Innovation Ambidexterity: Addressing Gaps in Theoretical and Empirical Interpretations

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Abstract: The paper discusses the discrepancy between the normative and the positive view on innovation ambidexterity, which is detrimental for theoretical robustness of the framework as well as problematic for business practitioners who often cannot rely on the vast but inconsistent body of research on innovation ambidexterity. The paper addresses the problem of divergent understanding of exploration and exploitation processes in academic literature and managerial practice, discusses various conceptualisation of innovation ambidexterity and points at the theoretical gap of unspecified conditions under which each ambidexterity structure is not only a viable option but possibly the best form of organisational design. We also problematise the assumptions of simultaneity and high levels of exploitation and exploration, central to the ambidexterity concept. These issues are illustrated by drawing on the case study of ARM, the British microprocessor IP designer and licensor. The presented findings are the result of research in progress that aims to test innovation ambidexterity theory by analysing balancing mechanisms across multiple levels of a single organisation and borrowing on the epistemological position of falsification.

Key words: exploration, exploitation, innovation ambidexterity, falsification

I. State of the art in Innovation Ambidexterity Theory

Given the fast paced pervasive change induced by modern technologies managers of any technology-based firm face the same crucial question: How to tap the value of today's capabilities and prepare for tomorrow's cutting edge innovations? Exploiting old certainties while simultaneously exploring new opportunities, termed innovation ambidexterity, has often been argued to be the best way for knowledge intensive firms to maintain technological innovation, organizational learning, and ultimately long-term performance and growth (Benner and Tushman 2002, 2003, March 1991, Tushman and O'Reilly 1996). More descriptive empirical research advocates the presence of exploration and exploitation and the optimal balance between the two as crucial components of a corporate strategy for firm longevity (Birkinshaw and Gibson 2004, Burgelman and Grove 2007, O'Reilly III et al. 2009, O'Reilly III and Tushman 2004, O'Reilly III and Tushman 2011). However, the popularity of the terms exploration, exploitation, and ambidexterity in managerial literature and practice may be outpacing their theoretical and conceptual development. Theoretical scrutiny of the concept of innovation ambidexterity seems to provide more questions than answers on the nature of the proposed balance between exploration and exploitation activities as it struggles to disentangle the two in a variety of application contexts.

For example, whereas exploration and exploitation are seen as inherently conflicting and crowding out one another on an individual level or in a tightly coupled system, and extensive research is dedicated to exploration-exploitation trade-offs (Leonard-Barton 1992, Levinthal and March 1993, March 1991), there is considerably less understanding of potential complementarities and spill-over effects between exploration and exploitation over longer periods of time in either a single context or across organisational levels (Cao et al. 2009, Katila and Ahuja 2002). Reconceptualising ambidexterity as behavioural rather than structural capability (Gibson and Birkinshaw 2004, McCarthy and Gordon 2011) or uncoupling exploration from exploitation into differentiated organisational structures (Birkinshaw and Gibson 2004, Kauppila 2010) or domains of the firm's broader social environment (Chesbrough 2003, Lavie and Rosenkopf 2006, Lavie et al. 2010, Powell et al. 1996) allows theorisation of exploitation and exploration as orthogonal and non-competing (Gupta et al. 2006), but leaves us with the challenge of distinguishing between the two, which in turn complicates the analysis of the interactive ambidexterity effect. Switching or combining levels of analysis necessary for a holistic and dynamic study of the organisation blurs the notions: an individual employee might consider their work inventive and explorative but it may be advancing the firm along the existing trajectory, therefore, amount to exploitation. Conversely, various exploitative efforts of individuals might result in novel qualitative recombinations and off the trodden path advancements for the firm and, therefore, equal exploration.

The twin concepts of exploration and exploitation have transcended their original application field of organisational learning and expanded beyond the organisational level analysis. United in the notion of innovation ambidexterity they have become a convenient lens for interpreting various behaviours and outcomes within and across firms and have received substantial scholarly attention. However, research on innovation ambidexterity is polarised between those who claim its analytical weakness, point at inconsistent empirical evidence and therefore view it at best as a convenient metaphor (DRUID Society Conference Debates 2012) and those who strive to ground its principles (Jansen et al. 2006, Lin et al. 2012), reconcile issues of definition and conceptual tensions (Gupta et al. 2006, Raisch et al. 2009, Smith and Tushman 2005), generalise across multiple contexts of its application (Luo and Rui 2009, Siggelkow and Rivkin 2006), and systematise various literature streams (Lavie

et al. 2010, Nosella et al. 2012, Raisch and Birkinshaw 2008) to increase its theoretical robustness and empirical relevance. Importantly, both parties unanimously emphasise that if we are to use innovation ambidexterity theory as a robust analytical framework rather than a rhetoric device and provide a constructive contribution to managerial practice, further research needs to be done to advance the theory's conceptual apparatus, scrutinise its assumptions, and define contexts of its application.

One path to it is to conduct research that would consider multiple contexts of innovation ambidexterity and take into account organisational pressures that influence the firm's behaviour at various levels, reflecting organisational reality in its complexity and entirety. Prior research on innovation ambidexterity has predominantly focused on the organisational level or separate contexts of innovation ambidexterity such as dual structures for exploration and exploitation. It has been recognised that low dimensional studies yield conflicting results and support a variety of inconsistent propositions partly because they rely on different conceptualisations and measures of ambidexterity (Cao et al. 2009, Lavie et al. 2010) and assume different literature streams as a theoretical lens (Nosella et al. 2012). Disjoined and conflicting empirical evidence undermines the robustness of the innovation ambidexterity framework as a theoretical tool for explanation and prediction of firm innovation behaviour and output.

To evaluate innovation ambidexterity theory from a more demanding perspective, we assume the epistemological rationale of falsification and challenge the theory's central proposition that simultaneous pursuit of high levels of exploration and exploitation is in fact beneficial for any firm and seek to identify contexts when it is not the case. Thus, this research adopts a falsification approach to examine balancing mechanisms of innovation ambidexterity across multiple levels of a single organisation, assuming that differences in these organisational contexts may have merits for the theory. Such research design would offer a more robust theoretical evaluation of the innovation ambidexterity framework, which in turn would increase its potential for informing managerial practice.

II. Research goal

This paper presents initial findings of the PhD research in progress that aims to test innovation ambidexterity theory by adopting a dynamic multi-dimensional perspective on innovation processes and examining mechanisms, processes, and routines that are directly involved in balancing and resolving ambidexterity tensions across multiple levels of a technology and management intensive firm. To approach this goal, the present study has been carried out with the objective to identify points of contradiction between normative and positive interpretations of innovation ambidexterity. The case study of ARM, the world's leading microprocessor IP supplier, provides empirical evidence for the study as well as subsequent PhD research. The paper aims to make a theoretical contribution to the state of the art of innovation ambidexterity theory by illustrating the lag of the theory in addressing empirical phenomena, demonstrating divergent understanding of ambidexterity by academics and practitioners, and pointing at its weaknesses in making practical assessment of the choice of exploration and exploitation strategies for firms.

The study addresses the following questions: (1) *what are the organisational processes, structures, and managerial decisions associated with exploration, exploitation, and innovation ambidexterity in the chosen empirical setting?* (2) *What are the contexts in which these phenomena operate?* (3) *How do exploration-exploitation mechanisms and definitions vary across these contexts?* And (4) *how does the obtained empirical evidence relate to the extant conceptualisation of exploitation, exploration, and innovation ambidexterity?*

The remainder of the paper provides an overview of discrepancies between the theory of innovation ambidexterity and empirical observations (Section III), outlines the study design and methodology (Section IV), presents and discusses initial findings (Sections V and VI), and finally, provides conclusions and plans for further development of the research (Section VII).

III. Innovation Ambidexterity: Theoretical and Empirical Aspects

Although research on innovation ambidexterity is burgeoning, there are still several gaps that relate to the theoretical content of the concept and its empirical interpretations as well as problematic linkages between theory and practice. For example, the contrasting interpretations of the relationship between exploration and exploitation as complementary or competing have been addressed by conceptually distinguishing between the combined dimension (CD) of ambidexterity that encapsulates the joined magnitude of exploration and exploitation and the balance dimension (BD) that stresses the need to make discrete choices between exploration and exploitation, and thus, deal with the trade-offs between the two (Cao et al. 2009). Given this theoretical distinction, however, the complementary relationship between exploration and exploitation seems to relate to the ambidexterity notion more than the trade-off between them because it emphasises the benefits of doing two things simultaneously rather than doing one at the expense of the other. Additionally, although researchers recognise that actual firms display a mix of CD and BD (Cao et al. 2009), the conceptual distinction between CD and BD is also problematic because it is based on the assumption that any single activity in the firm is either explorative or exploitative but not both at the same time. Categorising a wide spectrum of firm's activities as explorative or exploitative is very difficult in actual practice. Furthermore, the relationship between CD and BD of ambidexterity in actual firms is poorly understood: they are neither easily demarcated in practice, nor are they mutually exclusive in theory. For example, the orthogonal exploitation and exploration design, which is maintained by buffering exploration from exploitation in corresponding dedicated structures, justifies itself only at the point when the separation is lifted and ideas produced by the explorative unit for tomorrow become processes and products utilised by the exploitative unit today. Therefore, CD necessarily implies the transition point from exploration to exploitation and vice versa, which is characterised by the trade-off relationship, i.e. BD.

The discrepancy between the normative and the positive view on innovation ambidexterity remains one of the framework's major weaknesses undermining its explanatory and predictive power. Here, the normative scientific perspective is understood in the Keynesian sense as "a body of systematised knowledge discussing criteria of what ought to be" while the positive view constitutes "a body of systematised knowledge concerning what is" (Keynes 1897, p. 34-35). The fundamental conceptualisation of ambidexterity advocating the merits of simultaneous exploitative and explorative innovation (Levinthal and March 1993, March 1991) is frequently at odds with the actual behaviour of firms which struggle to balance these activities and employ various balancing mechanisms across multiple contexts to relax the tensions between exploitation and exploration (Benner and Tushman 2003, Lavie and Rosenkopf 2006). The inability of the innovation ambidexterity framework to account for a variety of innovation strategies in firms is one of the reasons why the framework has a limited value for business practitioners, and why the terms exploitation, exploration, and innovation ambidexterity have gone on to live lives on their own in managerial parlance, understanding, and practice. Eventually, the lack of conceptual clarity and consensus regarding the underlying balancing mechanisms of innovation ambidexterity means that it has

been conceptualised and measured in different ways, which produced incompatible empirical findings that are difficult to compare and generalise in a theory (Cao et al. 2009, Lavie et al. 2010).

Another reason why empirical application of innovation ambidexterity theory is problematic is ambiguity over definitions of exploitation and exploration. Following advancements in organisational learning theory, researchers have abandoned the distinction of exploration and exploitation on the basis of presence versus absence of new knowledge and instead distinguished the two basing on the type and amount of learning. Exploration and exploitation have been conceptualised as search scope versus search depth (Katila and Ahuja 2002), time spread versus recency of the past knowledge (Nerkar 2003), relations with new versus existing partners (Beckman et al. 2004), and learning from others' experience versus from one's own (Baum et al. 2000). These definitions imply that learning, improvement, and acquisition of new knowledge are essential to both exploitation and exploration, though each definition is operationalised for a specific level of analysis. Variations of the level of analysis or multi-level study may affect conceptualisation of exploitation and exploration. For this reason, it is not only necessary to be aware of differences in the definitions, but also to understand the extent to which these organisational levels vary to cause these differences.

March's classic definitions of exploration as "search, variation, risk taking, experimentation, play, flexibility, discovery, innovation" and exploitation as "refinement, choice, production, efficiency, selection, implementation, execution" are unproblematic in the context of adaptive systems and organisation level analysis where they originated (March 1991, p.71). However, when one moves the focus from the organisational level to the individual or team level, exploration and exploitation can be operationalised both on a learning continuum and as presence versus absence of new knowledge. Given this, any multi-level analysis will require careful definition of the terms in the particular context as well as specifying an appropriate measure to operationalise these at every level. Universal definitions are metaphoric at best and would be meaningless in the analysis across multiple organisational contexts. Expansion of research on exploration and exploitation beyond March's original focus and the variability of definitions of exploitation and exploration are the factors perhaps also responsible for the occasional arbitrarily broad interpretation of innovation ambidexterity as any situation, where actions, behaviour, or outcomes are polar, paradoxical, diametrically opposed or simply appearing to be in conflict with each other. Although a holistic multi-level study of this important phenomenon may promise valuable findings, the difference in definitions and conceptualisations at various levels may prove a challenge for new generalisations.

Empirical studies have demonstrated that depending on the organisational and wider environmental context firms can be ambidextrous and balance dual tasks (O'Reilly III and Tushman 2004, Tushman and O'Reilly 1996), specialise in exploitation or exploration alone (Benner and Tushman 2003, Teece 1992) or alternate between the two (Burgelman 2002) - each being a completely viable organisational scenario. This raises the question under which conditions each of the scenarios will not only be a possible alternative, but a more effective strategic choice above another or even perhaps the only way for the firm to foster its long-term growth (Gupta et al. 2006). Moreover, given a wide spectrum of organisational forms, we can ask if there can be other types of balancing mechanisms that can be usefully employed by firms and if those can be better accounted for with alternative theoretical concepts and theories such as absorptive capacity, dynamic capabilities, routines, or evolutionary theory of the firm.

The innovation ambidexterity framework has become an increasingly important paradigm in the field of innovation and knowledge management, organisational learning, and strategic alliances, but it seems to be more useful for post-hoc explanation rather than prediction of organisational success of failure. This might be for the following reasons. Firstly, as noted above, the scope and conditions of application of the theory are not fully understood. For example, inter-organisational learning research has presented empirical evidence of ambidextrous design enacted on the level of a wider social environment when the firm connects with interdependent organisations to leverage the necessary capabilities via mergers, alliances or acquisitions (Lavie and Rosenkopf 2006). However, given its focus on trade-offs and static tensions rather than complementarity and dynamic unity of exploration and exploitation, the framework has little guidance in informing firms when and how to tap into complimentary resources of other firms or open innovation and harmonise inter-organisational learning, cultures, and identities. Though progress has been made in understanding antecedents, environmental moderators, and a contingent nature of exploitation and exploration, there are few studies that take into consideration multiple dimensions of the exploration and exploitation context.

Secondly, the existing body of research on innovation ambidexterity rarely discusses negative data, when ambidextrous organisations experience innovation failure or performance deterioration. Though findings on performance outcomes of innovation ambidexterity are mixed reporting both positive and negative effects (Jansen et al. 2006), the emphasis has continuously been on improved performance, which is also responsible for fuelling the topic. There are no studies that are explicitly designed in a more demanding falsification manner to seek to establish evidence of no or negative effect of ambidexterity on organisational performance. Studies that look at the full spectrum of innovation outcomes rather than innovations that lead to increased performance are rare within the innovation ambidexterity paradigm (Taylor and Greve 2006). Thus, there is a theoretical gap about environmental conditions under which equal pursuit of exploitation and exploration leads to failure and is not the best organisational design, because these are not the direct reverse of the conditions that lead to success. Both sets of conditions need to be disentangled and contextualised, because research demonstrates interesting findings that explorative innovations that lead to extreme success or failure and exploitative innovations that lead to high average performance are influenced by similar factors such as diversity of knowledge and experience of team members (Taylor and Greve 2006). In this respect, the study of ambidexterity as a function of organisational capabilities seems to be a promising avenue for research.

Importantly, the theory of ambidexterity becomes tautological when its effectiveness in terms of constituting processes and performance outcomes is explicitly compared to other balancing mechanisms. By definition, ambidexterity means equally high proficiency in both of the constituting opposite skills (Oxford English dictionary, Oxford English Dictionary 2013), in case of innovation ambidexterity - concurrent excellence in both exploitation and exploration (Tushman and O'Reilly 1996). Thus, ambidexterity by definition implies doing more and better than any other mode of balance. The simultaneity assumption central to innovation ambidexterity theory is highly misleading, though, because in actual strategy not only the quantity of both activities will be different, but each will also need to be activated by managers and will depend on how the firm and its employees interpret stimulus to engage in a particular activity over another at any one point in time. Hence, alternative theoretical approaches may be more useful to understand firms' innovation strategy building, for instance, the evolutionary theory of the firm that considers how a firm interprets its external environment in line with its internal organisation to inform its innovation strategy.

When innovation is a crucial strategic factor for the firm's long-term success, strategies are designed not by mere safeguarding that both exploitative and explorative activities are

nominally present on the firm's agenda. What matters more is the prioritisation of exploitation and exploration activities in the firm, the degree of their actual realisation given the organisational circumstances, more than mediocre level of proficiency in either or both of them and the interactive effect of the two.

Theoretical research has only relatively recently raised the question of whether ambidexterity, specialisation or punctuated equilibrium are interchangeable and equally valid innovation strategies for the firm or whether they are a function of the firm's capabilities, knowledge, technology base, and industrial environment (Gupta et al. 2006). Some progress has been made in articulating fundamental conditions when a given innovation strategy is more beneficial for the firm than any other (Gupta et al. 2006). Until such conditions are fully specified and ranked in terms of their importance, innovation ambidexterity remains a dominant paradigm in management research and is often thought of as the most desirable organisational design in actual managerial practice, regardless of practical challenges and considerable academic criticism for the vague conceptual apparatus, controversial assumptions, and propositions based on fragmented analysis.

To enhance the robustness of ambidexterity as a theoretical framework and validate it as a desirable organisational design for firms in certain contexts, one has to subject the theory's fundamental propositions to criticism and indeed clarify its very language that has been shaping our thinking in terms of dual opposites of a uni-dimensional continuum: the "right" one and the "left" one. In this vain, this research adopts the principle of falsification of theory rather than corroboration with the empirical evidence to the extent possible in the social science analysis. This epistemological position keeps open an opportunity to consider alternative theoretical frameworks that might have a greater potential to account for organisational design and innovation strategies of firms, thus, helping to assess theoretical robustness of the innovation ambidexterity framework in comparison with alternative extant theories.

IV. Research methodology

To answer the research questions and illustrate the divergence between the normative and positive interpretations of innovation ambidexterity, a case study methodology has been adopted with the empirical setting in the British technology and management intensive company ARM, the world leading microprocessor IP designer and licensor. This complies with Stake's criteria for case selection "selecting a case of some typicality, but leaning towards those cases that seem to offer opportunity to learn" (Stake 1994, p.243) and to select "that case from which we feel we can learn the most" (ibid.). The case study is informed by qualitative data consisting of nine semi-structured interviews with top executives, senior and middle managers, as well as by the analysis of the firm's documents: performance reports, product portfolios, acquisition announcements, web casts, industry presentations, blogs, and so on. The research represents what Stake calls an "*instrumental case study* [where] a particular case is examined in order to provide an insight into an issue or refinement of theory. The case, therefore, is of secondary interest, it plays a supportive role, facilitating our understanding of something else" (Stake 1994, p.237, original emphasis). The methodological focus is placed on specific conditions within ARM inasmuch as they illustrate divergent definitions and gaps in innovation ambidexterity theory and provide a basis for further theorising.

The goals of the data analysis were to (1) elicit definitions attributed to various innovation activities, (2) identify managerial decisions and organisational processes associated with innovation activities, (3) analyse organisational structures that support these,

and (4) describe organisational domains across which they operate. This will then enable us to discuss empirical findings in relation to the theoretical conceptualisations.

The important advantage of the qualitative method is that it allows soliciting insider accounts that provide a contextual portrayal of innovation ambidexterity as it is understood and unfolded within the firm. Sociology has long recognised the importance of personal accounts as explanation of social behaviour and social events (Orbuch 1997). According to Hammersley and Atkinson, accounts are important because "we can use what people say as evidence about their perspectives" (Hammersley and Atkinson 1995, p.125). Obtained accounts are important because they represent evidence of how managers see their innovation activities, which has to be taken into account by the theoretical framework of ambidexterity. Thus, the collected empirical data were used to define the concepts within the chosen context and address the divergence between the normative and positive perspectives on innovation ambidexterity.

V. ARM: Innovating for Today while Innovating for Tomorrow. Initial Empirical Findings

ARM: "The Architecture for the Digital World". Brief Company profile

The British company ARM is the world's leading semiconductor intellectual property designer and licensor, supplying low-power high-performance microprocessor designs to a network of over 2500 microprocessor and original equipment manufacturers called the ARM Connected Community. Among ARM's top customers, who are rather referred to as partners, are some of the world's leading semiconductor and IT system companies such as Intel, Samsung, Texas Instruments, AMD, Apple, Qualcomm, Fujitsu, Lenovo and others. These partners utilise ARM's technology know-how to create and manufacture systems-on-a-chip that are deployed in a wide range of electronic devices such as smart phones, digital TVs, washing and sewing machines, car braking systems, hard drives, network routers and other (ARM Company Profile, 2013).

ARM is a fabless semiconductor company without manufacturing facilities that specialises in designing and selling microprocessor intellectual property (IP) via a number of flexible licensing and royalty models tailored to address the needs of partners. According to ARM's business model, partners pay royalties for every ARM technology-based chip manufactured. In addition to the microprocessor IP, ARM produces and licenses a range of tools, physical or systems IP that optimise system-on-a-chip design known as the ARM architecture. Technology is supplied in two ways: one where ARM delivers whole designs (the ARM's architecture) and one where ARM delivers specifications, which are then used by partners in their own microprocessor designs.

Over 40 billion ARM-based chips have been shipped since the company's foundation in 1990. Headquartered in Cambridge, the company employs over 2300 people across 28 offices around the world, including design centres in China, Taiwan, France, India, Sweden, and the US. To date, ARM's technology is used in 95% of smart phones and tablets, 45% of digital TVs, 35% of networking devices, and 18% microcontrollers (ARM Annual Report 2012).

ARM explicitly declares innovation as one of its core values. According to ARM's public value statements, it considers itself innovating when it "*develops practical solutions to problems, draws upon alternative viewpoints and ideas to refine propositions, questions and challenges the way things have been done in the past, suggests new and better ways, recombines existing ideas in novel ways to create new things, is open to change,* [and] *supports others in their innovation*" (ARM Values 2013).

Notions and Definitions

Interviews with ARM's top executives and senior managers revealed that the terms ambidexterity, ambidextrous organisation, exploration, and exploitation are habitually used internally in relation to the company. Judging by the manager's use of the terms, ambidexterity is understood as a capability that implies three layers as commented by one interviewee:

(1) a temporal layer:

"exploiting yesterday's innovation and realising the full financial benefit from old innovations created 5 years ago" and *"looking at things … further ahead, 10, 20, 25, year time frame on where we are … going with business"*,

(2) a technology layer:

"working on quite well defined technology problems" and "branching out into areas that are less closely coupled", and

(3) business model layer: *"new business ideas … for areas that are outside the scope of business as usual today … making sure we don't miss an opportunity to grow and diversify the business"*. This also contains balancing financial gains: *"[balancing] the longer-term budgeting with … the short-term perceived share-holder requirements or share-holder pressure to be steadily growing our earnings"* (interviewee 1, senior executive).

Because these definitions embrace a number of organisational functions, it can be concluded that ambidexterity is perceived by ARM's managers as organisational rather than individual capability. The interview data also provides evidence of the role of the top managers in coordinating and prioritising among these various tasks. Although at this stage the study has not collected sufficient data to make substantial conclusions on behavioural and cognitive propensity of individuals to act ambidextrously, the agency of the company's leaders can be noted in initiating an opportunity search, creating loosely coupled dedicated structures for the established and experimental technological activities, and distributing tasks between the two structures.

One observation is that by actively stressing the need to foster exploration the managers communicate the dominance of exploitation in their present business. This in part can be explained by the nature of the semiconductor business development: incremental evolutionary improvement of microprocessor performance summarised in the Moore's law: doubling the efficiency while reducing the size and the cost of the microprocessor by a factor of two approximately every 18 months (Intel 2013). The predominant innovation path of semiconductor companies to make their devices smaller, cheaper, faster, and less energy consuming is also characteristic of ARM. This innovation strategy is reciprocated by partners who require incrementally improved microprocessor designs to update their existing products lines. An interviewee comments:

"we always try to evolve our product, that's the evolution and evolution is actually the easiest way of changing the future product, we've done the design of A or A plus some little bits. It's a very easy sell" (interviewee 2, top manager).

Importantly, the investigation so far has shown that current exploration activities predominantly concern the technology rather than the business model. ARM's business is fundamentally based on the licensing and royalties business model and although ARM engages with a multitude of partners through alliances, mergers or acquisitions, who in turn utilise ARM's technology in the variety of their business models, ARM hardly experiments with a different revenue generation model, but adheres to the licensing and royalties one.

Interviewees report that in terms of financial and human resources dedication the company's technological and business engagement with the existing microprocessor IP is always greater than with new microprocessor families. Thus, viewed as a whole, the company has a strong focus on exploitation of the technology IP reinforced by the evolutionary

development trajectory of the microprocessor technology and the licensing and royalties business model that gain power from exploitation: “designing once and licensing many times” is the business rationale of ARM underscoring the emphasis on exploitation (ARM Company Profile 2013).

Based on the qualitative interview reports, exploration and exploitation activities are neither equally represented simultaneously, nor pursued with the equal dedication intermittently. Exploration is always present alongside exploitation and is an essential component of ARM’s strategy and self-image, but it is always represented to a weaker degree in terms of human and financial resources dedication. Directing the focus to the company’s top executives and senior managers does allow a stronger conclusion about the ambidexterity of the company: it is top managers who have the strongest agency in decisions regarding the balance of explorative and exploitative processes. This is in accordance with prior findings that highlight the role of leaders as locus of ambidexterity (Smith and Tushman 2005). The question remains, however, if decisions regarding the balance at the top management level equal individual level ambidexterity, and if yes, how it translates to organisational ambidexterity and to what degree employees at other levels play a role at making their organisation ambidextrous.

It can be summarised that ARM is an innovative company which sees itself as ambidextrous by virtue of purposefully pursuing explorative activities alongside predominantly exploitative processes dictated by the evolutionary nature of the development of the dominant microprocessor technology and the semiconductor industry in which the company operates. From the organisational level perspective, it is early to make straightforward conclusions at this point regarding the ambidexterity of ARM’s organisational design. The important point of this study is that subsequent definitions of the firm’s organisational structure will depend not only on the choice of the theoretical framework from among the problematic theoretical conceptualisations to rely on in the analysis, but also on the stand point from which the organisational levels will be observed in the holistic study of the firm. Namely, following Cao et al. ARM can be described as practicing CD of ambidexterity, where innovation is represented by the combination of predominantly licensing and modifying the existing microprocessor cores and occasionally producing a new microprocessor design (Cao et al. 2009). Alternatively, following the original conceptualisation of Tushman and O’Reilly ARM can be viewed as weakly ambidextrous because exploration is not represented to an equal degree as exploitation in terms of human and financial recourses dedication (Tushman and O'Reilly 1996). In any case, the task of providing definitions and characterisations of the actual firm consists in more than choosing the most comprehensive theoretical framework, because theorisation diverges with the actual organisational complexity and the organisational reality offers phenomena observed but not yet theorised. What is also important is the impact of the levels of analysis (ambidexterity contexts) on the finial conceptualisation and the degree to which shifting between these levels matter for theoretical conclusions, which is the focus of this study.

Organisational Processes, Structures, and Managerial Decisions Associated with Innovation

Perhaps the first immediate finding regarding organisational structures for ambidexterity is the reported subdivision of ARM into two distinct structures: ARM 1.0 and ARM 2.0. These are somewhat metaphorical names reflecting the IT specialisation of the company and alluding to the Web 1.0 to Web 2.0 paradigm shift, a break up with the old way of using information and communication technologies (ICTs) and a qualitative change in understanding and employing ICTs, primarily the Internet. ARM 1.0 is charged with evolving current products and delivering financial results, whereas ARM 2.0 is vested with

experimenting *"completely outside the current business model" "in may be completely different cultures, systems, processes, etc." "[having] the freedom to develop into a completely different framework"* (interviewee 1, senior executive).

The ambition of ARM 2.0 is to explore business opportunities outside the existing corporate strategy and move away from the distinctive core technology to competences that are new to the company. For example, shifting from licensing microprocessor hardware designs to related but quite different technological competence – developing and licensing software IP, as well as experimenting with the licensing business model and form joint ventures, incubators, and merge with the companies that operate in different technological fields and markets: banking, security, server market, as well as getting involved into a new technological paradigm of the Internet of Things which spans a plethora of smart ICTs in a multitude of novel market applications such as smart home, telecare, transport, entertainment, and so on.

The AMR 1.0 structure is the core of ARM's business. It consists of four established product development units, which follow the existing product maps and advance the existing product lines in the corresponding divisions: Processor division (major revenue generator), Graphics Processor division, Tools division and Support and Services division. These divisions are charged with incremental advancement of the existing technologies and competences in the time span of one to five years. The corporate R&D division, which is concerned with the development of roadmaps for the near future, and the Advanced Product Development (APD) division, which is responsible for generating insights along the existing technological trajectories but in a longer time span of ten to twenty five years, are referred to by the interviewees as units extending the current business, thus, part of ARM 1.0.

Unlike APD, corporate R&D aims to operate outside of the scope of the product divisions and has more flexibility to explore new ideas and technology components, is based on intuition as well as informed by market intelligence, oriented on the long-term track record, and taps into external knowledge resources such as universities. It is accountable to the Chief Technical Officer who together with the Vice-President of R&D engages in iterative negotiations with R&D staff regarding technology development and allocation of funding. About 5-10% of corporate engineering activity takes place in corporate R&D (interviewee 1, senior executive).

ARM 2.0 has been established by senior management in recognition of the need to explore radical technological and business opportunities for the future. Unlike ARM 1.0 that employs the majority of the staff, ARM 2.0 in the words of an interviewee employs "a handful of people" (interviewee 3, top manager). The value of the unit is in strategic probing into new markets and experimentation with technology rather than tangible product development. The explorative function of ARM 2.0 consists not as much in new technology development as exploration of new environmental segments: generating business links with companies outside the traditional markets, for example, in security business, servers business, and the novel area of the Internet of Things. The scarcity of the collected data on ARM 2.0 aims and outcomes may be due to the initial stage of the research, but may also be indicative of the generality of its strategic purpose. The emphasised function of ARM 2.0 is scanning the business horizon with the aim of setting foot in radically new businesses via mergers, acquisitions, and investment activities rather than tangible product development outcomes. Technology and business opportunity exploration processes within ARM 2.0 are reported to be driven by the firm's value to innovate and is guided purely by intuition rather than any specified guidelines.

These observations allow us to describe ARM as embodying structural ambidexterity, where two organisational structures are strategically charged with explorative and exploitative innovations. However, the main business focus is reported to be always on the

core ARM 1.0 business. ARM 2.0 has a strategic rather than tangible function to seek to link with new businesses outside of ARM's main markets and technological and business model trajectory. This takes us to the next level of analysis.

Innovation Contexts. ARM's Ecosystem

In the words of a top executive *"the ambidextrous nature of organisation is not ARM itself, it's the eco-system"* (interviewee 4, senior executive). Being a comparatively moderate sized company in the semiconductor world ARM *"has a business relationship with every single microprocessor company that matters"* (interviewee 1, senior executive). ARM has attracted over 2500 Connected Community partners who are utilising ARM's architecture, including over 1000 partners with whom ARM collaboratively works on brining ARM's IP to life in individual design development. Considering the apparent interdependence and complementarity of ARM's IP licensing business model and the microprocessor manufacturers' facilities and infrastructure, there is a considerable value for the both parties in the connected community. ARM has estimated that it would cost every semiconductor company between $50 million to $150 million of R&D investments to reproduce what ARM does; ARM claims that "*by designing once and licensing many times, ARM spreads the R&D costs over the whole industry and thereby helps make digital electronics cheaper*" (ARM Company Overview 2013).

Using the metaphoric expression of an interviewee, ARM provides *"a little bit of magic ingredient"*, i.e. the ARM architecture, *"and everyone else does something with the magic ingredient"* (interviewee 4, top manager). Though ARM is locked into the relationship with partners and its business model would be meaningless without the complementary manufacturing and down-stream business capabilities of partners, the company is never dependent on any single partner or even a number of partners.

One distinctive feature of this eco-system is *"stickiness"* (interviewee 3, top manager): the long-term dependence of partners on ARM's architecture once it has been adopted. Choosing to put a certain microprocessor design at the heart of one's electronic product effectively means deep integration of a system of technologies into the product, which leads to a long-term commitment and painful though not impossible switching from the ARM's architecture to a potential alternative. Moreover, it is interdependence not only in terms of technology but also in terms of business relationships.

The importance of ARM's ecosystem to its business cannot be overestimated. The presence of a vast number of IP buyers: semiconductor companies, original equipment manufacturers (OEMs), mobile handsets and embedded devices manufacturers and so forth fuels ARM's licensing and royalties business model. Partners provide necessary complementarities to ARM's products: manufacturing facilities, service infrastructure, and sales and marketing channels. Moreover, partners and the wider market environment are no longer seen as something external to the organisation, the boundaries between ARM and its partners are blurring. ARM and the connected Community control complementary resources and the eco-system is vital to ARM. Partners bring AMR's microprocessor IP to life and provide a link to consumers of digital products powered by ARM chips. In this respect, ARM is often seen by partners as external R&D, explorative part of their businesses. Partners re-design, integrate, and manufacture, i.e. exploit, acquired IP in a variety of their business models, product lines, and areas of application. These complementarities alleviate the need to pursue a wide spectrum of exploitation and exploration activities in house for both parties. In this sense, ARM performs the exploration role while OEMs take on the exploitation part so that they collectively enact innovation ambidexterity in a broader social and market environment.

VI. Discussion

In view of the empirical findings presented above, interpretations of ARM's organisational design in terms of innovation ambidexterity will vary not only depending on the level of analysis, but also on the standpoint from which the level is observed. Challenges and contradictions arise when contexts and perspectives need to be combined for a holistic and dynamic study of the firm.

On the macro organisational level throughout its history ARM has been exploiting an IP licensing business model and has been strongly relying on the existing knowledge of system-on-a-chip and microprocessor hardware, which predominantly took AMR along the evolutionary development trajectory. Given the current widely reported focus on the efficiency of ARM 1.0 business (ARM Annual Report 2012), ARM can be considered an evolutionary exploitative business. However, it is not surprising that ARM's top managers emphasise exploring business and technology opportunities for the future along the efficiency according to the specified road maps and actively establish organisational processes and structure that support both. In this sense, they act ambidextrously and, thus, ambidexterity in ARM reveals itself at the individual level of top managers. However, it is not clear at this stage, whether and how individual ambidexterity of managers translates into a more dynamic organisational capability to exploit and explore apart from the structural arrangements ARM 1.0 and ARM 2.0 discussed above.

At the level of organisational divisions, given the presence of ARM 1.0 and ARM 2.0 structures, the company's organisational design resembles structural ambidexterity. However, serendipitous (unguided) explorative activities are carried throughout both the divisions of ARM 1.0: ADP and corporate R&D and the dedicated explorative ARM 2.0 structure and cross-fertilise predominantly exploitative and explorative activities in these structures. According to an interviewee, this is where *"the boundaries tend to become fuzzy: [product divisions] would actually be working on designing an implementation of a microprocessor, whereas [ADP] might be working on exploring new ways of creating part of the instruction set of a microprocessor which is not a product in its own right but it is maybe a technology ingredient. Separate from there you've got your corporate R&D which is where you potentially start branching out into areas that are less closely coupled. […] It is vital to create future ingredient technologies that will feed through into your products, and (do) I always wanna say blue sky, but it's not blue sky research"* (interviewee 1, senior executive).

Additionally, not only developing new technology components is characteristic for both ARM 1.0 and ARM 2.0 but also links with new partners, new markets, and new external knowledge via mergers and acquisitions of companies in the microprocessor or wider digital electronics industry. Even with the regard to the business model, explorative elements can be observed in the ARM 1.0 business, given the potential of the corporate R&D division to take the established technology and business model in which it is packed off its existing trajectory.

Furthermore, from the partner's perspective, the company as a whole is considered to be their external R&D, the complementary explorative part of their businesses. Partners are said to exploit system-on-a-chip designs developed by ARM in manufacturing electronic consumer products. At the same time, as mentioned before, some OEMs prefer to buy IP components rather than the ARM's system-on-a-chip architecture and take a substantial active role in redesigning IP for their own needs.

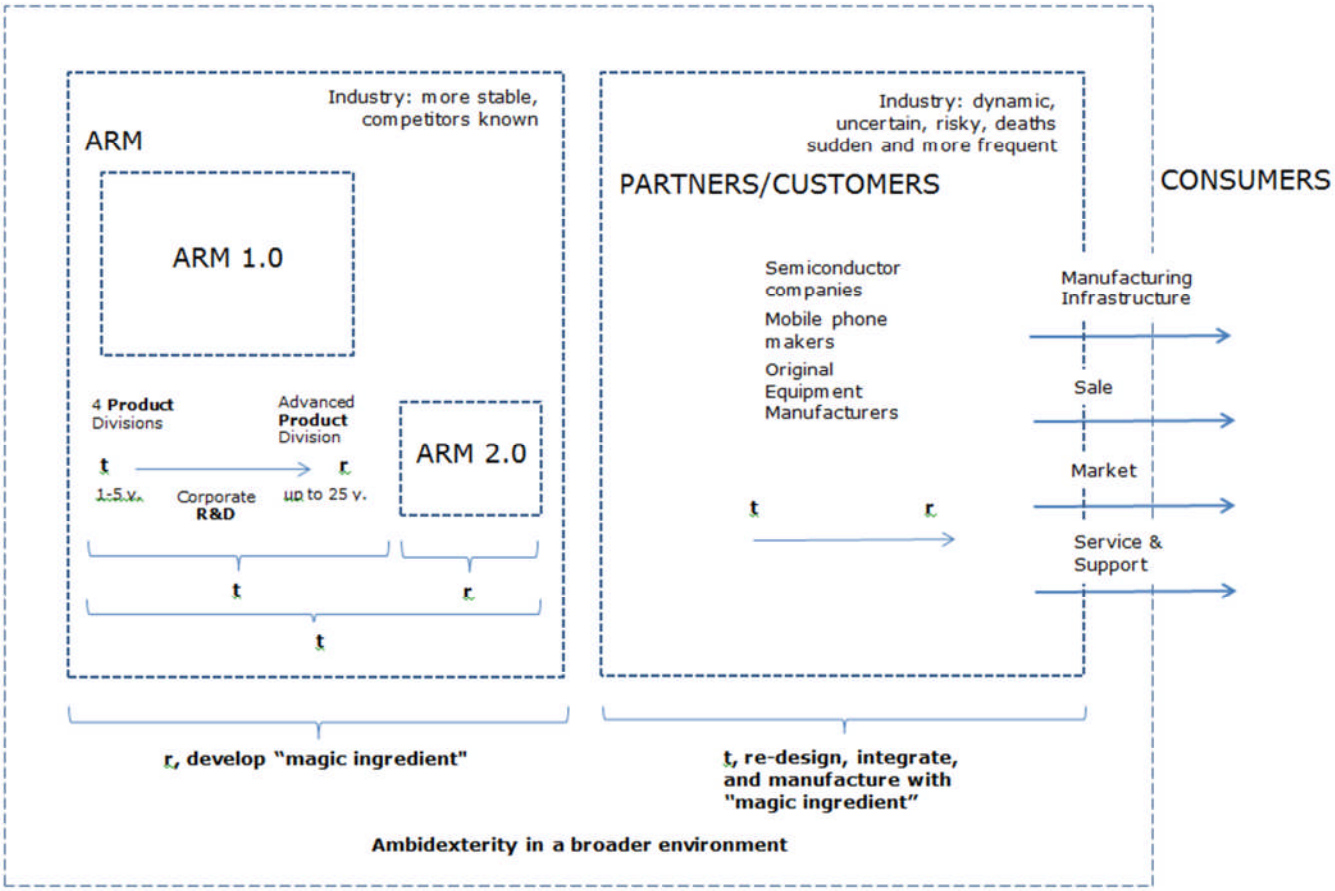
Lastly, given the complementarity of the Connected Community, ARM can be said to enact the ambidextrous design at the level of its wider eco-system, using the manufacturing, sales and marketing, service and support resources of the partners to bring ARM chip powered products to live. This is also in accordance with self-image of ARM as

ambidextrous organisation. These findings are presented diagrammatically in the figure below.

The advancement of digital technologies in the post PC era characterised by mobility, on-line presence, blurring of the boundaries between product lines most obviously seen among PCs, tables and smartphones, and unification in "the cloud" of mutually interconnected devices presents ARM with novel opportunities for capability development and recombination. While some innovative devices require cutting-edge systems-on-a-chip, other innovations thrive on microprocessor technology developed a decade ago which has implication to the balance of ARM's exploitative and explorative innovation processes. Because of the ARM's unique competence of designing the microprocessor core which lies at heart of every electronic device regardless of its level of sophistication, it can innovate equally successfully by advancing the technology proper, experimenting with the existing technology in the new areas of application or developing new systems-on-a-chip for new applications. This characteristic blurs the border between exploitation and exploration within ARM, which calls on conceptualisation of exploitation and exploration in relation to the level of analysis as well as theorisation across levels.

Figure. ARM's Nested Ecosystem

r - exploration, t - exploitation.



VII. Conclusion and Plans for Further Development

The goal of this study has been to analyse the inherent problematic inconsistencies between the normative interpretations of innovation ambidexterity, i.e. how organisations should build and benefit from ambidextrous designs, and the positive interpretations provided by the empirical evidence, i.e. the observed behaviour of the firm with regard to knowledge exploiting and exploring innovative activities. The paper illustrated that not only these diverge, but also, importantly, do the organisation's own interpretations of its behaviour differ from the definitions, propositions, and assumptions of the innovation ambidexterity framework. The greatest potential for further analytical insights of this empirical work is, perhaps, in the study of the ARM's ecosystem, which suggests blurring of the contexts of exploitation and exploration activities and employing multiple balancing mechanisms between various innovation processes.

Further empirical research will continue in ARM as the empirical setting for testing ambidexterity theory and will follow the methodological design and epistemological position presented above. Future research will aim at analysing various conceptualisations of innovation activities and defining the scope and conditions of the theory's application as well as assess its theoretical power in comparison with alternative theoretical frameworks that aim to understand firms' organisational design and choice of innovation strategies.

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