A QUESTION OF (MIS)ALIGNMENT: INNOVATION MANDATES AND ABSORPTIVE CAPACITY ROUTINES

Abstract: Research suggests that effective R&D requires the right combination of inward-looking and outward-looking absorptive capacity routines. However, we do not have an adequate understanding of how these routines influence innovative output in R&D units with different mandates. In this paper, we argue that adopting an absorptive capacity routine would positively or negatively influence the R&D subsidiary's innovative output, depending on whether the routine is aligned or misaligned with the subsidiary's innovation mandate to 'exploit' existing knowledge or 'explore' new knowledge. We test this using data collected from a global packaged-software firm with 14 international R&D subsidiaries that implemented six major absorptive capacity routines in the period 2000-2010. Our research provides new insights for both scholars and practitioners in R&D management, by showing that balancing of absorptive capacity routines should be considered in light of innovation mandates of subsidiaries as well as the firm. Our analysis also provides insights on why decision-makers may still adopt misaligned routines.

Key words: Innovation strategy, absorptive capacity routines, R&D mandates, technological innovation

INTRODUCTION

The purpose of R&D, argue Cohen & Levinthal (1989: 569), is not only to generate innovations, but also to develop "the firm's ability to identify, assimilate, and exploit knowledge from the environment". A firm that has these R&D knowledge capabilities can be said to have 'absorptive capacity' (AC); and according to Cohen & Levinthal (1990) this capacity is both inward-looking: acquiring knowledge from inside the organization, and outward-looking: gathering knowledge from the wider environment. Building on the routine-based view of capabilities, Lewin, Massini, & Peeters (2011) suggest that AC is comprised of routines; and mirroring the distinction between inward-looking and outward-looking AC, they suggest two distinct types of AC routines (ACR), namely internal ACR that acquire knowledge from the internal organizational environmental, and external ACR that acquire knowledge from the external organizational environment.

Research suggests that AC develops in response to organizational innovation requirements. These requirements, according March's (1991: 71) seminal theory of organizational learning, may direct the organizational processes towards exploration: search and experimentation activities that generate "new possibilities", or towards exploitation: activities that focus on developing "old certainties". However, March's (1991) theory also suggests that corporate R&D strategy must avoid becoming trapped in one of two extremes: exploitative R&D that exclusively mines the firm's existing knowledge base and past technologies, or explorative R&D that engages in developing multiple risky options that often fail to add to new knowledge.

To avoid this trap of extreme explorative or exploitative R&D, organizations often develop 'structural ambidexterity' wherein separate organizational units are given mandates for either exploration or exploitation. Benner & Tushman (2003) argue that a structural ambidexterity solution for R&D usually leads top management to mandate R&D units to focus their effort on exploitation – pursuing innovation within existing technological trajectories with a view to improving products that are already in the firm's portfolio; or exploration – directing R&D efforts towards creating significantly different products, often by accessing new external knowledge.

In this paper, we argue that in organizations with multiple R&D units, top management will often pursue structural ambidexterity by mandating units to be explorative or exploitative. Although the mandates instruct R&D units on the type of innovation it should pursue, they do not prescribe in detail what the units have to do. Instead, R&D unit managers are accorded discretion when it comes to selecting the processes they think are best for their R&D activities (Ecker, van Triest, & Williams, 2013). Exercising this discretion, R&D units adopt a range of absorptive capacity routines (ACRs). Some ACRs that are selected at the R&D unit level are aligned with the unit's assigned mandate – whether it is explorative and exploitative. But crucially, because units are not prohibited from adopting AC routines that are not aligned with the assigned mandate, units may decide that working with other units, or attaining greater efficiency, calls for adopting AC routines that are not aligned with their assigned mandate.

We examine the performance implications of R&D units adopting AC routines that are aligned and not aligned with their corporate mandates. Our main premise, in line with organizational alignment perspective, is that a firm's resources and capabilities must be aligned with its strategy for superior performance (Powell, 1992). We build on Gibson & Birkinshaw (2004: 209) argument that when it comes to ambidextrous organizations, performance will depend on creating "coherence among all patterns of activities in the business unit". Extending this point further, we argue that coherence, and its opposite, incoherence, are useful criteria for predicting the extent to which the patterns of activities in ambidextrous organizations can deliver competitive advantage. We therefore argue that R&D unit's adoption of ACRs interacts with its mandate, and that a unit's innovation performance is likely to be stronger when the ACRs are aligned with the mandate, and weaker when there is misalignment.

Our study has three key implications for research on ACRs. First, we provide evidence to show that the introduction of ACRs positively influences innovative output in firms. Using Lewin et al's. (2011) typology of internal and external ACRs, our study – to the best of our knowledge – is the first to provide evidence that the introduction of ACRs positively influences innovative output. Second, we show that ACRs do not work in isolation, but the alignment or misalignment with the

R&D mandate of a unit determines the influence of ACRs**.** Finally, and most significantly, we show that instances of misalignment between ACRs and R&D mandates can lead to poorer innovation outcomes. Our qualitative data provided further insights on why decision-makers still adopt misaligned ACRs.

ACRs AND R&D PERFORMANCE

Routine-based View of AC: Building on the stream of literature that views AC as built by organizational routines (Zahra & George, 2002), Lewin et al. (2011) propose two distinct types of ACRs: Internal and External ACRs. According to Lewin et al. (2011) internal ACRs relate to the efficiency of internal communication and sharing of knowledge produced in other units within the firm. In contrast, external ACRs target the acquisition of external knowledge that can be useful to the organization.

As is the case with other capabilities, the development of AC based on routines is also path dependent: ACRs are strongly influenced by prior problems and opportunities that organizations encounter as they search for knowledge (Zahra & George, 2002). Most organizations tackle the path dependency issue through structural ambidexterity i.e. they focus R&D efforts in a unit on one type of problem more than others. At the same time, because the adoption of new ACRs is ongoing and influenced by the innovation targets that R&D units are instructed to pursue – the mix of ACRs in R&D units is also likely to vary. Therefore, when top management explicitly instructs R&D units to follow an innovation mandate – specifically towards exploitation or exploration (Benner & Tushman, 2003), the question that arises is what influence would the adoption of ACRs have on the innovative output of R&D subsidiaries that have different mandates?

Influence of adoption of internal ACRs: Adoption of internal ACRs enable organizational units to share and access knowledge from other parts of the organization more freely and efficiently (Lewin et al., 2011). This may involve setting-up of cross functional teams (Freeman, 1989), establishing common development methodologies (Wheelwright & Clark, 1992), and setting up common

technological infrastructure and protocols for knowledge management systems (Davenport, David, & Beers, 1998).

Alignment of internal ACRs with exploitative mandate: Exploitation mandates require units to develop deep technical understanding of existing products, fill gaps in the product line, and incrementally extend products that have an established customer base. This requires R&D units to specialize in searching for opportunities near existing products and technological trajectories (Benner & Tushman, 2003). Evidence shows that R&D units with experience of exploitation tend to be more efficient at further exploitation and develop specialized competencies around existing products (Rosenkopf & Nerkar, 2001). As these units specialize, they become 'users of knowledge' from other units, which often hand over projects to specialized exploitation units (Gupta & Govindarajan, 2000). Therefore, to pursue an exploitation R&D mandate these units focus on utilizing internal knowledge. Since adoption of internal ACRs enhances the unit's ability to efficiently use internal knowledge, the unit is aligned with its mandate (Powell, 1992). Therefore, we expect:

Hypothesis 1(a): The adoption of internal ACRs in units with exploitative R&D mandate positively correlates with the unit's innovative output.

Misalignment of internal ACRs with explorative mandate: In contrast, an explorative mandate requires units to search for new technologies and markets. Execution of an exploratory mandate requires flexibility, autonomy, and freedom to experiment, all of which point to ambitious search for new technologies, building proof-of-concepts and prototypes, and market testing of new products and services (He & Wong, 2004).

Although explorative mandate requires seeking new knowledge that is completely new to the firm – and therefore is more likely to be found externally; the unit is also expected to serve as a 'provider of knowledge' to the rest of the organization (Gupta & Govindarajan, 2000). This means that even though adoption of internal ACRs is not aligned with the exploratory objective of the unit, internal ACRs are nevertheless essential for the unit to efficiently disseminate the newly acquired knowledge to the rest of the organization. For this reason, organizations often insist that all units

adopt common internal ACRs, even though such adoption is misaligned with some units' mandate. However, as the adoption of internal ACR is misaligned with the unit's R&D mandate of exploration (Powell, 1992; Gibson & Birkinshaw, 2004); adoption is likely to come at the cost of excessive standardization of processes that will reduce the unit's ability to capture new external knowledge needed for exploration. Therefore, we expect:

Hypothesis 1(b): The adoption of internal ACRs in units with explorative R&D mandate negatively correlates with the unit's innovative output.

Influence of adoption of external ACRs: R&D intensive firms often operate in environments where new knowledge is constantly being created. To ensure access to the latest knowledge, these firms develop external ACRs that are attuned to external knowledge sources (Lewin et al., 2011). The external ACRs enable capture of knowledge from external sources, and run the gamut from regular interactions that solicit end user feedback, to knowledge gained from long-term co-development of new products and services. These ACRs facilitate learning from partners, suppliers, customers and research institutes (Von Hippel, 1986).

Misalignment of external ACRs and exploitative mandate: As discussed, an exploitative mandate requires innovating 'near' existing products and technologies. The need for efficiency and control in such R&D units often leads to clear delivery goals and demands of executing projects within strict project management guidelines of time, cost and quality (He & Wong, 2004). While an exploitative mandate is aligned with the adoption of internal ACRs, incorporating the R&D mandate into the unit's activities is left to the managers. Local R&D managers may often resist strict implementation of only internal ACRs for exploitative R&D because this constrains their unit's ability to conduct explorative research. Managers may therefore want to expand the scope of the exploitative mandate by seeking more R&D responsibilities from the headquarters (HQ) (Bouquet & Birkinshaw, 2008). For instance, they may argue that satisfying customer demands calls for explorative R&D in their unit, or that failure to adopt external ACRs may hurt in the long-run. In contrast, if managers of a unit with exploitation mandate adopts external ACRs, they not only run the risk of diverting valuable resources

away from current focus areas but also the risk of excessively diversifying the unit's search scope to the determinant of more focused search on exploitative opportunities (Powell, 1992; Taylor & Helfat, 2009). Therefore, we expect:

Hypothesis 2(a): The adoption of external ACRs in units with exploitative R&D mandate negatively correlates with the unit's innovative output.

Alignment of external ACRs and explorative mandate: R&D units that work under an explorative mandate are set up to pursue new technological trajectories. This calls for reaching out to the wider environment for external knowledge sources that is not available internally (Monteiro & Birkinshaw, 2016). Adoption of external ACRs facilitates this process (Powell, 1992; Taylor & Helfat, 2009). Therefore, we expect:

Hypothesis 2(b): The adoption of external ACRs in units with explorative R&D mandate positively correlates with the unit's innovative output.

Based on these four hypotheses we propose the following 'interaction-model' of alignment and misalignment of ACRs and organizational mandates influence a R&D unit's innovative output.

----------Figure 1----------

DATA AND ANALYSIS

Research context: Scholars have pointed out that routines that build AC are unique, context specific, and embedded in the organization (Gibbons & Henderson, 2012). Therefore, to study the impact of R&D mandate on the adoption and effectiveness of the same routine we use data from multiple R&D subsidiaries of a single large packaged-software firm: SAP, a global packaged software producer. Like most large technology firms, R&D at SAP is globalized and managed out of 14 international R&D subsidiaries. Our choice of the firm was dictated to some extent by access to top management, and the firm's willingness make internal information available for research. Confining our data to one firm limits the generalizability of our findings, but it also has important advantages. To begin with, the firm operates in a single global industry i.e. it operates only in the packaged software industry.

Consequently, all of SAP's 14 R&D units, referred to within the company as 'subsidiaries' are focused on packaged software development and maintenance. We decided to drop the R&D activity at the HQ as the R&D was not set up separately, and thus not easily distinguishable from other corporate activities.

Using a single firm ensures that we are studying the same set of internal and external ACRs across all units. Therefore, using the subsidiary as our unit of analysis, and a longitudinal design, we can observe changes in different subsidiary's innovation performance as these ACRs are introduced. This means that our focus is deeper than previous research in this area as we aim to understand the nature and impact of the same ACR in organizational units with different mandates.

When it comes to allocating R&D investments, in the case of SAP, an overview of the R&D strategy reveals that the company essentially had two mandates for R&D investments in line with the typology proposed by Benner & Tushman (2003) and developed by scholars such as Sofka, Shehu, & de Faria (2014). The R&D investments to subsidiaries are either directed towards extending or maintaining existing products and technologies, i.e. an exploitative mandate, or they are directed to developing new products and technologies, i.e. an explorative mandate. Conceptually, this is a typical case of structural ambidexterity that "entails not only separate structural units for exploration and exploitation but also different competencies, systems, incentives, processes, and cultures—each internally aligned" (O'Reilly & Tushman, 2008: 192).

Data: We collected in-depth longitudinal data about the implementation of six major ACRs and mandates for all 14 global R&D subsidiaries for the period 2000-2010. There were three sources of data. First, we conducted detailed semi-structured interviews with 17 senior executives, including the executive board member responsible for R&D for the entire organization, the senior vice-president heading the R&D centres, five managing directors of different R&D subsidiaries, various vice-presidents of R&D based at the headquarters as well as from subsidiaries. These executives were identified by the senior vice-president heading the R&D centres and collectively they are responsible for setting the firm's R&D strategy. The interviews were conducted in 2010/2011 and further

information for clarification was collected in 2013/2014. Second, we were given access to more than 200 pages of internal reports, and numerous presentations. We also had more than 50 email correspondences with various managers clarifying and detailing the evolution of the R&D network and the implementation of various internal and externally focused organizational practices. Third, we collected all publicly available information about the firm and its subsidiaries. This includes patent applications (from European Patent Office (EPO)), acquisition records (from Factiva and SDC Platinum), press coverage on external practices (from Factiva) and key announcements like launching of new projects or significant investments in R&D (from Factiva).

Measures: ***Dependent variable:*** Subsidiary's innovative output. We use the count of patent applications made by employees of a subsidiary as the innovative output for each subsidiary in each year. Patents are regularly used as a measure of a firm's innovative output because they represent new knowledge created by the organizational unit (Kotha, Zheng, & George, 2011). Although our use of patent application count as a direct measure of innovative output is in line with past studies of innovation, we are mindful that in many industries not all R&D leads to patents, and not all inventions are patented. In the case of the packaged-software industry, R&D activity and patenting are closely aligned, reducing potential measurement bias (Gittelman, 2008). As in any technology intensive industry, patenting in the packaged-software industry is regarded as the grant of a property right to an inventor or a group of inventors for an invention. But in this industry, the rate of technical change is such that patent applications are considered vital for protecting any idea that is technically useful even when their market value is uncertain (Corrocher, Malerba, & Montobbio, 2007). SAP's approach to patenting conforms to this industry practice.

Independent variables: Count of internal & external ACRs. First, as part of our preliminary interview, the senior vice president heading the R&D centres helped us identify an initial list of practices that may have had an impact on accessing internal and external knowledge. Then as part of our interviews, we asked the executives to single out the most important 'standard practices', or routines, that had a significant impact on the ability of R&D teams to access internal or external sources of knowledge. To control for retrospective biases, we asked the executives to focus on

specific parts of the study period and corroborated the responses across interviewees as well as with documentary evidence (where available) to precisely track the introduction of the practice and any changes thereafter. We identified 3 internal and 3 external practices that were singled out as having had significant impact by the management team. Table 1 provides a description of the ACRs and how they relate to similar routines discussed in the AC literature. Appendix 1 provides further details about these ACRs. In the organizational context these routines are interchangeably called standard operating procedures, best practices or simply standard practice.

We identified the year in which a routine was rolled-out in each subsidiary. In a few cases a routine was withdrawn (e.g. withdrawal of the co-location policy) from some locations, while in a few cases there was a time lag between the initial roll-out and the full adoption of a routine. These cases were identified by managers with specific knowledge of such cases and were excluded from the active routine count. Subsequently, we created a record to count the number of active internal and external routines for each subsidiary-year.

----------Table 1----------

Exploitative and Explorative Organizational Mandates: Bettis & Prahalad (1995) note that the views of top managers, preferably obtained by first-hand interviews, are suitable source of data for determining the organizations strategy. We conducted semi-structured interviews with 17 senior executives in R&D. The interviews lasted between one-two hours, were recorded and transcribed. At least two researchers were present at all interviews. We followed an interview protocol for the semi-structured interviews. We used the interview text to establish HQ mandate to R&D units. Appendix 2 lists the key terms and further details we used for coding of the mandate. We treated subsidiaries engaged in 'blue sky' projects without anticipated payoff horizon, or product or technology research projects that are in an early stage, as following an explorative mandate. In contrast, we considered subsidiaries with relatively more mature and stable projects relating to existing products and technology, as following exploitative mandate. Based on our interviews with top managers we coded

the mandate for each subsidiary-year as two dichotomous variables i.e. presence of exploitative R&D mandate, and presence of explorative R&D mandate. Appendix 3 provides an overview of the data.

Control variables: We collected data on the following four control variables: Size, collaboration with HQ, number of acquisitions and age of the subsidiary. (a) Size: Previous research suggests that organizational size strongly influences innovation (Damanpour, 1992). We therefore used the size of the subsidiary as a control variable – measured by the average number of employees involved in R&D work in each subsidiary-year. Development headcount is a better estimate than R&D cost as we found that the average cost per developer in a high cost location (e.g. US or Germany) can be up to four times the average cost per developer in a low-cost location. (b) Collaboration with the HQ: Many scholars have proposed that a subsidiary's position and ties with the key source of internal knowledge may also influence its access to knowledge and therefore its innovative output (Schleimer & Pedersen, 2013). In a multinational R&D Network, the HQ is the primary source of internal knowledge and a tradition of collaboration with the HQ is likely to give the subsidiary more access to the HQ's knowledge pool. The collaboration with the HQ was measured as the percentage of joint patent applications between the subsidiary and the HQ. A higher percentage of joint patent applications indicate a stronger link with the HQ. (c) Number of acquisitions: Acquisitions can be a major source of new knowledge in a subsidiary. We count the number instances for each subsidiary-year where an acquisition valued over $100 million was integrated. (d) Age of the subsidiary: Scholars such as Autio, Sapienza, & Almeida (2000) have suggested that age is a key determinant of a unit's ability to acquire knowledge. Therefore, we control for age, measured as the number of years a subsidiary has been operational.

Methods and analysis: Since our dependent variable is count of patent applications we use a Poisson model. This is a better model than a negative binomial model as the fixed effect in those models lies in the variance term rather than the mean, making the negative binomial model misleading (Allison & Waterman, 2002). Table 3 reports the estimates of a panel Quasi Maximum Likelihood (QML) Poisson model with fixed effects for the dependent variable. A panel data model within the same organization enables us to effectively study variables that change over time but remain the same

across subsidiaries. In our model, we assume that something (unobserved) within the subsidiary may impact or bias the dependent variables and we need to control for this. A fixed effect model removes the effect of those time-invariant characteristics, so we can assess the independent variable's net effect.

Results: The descriptive statistics and correlation table (Table 2) show that as expected both internal and external ACRs are positively correlated with the innovative output of the subsidiaries. Next, we find that the control variables - age of the subsidiary, number of acquisitions and the size of the subsidiary are all positively correlated with the dependent variable. This supports our choice of controls. The correlation table also points to the relative adoption of internal and external ACRs by subsidiaries with exploitative and explorative mandates. For instance, we find that subsidiaries with an exploitative mandate are more likely to adopt internal AC practices and subsidiaries that have explorative R&D mandates are more likely to adopt external ACRs. This suggests that subsidiaries try to align ACRs to the mandate. Another interesting observation from the descriptive statistics table is that the collaboration with the HQ is positive in subsidiaries with an exploitative R&D mandate whereas it is negative in subsidiaries with an explorative mandate.

----------Table 2 & 3----------

We are specifically concerned with the directionality of the effect i.e. the sign of the coefficients. In model 2 of the regression table (Table 3) we find that the introduction of internal and external ACRs improves the units' innovative output. This provides empirical evidence to shows that the incidence of technological innovation is positively influenced by the build-up of AC, through the introduction of ACRs. Next, we take a closer look at how this impact can be understood as an interaction of the ACRs and organizational mandates. In model 3 and 4 we find support for all our hypotheses of the interaction model. We find that the influence of the internal ACR is boosted by the presence of an exploitative R&D mandate while the introduction of internal ACRs in a unit with an explorative mandate negatively influences its innovative output. Similarly, the introduction of external ACRs in a unit with an explorative R&D mandate positively influences its innovative output and has a

negative influence when the unit has an exploitative R&D mandate. However, in the full model (model 5), the results are significant only for the subsidiaries with an exploitative mandate. To ensure the validity of our results we obtained additional information from a senior manager from the organization who provided further insight that we discuss in the discussion section.

DISCUSSION AND IMPLICATIONS

Organizational scholars tend to reconcile opposing priorities such as exploration vs exploitation, or internal vs external ACRs, by proposing a balancing approach (Cohen & Levinthal, 1990; Tushman & O'Reilly, 1996). Conceptually, such a balance can be achieved through various mechanisms most notably: punctuated equilibrium i.e. one priority at a time within the same unit (Gersick, 1991), and structural equilibrium i.e. specialization of sub-units over time (O'Reilly & Tushman, 2013). This paper highlights the underlying dynamics involved in achieving a balance through structural equilibrium. In this section, we discuss our findings in the context of ACRs and draw implications for AC theory and practitioners involved in R&D management; particularly in organizations that have a structural equilibrium approach.

In our data, there is indication that decision makers try to align ACRs with mandates. This is in line with evidence from prior research that shows ACRs are more likely to be adopted when managers perceive them to be useful in meeting their R&D objectives. For instance, Allen, Lee, & Tushman (1980) found that when organizations pursue incremental innovations in existing products and processes, they stand to benefit from adopting good internal knowledge sharing practices. While Cardinal (2001), in a study of pharmaceutical firms, found that projects that had an exploratory objective were more likely to tap external knowledge sources. This observation is also reflected in our interview data. For example, a senior vice president in R&D pointed out the essential role of internal ACRs in subsidiaries with exploitative mandates:

"We have some labs with a pure maintenance focus … [standard X] makes sure that we keep a common development standard across this network [of R&D units doing maintenance]"

This is also likely to be the case for external ACRs and exploration mandates, as is evident from the high correlation between these two variables in table 2. For instance, an R&D subsidiary was built with the mission of connecting with external stakeholders in a key market. In this case, external ACRs clearly enable this objective and are likely to be encouraged. A development head recounted the underlying reasons for setting up a research centre in Silicon Valley as:

"[A founder of the firm] moved to Palo Alto to set up a lab there … our largest partners were American, North America was our biggest market … we wanted to be part of the innovation from the Silicon Valley"

On the other hand, we find that misalignment of internal ACRs and explorative R&D mandates can negatively influence innovation outcomes. This is in line with prior studies that show internal ACRs can impose strict standards that form barriers to innovation because they run counter to the requirements of new product development (Dougherty, 1992). Similarly, in our context, when internal ACRs are introduced in subsidiaries with an explorative mandate, managers do not always find them useful in meeting their primary objective. However, these internal ACRs are often imposed by corporate teams to ensure more effective diffusion of new knowledge throughout the organization. As one senior executive at a unit with an explorative mandate points out:

"I encourage my developers to experiment. There are no rules here. We want to build the latest and greatest cutting-edge technology… You will see this in the culture in everything we do. The way we work, our workspace, the tools … everything." He later adds *"Our strategy is to innovate on a stable core, which means that whatever innovations we bring must complement and not disrupt the core. It is very important that the customer's landscape is not disrupted and that the end-user has a seamless experience... We have to follow the same development standards as everyone else."*

Therefore, we find that internal ACRs are often adopted in a subsidiary with an explorative mandate due to the potential benefits for the rest of the organization – even though it may be perceived as 'bureaucratic' and may lead to *excessive standardization of processes* in these subsidiaries. We find that decision-makers are cognizant of the wider benefits to the organization even

though adoption of internal ACRs may not be aligned with their own immediate exploratory objectives. As a development head at a subsidiary with an exploratory mandate compared adopting a standard development methodology to the trial and tribulation of learning a common language to communicate.

"… imagine if we were all speaking our own languages … I may have wonderful ideas, but I will not be able to tell it to anyone. … So naturally, folks [internally] need a common language first. Without this there will only be islands, there will be no real network… But it's very difficult."

Misalignment can also happen when units with an exploitative R&D mandate adopt external ACRs. When the mandate of the organizational unit is to exploit existing knowledge, the introduction of external ACRs exposes the unit to external knowledge that is new and often unrelated knowledge. This expands the knowledge pool available to the unit. But the additional knowledge may lead to an *excessive diversification of the scope* of the unit. In addition, the adoption of external ACRs, especially by units with an exploitative mandate, can be costly. It may be one of the reasons why decision makers in exploitative units generally avoid investing in such routines. Nevertheless, in our dataset we found that 13 out of 41 exploitative subsidiary-years had at least one active external ACR. One explanation of why decision makers in exploitative units adopt ACRs that may cause misalignment is provided by institutional theory, which argues that mimetic and normative mechanisms may lead to adoption of routines independently of the mandate of the subsidiary (DiMaggio & Powell, 1983). As a Managing Director of an R&D centre with an exploitative mandate notes:

"We are here not just because of the cost and talent. We see great opportunities in this location for both the market and the partner ecosystem … We want to develop our local ecosystem … [by] training partners … [by] training university students"

Limitations: Our study has several notable limitations. First, our analysis is limited by our decision to study the *same* ACRs across multiple units in one firm. Future studies may seek to compare similar routines across a sample of firms. Second, we have assumed that ACRs and mandates have the same

magnitude, and are dichotomous (explorative or exploitative). While this greatly facilitates our analysis, a study that examines greater variety of ACRs and mandates, at different strengths, should provide more nuanced analysis. Finally, as many scholars have noted – the count of patents does not capture all innovative output and not all patents have the same potential for commercialization. An examination of the impact and quality of inventions would further improve our understanding of this effect.

CONCLUDING REMARKS

In this paper we examine how the R&D mandates that are formulated by top management influence the innovative effectiveness of ACRs. We find that while organizations may wish to tailor each R&D unit's ACRs to fit with the unique context in which it operates – the fit is often imperfect, i.e. R&D Mandates and the ACRs of the unit that must follow the mandate are often misaligned resulting in suboptimal innovation outcomes. This suggests that from the point of view of optimizing innovation productivity practitioners may want to consider setting targets and incentives for the firm, as opposed to setting targets and incentives for individual subsidiaries.

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TABLE 1: LIST OF ACRs

Routine	**Nature of the routine**	**Description**	**Similar routines in AC literature**
Standard development methodology [Standard X]	Internal AC	A common standard of how the firm aims to innovate, produce, and manage products throughout the entire lifecycle i.e. from design to maintenance across multiple versions, teams and locations. It contains specific guidelines on all aspects of development most notably documentation and knowledge management, software security, testing and production standards.	Standardization of processes to ensure efficiency in sharing internal knowledge, interoperability and interchangeability across projects. (Kanigel, 2005; Wheelwright & Clark, 1992)
Co-location programs	Internal AC	A program in which a group of expatriates are sent to a location to achieve a specific objective like setting up of a new R&D centre, new team, or participate in long-term intense development activities.	Expatriate programs to facilitate internal knowledge flows (Chang, Gong, & Peng, 2012; Mäkelä, 2007)
Mandatory setting up of cross functional teams	Internal AC	The R&D organization had built up teams of specialists who were not necessarily part of the core development team. For example, specialists in user interface (UI) design or quality management were included in an actual development project only at the behest of the development head.	Setting up of cross functional teams to promote the crosspollination of ideas (Freeman, 1989; Sethi, Smith, & Park, 2001; Clark & Wheelwright, 1992)
Links to the local developers' community	External AC	Program to establish connections with the local developers' community. A local subsidiary organizes events where members of the community are invited to participate in various activities like showcasing new ideas, demonstration of prototypes and products, co-development projects.	Development of local networks with partner organizations, universities and research institutions to improve the firm's ability to learn from external knowledge (Koch & Strotmann, 2008).

Alliance with local partners	External AC	Program of collaboration with local partners in co-development mode within the research centre.	Co-development, partnerships, and alliances as source of new knowledge for the firm (Dyer & Singh, 1998; Tether, 2002; Joshi & Nerkar, 2011)
Collaborating with local customers	External AC	Standardized program in which teams of developers work with early adopters of technology in the local market.	Customer engagement and lead user engagement programs as source of new opportunities for innovation. (Foss et al., 2011; Von Hippel, 1986, 2009)

TABLE 2: DESCRIPTIVE STATISTICS

	Variable	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8
1	Subsidiary's Innovative output	15.18	23.78	0	151								
2	Internal ACRs	1.13	0.77	0	3	0.21*							
3	External ACRs	1.46	1.00	0	3	0.34***	0.23**						
4	Exploitation mandate	0.32	0.47	0	1	-0.10	0.25**	-0.52***					
5	Exploration mandate	0.73	0.45	0	1	0.08	-0.08	0.74***	-0.84***				
6	Age of the subsidiary	6.56	4.51	1	34	0.31***	0.51***	0.40***	-0.02	0.15+			
7	Collaboration with HQ	29.94	32.16	0	100	0.05	0.03	-0.08	0.33***	-0.29***	-0.08		
8	Number of acquisitions	0.16	0.48	0	4	0.38***	0.20*	0.26**	-0.05	0.09	0.22*	-0.03	
9	Size of subsidiary (log of headcount)	5.32	3.26	3.91	7.60	0.48***	0.42***	0.14	0.32***	-0.18*	0.46***	0.10	0.32***

Sample size 14 subsidiaries, 128 subsidiary-year observations
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

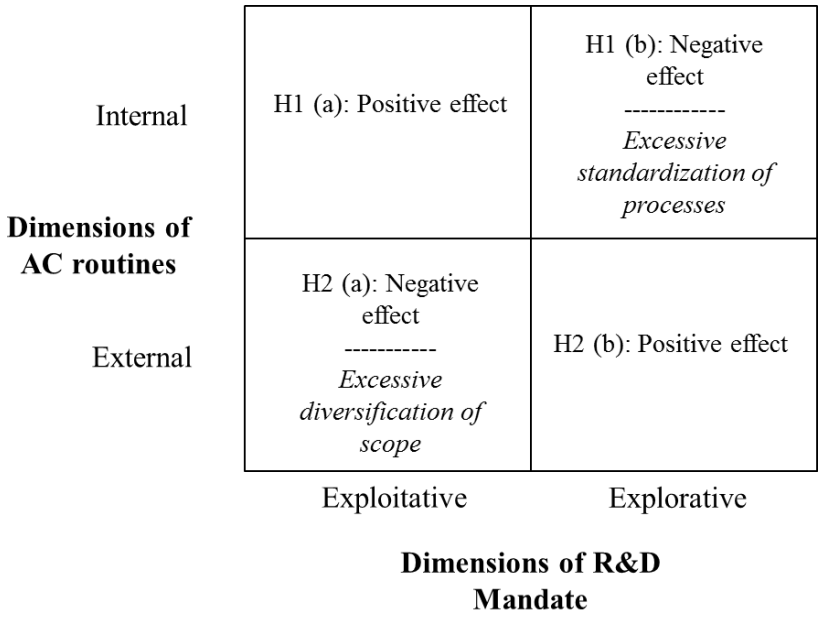
TABLE 3: RESULTS OF A PANEL QML POISSON REGRESSION WITH FIXED EFFECTS FOR SUBSIDIARY'S INNOVATIVE OUTPUT

VARIABLES	Evidence for hypothesis	Model 1 Base		Model 2 Only ACRs		Model 3 ACRs and Exploitation mandate		Model 4 ACRs and Exploration mandate		Model 5 Full model	
Exploitation mandate						-0.67*	(0.34)			-0.74	(0.47)
Exploration mandate								0.16	(0.34)	-0.16	(0.47)
Internal ACRs				0.15*	(0.06)	-0.37***	(0.09)	0.61***	(0.11)	-0.49*	(0.21)
External ACRs				0.40***	(0.07)	1.22***	(0.15)	0.26+	(0.13)	1.31***	(0.26)
Internal ACRs * Exploitation mandate	H1(a)					1.10***	(0.13)			1.19***	(0.19)
External ACRs * Exploitation mandate	H2(a)					-1.09***	(0.17)			-1.12***	(0.22)
Internal ACR * Exploration mandate	H1(b)							-0.74***	(0.13)	0.13	(0.20)
External ACR * Exploration mandate	H2(b)							0.39*	(0.16)	-0.08	(0.22)
Age of the subsidiary		-0.02	(0.02)	-0.01	(0.02)	-0.02	(0.02)	-0.02	(0.02)	-0.02	(0.02)
Collaboration with HQ		0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Number of acquisitions		-0.03	(0.03)	-0.03	(0.03)	0.05	(0.03)	0.03	(0.03)	0.05	(0.03)
Size of subsidiary (log of headcount)		0.28***	(0.07)	0.30***	(0.07)	0.13+	(0.08)	0.23**	(0.08)	0.14+	(0.08)
Subsidiary FE		Yes		Yes		Yes		Yes		Yes	
Year FE		Yes		Yes		Yes		Yes		Yes	

Observations	128	128	128	128	128
Number of subsidiaries	14	14	14	14	14
Wald Chi^2	522.23	550.73	637.54	580.32	638.67
$P > Chi^2$	0.00	0.00	0.00	0.00	0.00
Log likelihood	-374.31	-352.71	-304.42	-333.19	-304.14

Standard errors in parentheses, year dummies calculated not shown
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

FIG 1: THE INTERACTION OF ACRS AND R&D MANDATES AND ITS INFLUENCE ON ORGANIZATIONAL UNIT'S INNOVATIVE OUTPUT



APPENDIX 1: DETAILS OF ABSORPTIVE CAPACITY ROUTINES

Routine	**Nature of the routine**	**Description**	**Similar routines in AC literature**
Standard development methodology [Standard X]	Internal AC	The Standard X methodology was rolled-out across all locations in the period 2004 – 2006. During this time frame all developers underwent training relevant to their role on how to adopt these standards. This common development standard is considered to be a significant enabler in the globalization of R&D. As one of the development heads pointed out - *"I have teams in Germany, China and India … these standards ensure that we are all on the same plane of reference. It ensures that all our products are developed to the same highest standards wherever its developed"*	Standardization of processes to ensure efficiency. For example Szulanski (2000) notes how the 'copy exact' principle is used by organizations to leverage optimization of processes across different units. A standardized development methodology is known to create the basis for interoperability and interchangeability of pieces of large projects (Kanigel, 2005; Wheelwright & Clark, 1992) In their review of AC routines Lewin et al. (2011) also note that routines that share of superior practices and knowledge are key internal AC routines.
Co-location programs	Internal AC	A program in which a group of expatriates are sent to a location to achieve a specific objective like setting up of a new R&D centre, new team, or participate in long-term intense development activities. The co-location program is separate from short term travel (which is common). As part of this practice the group of developers are given long term (usually more than 12 months) expatriate contracts. If more than 1% of the employees of a location are on expatriate contracts then the host location is said to have an active co-location program.	The use of practices involving expatriate to facilitate internal knowledge flows is well documented. (Chang, Gong, & Peng, 2012; Mäkelä, 2007)

		Such programs are estimated to be quite expensive for the firm and require approval from a board level executive. This routine was practiced in a number of locations between the years 2002 – 2007 but discontinued in most locations due to cost reasons. A development head notes the importance of this initiative in the early stages of development of a project – *"Three [locations] is not a very good number from a coordination perspective… they are crying for co-location sessions! They believe that co-location would benefit and focus now [early stages]"*	
Mandatory setting up of cross functional teams	Internal AC	The R&D organization introduced mandatory policy of setting up cross functional teams as part of a major reorganization. This was introduced in 2009 and was subsequently implemented across locations in a phased manner. Such routines enable development teams to identify new opportunities as they plan and develop as opposed to discovering opportunities on completion of development – when it might be too late or too expensive to implement. A development head pointed this out as - *"Experts can contribute early on in the development cycle … quality managers can work with the developers to fix bugs as they appear … [so that] the developer would not do the same error again"*	In the technology management literature the internal routines of setting up of cross functional teams has been known to promote the generation of new ideas (Freeman, 1989; Sethi, Smith, & Park, 2001; Clark & Wheelwright, 1992)
Links to the local developers' community	External AC	The programs were first introduced before 2000 and replicated in other subsidiaries later. As part of the routines the local subsidiary organizes 2-3 day events where members of the community are invited to participate in various activities like showcasing new ideas, demonstration of prototypes and products, co-development projects etc. These events target freelance developers and individuals from partners firms and universities.	Routines that enable the development of local networks with partner organizations, universities and research institutions are known to improve the firm's ability to learn from external knowledge (Koch & Strotmann, 2008).

		This routine not only provides a gateway to establish connections with the local developers' community it also serves as a multiplier. For example, the head of a local community development program notes – *"When a partner sees a demo of an exciting new product that was developed with another partner, they want to do the same with us… [This event] makes our ecosystem grow."*	
Alliance with local partners	External AC	The program was practiced in a subsidiary before replicated to others as part of a centrally coordinated effort to engage with local partners. As part of this routine, developers co-locate to the R&D centre of the firm to pursue a common objective. The infrastructure is jointly sponsored by the firm and the partners. Before commencing on such collaboration, an alliance agreement is signed between the involved parties. Partners bring in their expertise and new knowledge into these collaborations. The development head of this initiative notes – *"We and our partners bring the latest generation hardware and software [as part of this program] … we hope that this collaboration will lead to prototypes that can meet the most pressing challenges and opportunities"*	Routines that build different types of long term relationships with partners can be a source of new knowledge for the firm. These routines can be co-development relationships (Dyer & Singh, 1998) , R&D partnerships (Tether, 2002), or strategic alliances (Joshi & Nerkar, 2011)
Collaborating with local customers	External AC	The firm introduced a standardized program in which teams of developers from a R&D subsidiary work with early adopters of technology in the local market. As part of this initiative developers get feedback directly from the end user of the prototype. This often leads to fine-tuning of the product's features, release dates etc. These collaborative engagements are usually set up with important long-term customers and are bound by confidentiality agreements. Customers and end-user feedback during the early stages of the	Customer engagement and lead user engagement programs are known to be a source of new opportunities for innovation. (Foss et al., 2011; Von Hippel, 1986, 2009)

		product lifecycle can provide valuable insights. For example a development head notes that – *"One of our largest customer wanted [a new application] seamlessly integrated with … We set up a project with the customers to prototype this new app … now it is a standard feature"*	

All references are available in the main document

APPENDIX 2: DETAILS OF SUBSIDIARY MANDATES

Mandate	Project attributes	Location attributes	Typical performance indicators	Typical quotes from executives
Exploitative	Presence of R&D topics that were initially developed in other subsidiaries and were subsequently relocated. Key terms used in this context are hand-over, localization, integrations, and building on core/stable products, maintenance These topics were described to have strict delivery road maps, characterized by long periods of knowledge transfer, quality management, testing or maintenance.	The subsidiary was set up organically (As opposed to an acquisition) and the reasons of founding were observed as availability of low cost talent in large numbers, overlap of normal working hours with the HQ, or common communication language	The subsidiary's performance is likely to be measured by the following metrics: fully loaded cost per developer, attrition/ turnover, project delivery timelines, quality of products	"The entire [Product P] is *now* developed from this location" Product P is a mature and stable product. Its largest market is the US. It was conceived and initially developed in other subsidiaries and the responsibility for future incremental releases and maintenance was later transferred to this subsidiary.
Explorative	Presence of topics that are at the early stages of research, including prototyping and market testing. Key terms used in this context are next generation, design, prototypes, demos, future technology. These topics also have delivery timelines but the focus is more on building the 'latest' and 'greatest' products for	The subsidiary was acquired and the reasons for founding were observed as presence of partners, key customers or specific technical experts (start-ups) or academic research centres. Or the subsidiary was established despite it relatively high cost. Typically, 3 -4 times	The subsidiary's performance is likely to be measured by the following metrics: Innovations in the development of new products, technologies, design that generate new revenue opportunities, product launches.	"We want to build the latest and greatest cutting edge technology" The team was working on a new UI technology that would be used by other teams in the future. "We are in investment mode now. It's not revenue generating – yet!"

	the future rather than sticking to a deadline.	more than exploitative subsidiaries.		Indicates that this project is in an early stage of research.

In our study period, while most subsidiary mandates remained same, we observed changes in a few cases. This happened for two reasons. First, due to acquisitions that had substantial impact on the subsidiary. For example, a Canadian acquisition that was eight times the size (by headcount) of the existing subsidiary led to the introduction of a new mandate. Second, management concluding that changes in the external local environment of the subsidiary required mandate change. Modification in a subsidiary's mandate due to external environment was coded when the firm set up a special program to initiate the change. For example, the firm introduced an exploration mandate in the R&D centre in China by announcing a multimillion dollar investment package to develop products in China for the Chinese market by outlining its intention of working closely with local partners.

APPENDIX 3: OVERVIEW OF THE DATA STRUCTURE

	Exploration Mandate	Exploitation Mandate	Internal ARC 1	Internal ARC 2	Internal ARC 3	External ACR 1	External ACR 2	External ACR 3
Sub 1	2003 - 2010	-	2005 - 2010	2003 - 2006	2010	2003 - 2010	-	2003 - 2010
Sub 2	-	2003 - 2010	2004 - 2010	2003 - 2006	2010	-	-	-
Sub 3	2008 - 2010	2004 - 2007	2004 - 2010	2004 - 2005	2010	-	-	2008 - 2010
Sub 4	2003 - 2010	-	2005 - 2010	-	2010	2003 - 2010	-	2003 - 2010
Sub 5	2009 - 2010	2003 - 2010	2005 - 2010	2003, 2005 - 2007, 2010	2009 - 2010	2007 - 2010	2007 - 2010	2008 - 2010
Sub 6	2002 - 2010	-	2006 - 2010	-	2010	-	-	2002 - 2010
Sub 7	2000 - 2010	-	2004 - 2010	2000 - 2003	2009 - 2010	-	2000 - 2010	2003 - 2010
Sub 8	2003 - 2010	-	2005 - 2010	-	2010	2003 - 2010	2007 - 2010	2003 - 2010
Sub 9	-	2003 - 2010	2004 - 2010	-	2009 - 2010	-	-	-
Sub 10	2001 - 2010	-	2005 - 2010	-	2010	-	2005 - 2010	2001 - 2010
Sub 11	2007 - 2010	2000 - 2010	2004 - 2010	2003 - 2007	2010	2004 - 2010	2007 - 2010	2008 - 2010
Sub 12	2000 - 2010	-	2005 - 2010	2006 - 2007	2010	-	2003 - 2010	2000 - 2010
Sub 13	2002 - 2010	2009 - 2010	2005 - 2010	2009 - 2010	2010	2006 - 2010	-	2002 - 2010
Sub 14	2000 - 2010	-	2005 - 2010	2000 - 2010	2010	2000 - 2010	2003 - 2010	2000 - 2010