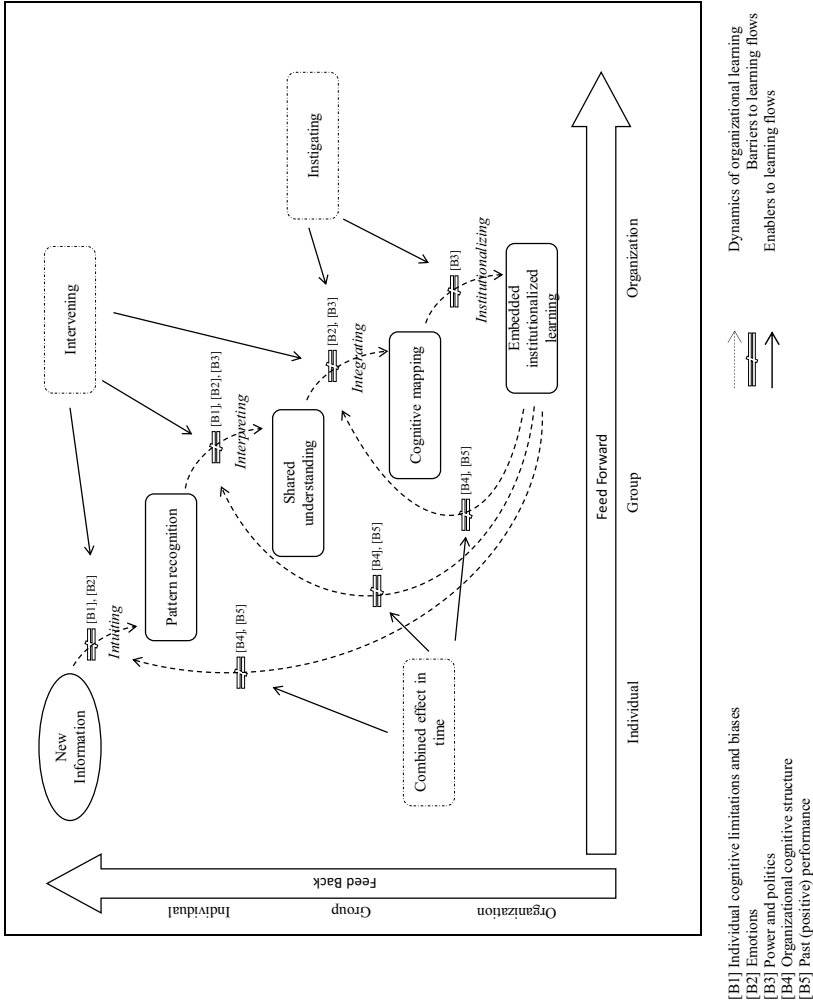


Table 1
Organizational Learning Sub-Processes and Barriers to Learning Flows

Level	Sub-process	Barrier – feed forward	Barrier – feed back
Individual	Intuiting	[B1], [B2]	[B4], [B5]
	Interpreting	[B1], [B2], [B3]	[B4], [B5]
Group	Integrating	[B2], [B3]	[B4], [B5]
	Institutionalizing	[B3]	
Organization			

- [B1] Individual cognitive limitations and biases
- [B2] Emotions
- [B3] Power and politics
- [B4] Organizational cognitive structure
- [B5] Past (positive) performance

Table 2
Intervening and Instigating: Mechanisms and Outcomes

Process	Mechanism	Outcome	Targeted barrier	Original 4I process	Level
Intervening	Entice shift in information processing mode	Switching to conscious information processing	[B1]	Intuiting and interpreting	Individual
	Challenging expert's knowledge capacity	New schema formation Broadening relationships	[B1]	Intuiting and interpreting	Individual and group
	Promotion of dialogue and critical self-reflexivity	Instilling learning culture Reduction of ego defenses	[B2]	Interpreting and integrating	Individual and group
Instigating	Giving status and formal authority	Shifting power dynamics Reduce power advantages	[B3]	Integrating and institutionalizing	Group and organization
Intervening and Instigating	Continuity	Exploration and exploitation coexist	[B4], [B5]	Feed - backward	Organization

[B1] Individual cognitive limitations and biases

[B2] Emotions

[B3] Power and politics

[B4] Organizational cognitive structure

[B5] Past (positive) performance

CONCLUSION

This research has addressed the need for more theoretically grounded and systematic empirical research into scenario planning (Burt and Chermack, 2008; Hodgkinson and Healey, 2008). More broadly, it has contributed to the organizational learning and ambidexterity literatures by empirically and theoretically investigating the mechanisms that might enhance or restrict flows of learning and by showing some of the individual actions and decision that balance exploration and exploitation. Figure 2 presents the main findings and contributions of this PhD project as whole, and the individual contributions of the four papers contained in this project.

Figure 2
PhD project. Main objectives and findings

Paper	Objectives	Findings
P1	<ul style="list-style-type: none"> • Integrative review, framework and debate areas (DA) 	<ul style="list-style-type: none"> • DA1: Prowess of scenarios as cognitive devices • DA2: Embeddedness of SP and influences • DA3: SP team, composition, function and position • DA4: SP transfer flows into the organization level
P2 DA2 DA4	<ul style="list-style-type: none"> • Theoretical grounding of SP • Investigate mechanisms that might enhance or restrict flow of learning 	<ul style="list-style-type: none"> • SP acts as learning system • Cognitive and socio-psychological barriers identified along learning system
P3 DA2	<ul style="list-style-type: none"> • Investigate individual actions and decision underpinning ambidexterity • Investigate ambidextrous design at NZ 	<ul style="list-style-type: none"> • SP integrating mechanism • Ambidextrous design is dynamic • Important role of middle managers • Important role of internal and external networks
P4 DA2 DA3 DA4	<ul style="list-style-type: none"> • Integrate behavioral strategy with 4I organizational learning framework 	<ul style="list-style-type: none"> • 5 behavioral and social barriers discussed and integrated into the 4I framework • 2 new mechanisms proposed to open up learning flows
Thesis	<ul style="list-style-type: none"> • Effects of SP on organizational learning 	<ul style="list-style-type: none"> • SP is influenced by various behavioral and social influences • Proposed 2 new mechanisms that might enhance effectiveness of SP and organizational learning in general • SP applications different as proposed – integrating mechanism • Theoretical and empirical work strengthening SP, organizational learning and ambidexterity literatures

The main objective of this thesis was to investigate the effects of scenario planning on organizational learning. Taken together, the findings presented along this project show that the intended, utopian learning outcomes of scenario planning – e.g. exploration of new possibilities - may never materialize as various barriers might block or bias potential learning benefits. To be certain, scenario planning was found to generate exploratory learning in some isolated instances but broadly speaking, due to various behavioral and organizational influences, the process rarely translated into exploratory learning at the organizational level. Rather, scenario planning was found to serve as an integrating mechanism used for fine tuning exploitative efforts.

By theorizing scenario planning as a learning system, this research provides a solid theoretical foundation to empirically explore the effects of scenario planning in organizations. By the same token, by showing different barriers that potentially constrain the learning generated by scenario planning, organizations should better prepared in designing processes that could sidestep or overcome these learning barriers. Importantly, by presenting two potential mechanisms that could alleviate these learning barriers, this project sets the stage for further research by academics and practitioners alike investigating – theoretically or empirically – or designing potential mechanisms and organizational processes better prepared at overcoming the various learning barriers. For instance, in the 4I framework (Crossan and colleagues, 1999) is not evident how new learning enters the learning system. The *intervening* mechanism presented in paper 4 contains three underlying processes that might shed some light and ideas about how to facilitate new learning into the system. Similarly, the scenario planning literature rarely addresses the ideas presented surrounding the *instigating* mechanism. In the absence of appropriate actions for shifting power dynamics, scenario planning in particular, and organizational learning processes in general are at great risk of becoming biased exercises.

This research also highlights the potential value of shifting the level of analysis in organizational processes from “organizational levels” – e.g. individual, group or organization - into “hierarchical levels” – e.g. analysis, managers, directors, executives and so on. The findings indicate that upward flow or learning is not so much about traversing individual or group levels, but rather about negotiating the hierarchies of the individuals interacting in the social context of the organizational. Hence, conceptualizing the flow of learning as a progression across hierarchies rather than broader organizational levels might provide interesting conceptual lenses. Similarly, it opens up interesting areas for further research. For instance, examining individual-level differences across hierarchical levels may advance our understanding of the various factors influencing learning flows.

The main proposition of this project was presented in the earlier chapters of this dissertation, namely: “whether scenario planning in organizations might seek exploratory learning, a combination of poorly designed processes and a variety of learning barriers at various levels renders organizational outcomes that have little to do with exploration”. This main proposition was born from a combination of practical experiences and a dedicated literature review. For instance, while attending classes on the topic of scenario planning at a renowned international university, I could not get answers or a basic understanding of what mechanisms were underpinning the process. I got the commercial rhetoric, but I could not get under the hood. This was disappointing as I was in no position to design a process around scenario planning and bring it home to my own organization. I was confused. This experience was followed by many months of an extensive review of the scenario planning literature. As pointed in paper 1, the reader in this literature is likely to be either misguided, or frustrated by a similar review exercise. Under these conditions, I had many doubts that a manager at a given organization will have the necessary elements to guide her or him in the design of a scenario planning process. The second part of proposition – e.g. about learning barriers -

comes from my various years of experience working at organizations. The lack of factual evidence and simplicity of the histories described in the scenario planning literature where in direct conflict to what I had experienced for many working at four different organizations in three different continents – e.g. there are various individual and organizational barriers or realities that block learning and subsequent action.

The various findings and discussions along the four papers provide support to the main proposition in this thesis. For instance, paper 3 reveals the coexistence of two scenario processes in the focal company. Similarly, the views of various participants in the scenario process presented in paper 2 are quite dark in regards to its purpose and outcomes. Both of these findings point out to confusion and doubts about the scenario planning process at this organization. Importantly, various individual and social barriers are identified, which generally nullified the exploratory learning of this process and subverted it into an exploitative outcome. This provides further support to the overarching proposition.

These findings are indeed worrisome for managers and businesses. At Novozymes, transforming an exploratory process into exploitation works fine as the company has many other redundancies to explore and adapt. The company makes an exceptional effort in this regards, as discussed in Paper 3. But not all organizations are like Novozymes. Generalizing out of a single case study is difficult, but if the reader bears with me for a minute, I will argue that if an organization like this - so devoted to learning and exploring - can subvert an explorative process into exploitation, it is not a stretch to expect the same out of other organizations. In the event this proves to be the case, it can be argued that scenario planning has the potential to veer organizations towards exploitation, inadvertently reinforcing current strategies. On any event, this warrants further research.

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