

Boundary Capabilities in MNCs: Knowledge Transformation for Creative Solution Development

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ABSTRACT

The management of knowledge across country units is critical to multinational corporations (MNCs). Building on the argument that boundary spanning leads to the development of creative problem solving outcomes, this study advances the concept of MNC knowledge transformation and examines its relationship with solution creativity. Using questionnaire data on 67 problem solving projects, we find that opportunity formation is an underlying mechanism linking MNC knowledge transformation to the development of creative solutions. These insights contribute to our understanding of boundary spanning in global organizations by substantiating MNC knowledge transformation and elaborating the relationship between boundary spanning and creative solution development. If successful at knowledge transformation, collaborators from across the MNC can construct previously unimagined opportunities for the generation of creative outcomes.

Keywords: MNE/MNC management, subsidiaries, boundary spanning, problem solving, knowledge transformation, opportunity formation.

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INTRODUCTION

For multinational corporations (MNCs), competitive advantage rests on utilising their most valuable resource, the diverse knowledge located in dispersed headquarters and subsidiaries to generate creative and innovative outcomes (Bartlett and Ghoshal, 1989; Doz et al., 2001; Kogut and Zander, 1993). The challenge for MNCs, however, is unlocking this diverse knowledge, as the underlying specializations and context sensitivities make it difficult to apply this knowledge in new ways when collaborating across the organization (Mudambi, 2011). To generate creative or innovative outcomes in this complex setting, collaborators from MNC units located in different countries need to find ways to draw on and interlink their diverse knowledge. The ability of collaborators to span the boundaries that separate their diverse knowledge is critical.

To date, explorations of the challenges of managing knowledge in MNCs have largely investigated the pattern of knowledge flows (e.g., Gupta and Govindarajan, 2000; van Wijk et al., 2008), or the search activities of locating and accessing dispersed knowledge (Parker and Tippmann, 2016; Tippmann et al., 2014). In addition, work on innovation within the MNC recognises the value of utilising diverse knowledge across country units (Berry, 2014; Mors, 2010; Mudambi et al., 2007). Yet, the implicit boundary spanning work (Schotter et al., forthcoming), in particular the action and interaction required to successfully deal with diverse knowledge, is not sufficiently theorised. Similarly, research concerned with boundary spanning in the MNC context has thus far focused on the role and skills of individual boundary spanners (Barner-Rasmussen et al., 2014; Schotter and Beamish, 2011) in connecting different knowledge pockets, and on the role of communities of practice in the

access and dissemination of tacit knowledge (Tallman and Chacar, 2011). Despite this progress, there remains a gap in our understanding of the boundary spanning behaviours of individuals when working together as a group across geographically distributed MNC units. Little is known about how collaborators from across subsidiary and headquarters units collectively mobilise their unique and specialised knowledge to achieve boundary spanning. In sum, there is a need to examine the micro-social activities of collaborators from different geographically dispersed locations as they seek to apply their knowledge in new and useful ways and the specific mechanisms that govern the impact of these boundary spanning efforts on the generation of creative or innovative outcomes.

To address this gap, we draw on seminal work by organization scholars, who have explored more deeply the micro-social interactions of collaborators with diverse knowledge backgrounds in the context of innovation projects (e.g., Carlile, 2002, 2004; Dougherty, 1992). This work suggests that boundary spanning is at the heart of the generation of innovative and creative outcomes during problem solving. However, transferring knowledge in the sense of ‘simple’ processing of information, or even translating knowledge in the sense of developing a common meaning to overcome interpretive differences between contexts is insufficient for solving non-routine problems. Instead, knowledge transformation is required, that is a systematic approach by individuals to utilise, learn from and synthesise knowledge at boundaries (Carlile, 2004; Carlile and Rebentisch, 2003). This necessitates active and deep engagement to modify common and individual domain-specific knowledge to effectively share and synthesise knowledge at the boundary. If collaborators succeed in this demanding task and exhibit a capacity and ability to act and interact in a manner which iteratively and repeatedly transfers, translates and transforms knowledge, then a boundary capability is developed (Carlile, 2004). Such a boundary capability enables effective utilization of a firm’s diverse knowledge for the generation of creative and innovative outcomes.

Following this, we propose the concept of *MNC knowledge transformation* as one underpinning of a boundary capability in the MNC, capturing the behavioural aspects of collaborators' actions and interactions in applying diverse knowledge across subsidiary and headquarters units in situations where innovative or creative outcomes are desired.

Combining arguments from problem solving theory (Baer et al., 2013; Nickerson et al., 2012) and the literature on opportunity creation (Alvarez and Barney, 2007; Alvarez et al., 2013), we further argue that opportunity formation, defined as the extent to which collaborators explore new possibilities and construct new ideas, is a generative or mediating mechanism through which MNC knowledge transformation leads to creative solutions. Breaking out of habitual and common problem definitions is a key challenge in problem solving (Baer et al., 2013, Enders et al., 2016; Ford, 2002). Therefore, we propose that opportunity formation, as an entrepreneurial approach to problem formulation, stimulates the oftentimes lacking, but critically important, activities of reframing or redefining a situation. This in turn leads to the development of previously unimagined solutions. Our interest is in the level of creativity of the final, implemented solution (Godart et al., 2015), defined as the degree to which the solution exhibits the two attributes of creativity – newness and appropriateness (Amabile, 1996; Oldham and Cummings, 1996; Perry-Smith and Shalley, 2003). A creative solution thus combines novelty and efficacy, meaning that while different to previous solutions, it is not too bizarre to prevent adoption by the firm. We test our theoretical model by examining 67 non-routine problem solving processes (Cyert and March, 1963; Nelson and Winter, 1982) at a project-level of analysis.

By finding empirical support for our arguments, this study contributes to theory in important ways. First, we respond to calls to draw on theories of boundary spanning to advance the MNC literature (Andersson et al., 2016). Specifically, by conceptualising MNC knowledge transformation as capturing the micro-social actions and interactions of

collaborators across MNC units as they seek to apply their diverse knowledge in new ways, we address a hitherto neglected perspective of boundary spanning in MNCs. Our findings demonstrate that knowledge transformation can be a collective accomplishment of a group of collaborators from different MNC units. Such a perspective on boundary spanning in global organizations is greatly needed given the rise of project-level organizing to perform innovative and creative activities. In addition, our finding that the micro-social interactions of collaborators lead to the collective achievement of creative solutions suggests that knowledge transformation is one critical micro-foundation of a boundary capability in the MNC.

Second, our findings confirm the value of boundary spanning for the attainment of creative solutions (e.g., Carlile, 2002, 2004; Dougherty, 1992) and offer interesting insights into this association. We develop arguments and find empirical support for a more complex association than previously considered: the influence of knowledge transformation on the development of creative solutions is unlocked by the mediating effect of collaborators reframing a problem as an opportunity. Knowledge transformation is the most demanding activity in spanning boundaries during problem solving (Carlile, 2004), and our results imply that proposing and applying diverse knowledge in new ways across MNC units enables the exploration of alternative problem formulations and unearths new solution options. Opportunity formation offers new possibilities for generating novel and useful products, services or processes. Our study thus provides new insights into the underlying mechanisms of how the difficult task of spanning boundaries in the MNC adds value.

Our third contribution is to reveal a path for subsidiaries to achieve creative contributions for the MNC. Despite acknowledging that subsidiaries can be creative (Cantwell and Mudambi, 2005, 2011), there is a lack of research investigating the specific ways in which creative solutions are achieved. Our findings show that creative outcomes in the MNC can be the result of a collective activity spanning different units, complementing

discussions focused on competence creating subsidiary mandates with arguments related to the collective, behavioural accomplishments of a diverse group of MNC collaborators. Last but not least, our study has implications for the literature on opportunity formation in established firms as well as insights for management practice.

THEORY AND HYPOTHESES

MNC Boundary Spanning Circumstances and Boundary Capability

We build on the theory of boundary spanning knowledge processes concerned with situations where innovative or creative outcomes are desired. There, the kind of boundary and corresponding challenges of boundary spanning depend on the degree of difference and dependence of knowledge between the various individuals engaged at the boundary as well as the extent to which the situational circumstances are atypical, differing from usual circumstances (Carlile 2004; Carlile and Reberich, 2003). We will now identify how differing circumstances lead to variation in the relative complexity of boundary spanning in the MNC context.

In the MNC, units located in different countries possess and nurture specialised and context-specific knowledge that may lead to various degrees of difference and dependence between headquarters-subsidary as well as between subsidiary-subsidary knowledge. In relation to the degree of difference in knowledge between MNC units, each subsidiary possesses a unique stock of knowledge, influenced by its mandate and associated capabilities (Ghoshal and Bartlett, 1990). This means that geographic distribution causes specialised knowledge pockets. In addition, each subsidiary follows an idiosyncratic pattern of knowledge development in response to its local cultural, administrative and economic environment (Ghemawat, 2001; Kostova and Zaheer, 1999). In particular, external interactions with local organizations can lead to highly specialised and context-specific

knowledge (Mudambi and Swift, 2009), increasing the degree of difference in knowledge between MNC units. Considering the degree of dependence of knowledge in the MNC, value creation in such organizations depends to a large extent on managing the multiple inter-relationships between these different and geographically distributed knowledge pockets. It is, therefore, fundamental to reintegrate specialised, yet interdependent knowledge across units (Doz et al., 2001; Ghoshal and Bartlett, 1990). Typical examples of high dependencies in knowledge across MNC units include international interdependencies at different stages in the global value chain and international co-development settings.

Carlile (2004) suggests that if the differences and dependencies in knowledge are known by the individuals involved at the boundary, a common lexicon is developed that becomes an adequate facilitator to share knowledge at the boundary. In such situations, the complexity of the boundary is relatively ‘unproblematic’: it is a *syntactic* boundary that can be crossed through an adequate capacity to process information when transferring knowledge (Galbraith, 1973; Lawrence and Lorsch, 1967). Many studies on knowledge transfer in the MNC have adopted this information processing perspective (e.g., Gupta and Govindarajan, 2000; Szulanski, 1996), assuming that stable conditions in the difference and dependency of knowledge between headquarters-subsiary or subsidiary-subsiary knowledge enable the creation of a common lexicon, which in turn functions as common knowledge between MNC units to effectively *transfer* knowledge at these syntactic boundaries.

However, if the situational circumstances are atypical to some extent, certain differences and dependencies in knowledge at the boundary become unclear or ambiguous. This leads to different interpretations among individuals and leads to, what is called, a *semantic* boundary (Carlile, 2004). Such atypical circumstances occur when facing different requirements, in the MNC, for example, distinct or changing local environments, and/or when working with unknown individuals as is typical in task-specific international or global teams

where individuals with certain expertise or competences are brought together from various MNC units. To address the arising interpretive differences at semantic boundaries in the MNC, a common meaning needs to be developed to effectively *translate* knowledge across boundaries (Carlile, 2004; Dougherty, 1992; Nonaka, 1994). Evidence of considerable efforts of individuals to dis-embed and re-contextualise localised and embedded knowledge in the MNC to make it meaningful and actionable in a different context (Erkelens et al., 2015; Noorderhaven and Harzing, 2009) as well as activities of communities of practice (Charcer and Tallman, 2011) are examples of knowledge translation in the MNC.

Last but not least, there are situations that are highly atypical, which are a commonplace scenario in settings where innovative or creative outcomes are desired. Such situations cause the most complex form of boundary – called a *pragmatic* boundary (Carlile, 2004), and lead to different interests between individuals at the boundary to become evident. This hinders their established ability to share knowledge. To effectively utilise knowledge across pragmatic boundaries thus requires a more engaged and deeper sharing than ‘simply’ transferring or translating knowledge between different contexts. Knowledge needs to be actively *transformed* to suit the specific situation at hand (Carlile and Reberntsch, 2003). In addition, to effectively utilise their diverse knowledge, individuals need to propose and apply knowledge in new ways (Carlile, 2002, 2004). To this end, individuals need to learn about the consequences of one’s own knowledge and require a willingness and ability to modify one’s own knowledge to achieve a novel synthesis (Bechky, 2003; Levina and Vaast, 2005; Pawlowski and Robey, 2004). Knowledge transformation also involves trying new alternatives, putting individual knowledge ‘at stake’, and accepting that some of it may be changed or abandoned (Carlile, 2004). The knowledge used at pragmatic boundaries then becomes a “transformed mixture” of the knowledge deemed valuable and of consequence to the specific situation (Carlile, 2004, p. 559). In addition, the uniqueness of the situation

requires a political approach whereby a new common interest between actors needs to be negotiated to provide an adequate means for sharing knowledge. Coopetition structures in the MNC – the duality of cooperative and competing arrangements between subsidiaries (Luo, 2005; Tsai, 2002), combined with usual pressures from headquarters to both integrate with the organization while demonstrating subsidiary-specific value (Mudambi, 2011), may amplify the political aspects of spanning pragmatic boundaries. The ability to negotiate different interests and trade off ideas to create a common interest across MNC units thus becomes critical to serve as a foundation for adequately sharing knowledge. Combining these arguments, we propose the concept of *MNC knowledge transformation* as the extent to which collaborators from different MNC units propose and apply in new ways one another's diverse knowledge at pragmatic boundaries.

Having discussed the various circumstances that can arise at boundaries in the MNC, it is evident that achieving innovative or creative outputs requires systematically managing knowledge at boundaries of various complexity, ranging from semantic, to syntactic, and pragmatic in terms of increasing boundary complexity. To this end, a boundary capability is needed (Carlile, 2004), defined as the repetitive and iterative approach of collaborators to not only transfer and translate knowledge, but to transform knowledge in atypical situations for application in new ways for solution development. By overcoming the challenges of divergent and different interests when working together, we conjecture that such a boundary capability enables the MNC to utilise and exploit the value of its diverse but geographically dispersed knowledge.

MNC Knowledge Transformation, Opportunity Formation, and Creative Solutions

The focus of this study is non-routine problem solving. Given that such complex problem solving occurs in response to situations that are atypical to the firm (Cyert and March, 1963;

Nelson and Winter, 1982) and require the reconciliation of divergent interests as well as the interlinking of diverse sets of knowledge in new ways (Nickerson and Zenger, 2004), the crossing of pragmatic boundaries becomes important. Thus, we now develop arguments that link MNC knowledge transformation to the generation of creative solutions.

Problem solving comprises both problem formulation, in terms of understanding and defining a problem, and solution development, in terms of designing and implementing a solution. Prior literature on boundary spanning during problem solving, however, typically examines the value of knowledge transformation on the solution development aspect of problem solving and does not explicitly explore the preceding problem formulation (e.g., Carlile, 2004; Carlile and Reber, 2003). A notable exception is the study by Bechky (2003), who describes how transformational knowledge exchange can recontextualise a problem to arrive at a shared problem understanding. Due to the central influence of problem formulation on shaping the direction of subsequent solution development (Baer et al. 2013; Nutt, 1992, Simon, 1973; Simon and Hayes, 1976), we also focus on the effect of the problem formulation aspect. We suggest that knowledge transformation is critical to achieving a comprehensive framing when solving challenging problems at boundaries within the MNC. This leads us to argue a more complex association between knowledge transformation and the generation of creative outcomes, and to propose that this relationship is mediated by opportunity formation.

Formulating complex problems is challenging and no single actor's knowledge covers all aspects of a problem (Baer et al., 2013; Lyles, 1981; Newell and Simon, 1972). In addition, problems are not objectively defined but socially constructed "from the knowledge available at a certain point in time and context" (Nonaka, 1994, p. 28). Alternative problem framings may emerge if solution ideas are not imposed and the generation of new options is encouraged (Lopez-Vega et al., 2016; Nutt, 1993, 2004). This suggests that bringing together

diverse inputs from individual collaborators can benefit the comprehensiveness of problem formulation, specifically the extent to which alternative, yet equally valid problem formulations are generated (Baer et al., 2013; Nutt, 1984).

Bringing collaborators together for problem formulation activities, for example, by gathering individuals from various subsidiary and headquarter units, generates substantial capacity for building on diverse inputs. However, it is also likely to amplify collaboration impediments (Baer et al., 2013), which may, in some circumstances, inhibit the generation of alternative problem formulations. It can, for example, lead to power imbalances whereby powerful collaborators push to reuse certain knowledge, thus constraining the ability of other individuals to exploit the boundary spanning situation to generate more novel ideas (Carlile, 2002, 2004). In addition, there is a heightened danger of task conflict and breakdown in collaboration because of considerable difficulties in interacting and communicating in boundary spanning situations despite the good intentions of collaborators to share knowledge across such pragmatic boundaries (Bechky, 2003; Carlile, 2004; Dougherty, 1992; Leonardi, 2011). It has been suggested that such impediments result in the generation of fewer problem formulation alternatives (Baer et al., 2013), constraining problem formulations within a narrow or existing range of options. Problem formulation can thus benefit tremendously from effective boundary spanning enabled by the micro-social activities of individuals collectively achieving knowledge transformation.

The debating and engaged interaction typical for knowledge transformation may avoid the narrow or rushed analysis and lack of synthesis of root causes which lead to inadequate initial definitions (Lyles, 1981) and constrain solution finding to arriving at 'only' an effective approach (Lyles and Mitroff, 1980; Spradlin, 2012). In addition, deep transformational knowledge sharing has the capacity to more fundamentally reframe the problem (Mintzberg and Westley, 2001). By identifying and representing different

knowledge and learning about differences across boundaries, knowledge can be applied in new ways to enable collaborators to reframe their past experiences. This allows a ‘richer’ understanding of the problem to be gained (Beck and Plowman, 2009), may trigger new interpretations that change previous problem conceptions (Hargadon and Bechky, 2006; Nutt, 1993), and may expand problem formulation to embrace broader purposes (Volkema, 1983). Such proposing and application of specialised knowledge may also stimulate ‘thinking outside the box’ (Ford, 2002; Gavetti and Levinthal, 2000) by synthesizing the diverse knowledge contributed in new ways. The ‘creative abrasion’ (Leonard-Barton, 1995) which can arise during knowledge transformation allows individuals to propose divergent and more novel forms of knowledge that help to shed new light on a problem, its root causes and can ultimately generate alternative problem formulations. By not only bringing together diverse inputs, but producing a novel synthesis, knowledge transformation allows alternative problem formulations to emerge – to generate problem formulations that look beyond the habitual, to generate ideas for improving and innovating. This aligns well with arguments that through activities of accessing, learning from and utilising diverse knowledge an opportunity can emerge (Alvarez and Barney, 2007; Alvarez et al., 2013; Barreto, 2012; Mitchell et al., 2008). We thus propose that knowledge transformation can result in collaborators exploring and generating new and alternative problem formulations – problems may be formulated as opportunities.

Following this, we suggest that MNC knowledge transformation enables opportunity formation as it modifies the contributions of collaborators across pragmatic boundaries within MNCs to generate new problem formulations. Subsidiary driven problem solving can exhibit strong tendencies to formulate problems within local and context-specific constraints (Tippmann et al., 2012). The value of MNC knowledge transformation in breaking out of such narrow and habitual problem formulation can be illustrated with an example of an

atypical situation experienced by one of the organizations that participated in our study, a French subsidiary. This unit, mandated with developing and manufacturing new products for developed markets, was challenged to significantly lower the cost of its products to improve margins. A narrow formulation of this problem suggests that the subsidiary would adopt its usual definition of root causes as being the cost of some supplies or inefficiencies in the production process. In this example, however, the French subsidiary engaged with a broad range of diverse collaborators from other MNC units to work together and pursue knowledge transformation intensely from the outset.

The French subsidiary managers identified colleagues in a sister R&D subsidiary in Asia who had innovated new product platforms for emerging markets. Although the collaborators from the French and Asian subsidiary shared some new product development knowledge, as different product platforms were involved, differences and dependencies in knowledge became ambiguous, requiring knowledge transformation to span this boundary effectively (Carlile, 2004). The French subsidiary managers also involved the global marketing team at the U.S. headquarters, bringing to the fore the political aspect of MNC knowledge transformation. The primary interest of the French subsidiary was margin improvement, while the global marketing experts were concerned with maintaining the premium positioning of the product. The same problem could have been formulated narrowly as a cost issue or as a marketing challenge. However, through iterations of proposing knowledge and learning about differences, facilitated by headquarter managers engaging in ‘lubricating’ activities to improve interactions (Birkinshaw et al., forthcoming), the collaborators moved from a narrow problem formulation and the idea of opening up a new market segment with the proposed lower cost product platform emerged – the problem was reframed as an opportunity. In sum, knowledge transformation can lead collaborators across

MNC pragmatic boundaries to explore and generate alternative problem formulations and reshape problems as opportunities.

Hypothesis 1: MNC knowledge transformation is positively associated with opportunity formation.

Our first hypothesis is concerned with activities during problem formulation and we now develop the argument that opportunity formation serves as the conduit by which MNC knowledge transformation contributes to solution creativity. Problem solving proceeds backwards from the ‘goal state’ (Cyert and March, 1963; Felin and Zenger, 2016) of an envisioned solution (Nutt, 1984, 2005) that guides the efforts of the problem solvers. Having expanded problem formulations by a variety of new possibilities, the spectrum of conceivable outcomes has increased to embrace more novel and appropriate solutions. This means that the potential for solution development expands as efforts are directed beyond the root problem towards attaining a solution that responds to an identified opportunity. However, potential creative solutions still need to be realised and may not be enacted or fall short of successful responses for a variety of reasons. In complex organizations such as MNCs, these include ineffective issue selling (Dutton and Ashford, 1993), political resistance (Dörrenbächer and Gammelgaard, 2006), failing to overcome the ‘not invented here syndrome’ (Birkinshaw and Ridderstrale, 1999) or to win senior management approval and the absence of a supportive organizational context (Burgelman, 1983). The translation of formed opportunities to enacted creative solutions cannot be taken for granted. At the same time, as collaborators from different MNC units repeatedly apply their diverse knowledge to attain an envisioned solution, solutions “emerge endogenously within a process of interactive human action” (Sarasvathy et al., 2010, p. 155). While collaborators are still required to resolve the initial organizational challenge that triggered the problem solving efforts, thus working towards

attaining an appropriate solution, the broader perspective of opportunity formation allows for the “proliferation and branching” of solutions (Collins, 2005, p. 211) and for the emergence of “new means, ends, or means-ends relationships” (Eckhardt and Shane, 2003, p. 336). This is likely to increase the novelty of solutions (Aldrich and Martinez, 2010). Thus, opportunity formation allows the benefit of MNC knowledge transformation to be realised because individuals collaborating from across the MNC are unified by a common interest to generate a solution that has the required newness to fill the identified gap. In this sense, formed opportunities represent a concrete means for headquarters and subsidiary collaborators to apply their unique knowledge in new ways for the generation of novel outcomes. Compared to a final outcome that ‘merely’ represents a workable or habitual solution to a problem, the novelty of the solution now reflects both the knowledge diversity of collaborators from across the involved MNC units and the reformulated problem definition to achieve an outcome that combines novelty and usefulness.

In the context of our earlier example, reframing of the French subsidiary’s initial problem to launch lower cost products to improve margins as an opportunity led to the exploration of new solutions to deliver on the identified opportunity. The final solution, achieved by bringing together knowledge from various MNC units, not only increased margins, but created a new market segment in developed markets for ‘good value’ products. This solution was particularly creative for this MNC given the unusual direction of technology transfer from emerging to developed markets that formed part of solution development and because it tapped unmet market potential, generating new revenue streams.

In sum, we argue that the emergence of new solutions is stimulated through opportunity formation, while the need to address the initial problem simultaneously pushes towards the attainment of appropriate solutions.

Hypothesis 2: Opportunity formation is positively associated with solution creativity.

METHODS

Sample of Problem Solving Projects

A distinct feature of investigating problem solving processes is using the problem solving project as the level of analysis (Obstfeld, 2012). These projects are initiated as a response to an organizational problem, defined as “a deviation from a desired set of specific or a range of acceptable conditions resulting in a symptom or a web of symptoms recognised as needing to be addressed” (Baer et al., 2013, p. 199). Given the atypical nature of non-routine problems, they lend themselves to the investigation of knowledge transformation at pragmatic boundaries. We sampled 67 such problem solving projects. This sample size compares well with other studies that examined complex, organizational projects or initiatives (Ciabuschi et al., 2011; McGrath, 2001).

The problem solving projects in our study were undertaken by 29 subsidiary units of 27 MNCs and are located mostly in Ireland, but also in France and the UK. The chosen subsidiary units exhibited good variance in a range of characteristics at the unit, subsidiary and corporate level increasing external validity. First, at the corporation level, the MNCs operated in highly to moderately dynamic industries of ICT, pharmaceutical, building materials and social media, where organizational challenges regularly trigger problem solving processes. The MNCs also have different countries of origin (France, Germany, UK, USA and Sweden) to enhance cross-national coverage. Second, we aimed to introduce constructive variation at the subsidiary unit level. In the context of MNC value chain disaggregation and more ‘fine-sliced’ subsidiary mandates, each unit at the subsidiary may be characterised by a unique organizational context, making it more appropriate to consider the specifics of each unit rather than subsidiary level aggregations (Rugman et al., 2011). The chosen subsidiary units varied in their age, size, mode of establishment and function. Table I summarises the

characteristics of the subsidiary units that were used as a platform for investigating problem solving projects.

Insert Table I about here

For each subsidiary unit, the unit manager (usually the General Manager, Managing Director or Director) identified all the relevant projects, i.e., created a representative list of projects that fitted our sampling criteria. To ensure consistency in identifying problem solving projects, the predetermined sampling criteria included: (1) the problem was non-routine, that is an atypical situation for which the organization did not at that time have a predetermined response (Cyert and March, 1963; Newell and Simon, 1972), (2) the problem solving process was completed or terminated within the past 12 months, a recent timeframe that reduces retrospective bias (Huber and Power, 1985), and (3) the problem solving efforts were initiated at the subsidiary level (rather than at headquarters or another unit). We emphasised that the problem solving project selected should include projects deemed more or less successful to reduce potential success bias. Following this procedure, 67 problem solving projects were identified with an average of 2.3 per subsidiary unit, with a range of 1 to 8. They originated in different functional areas, including R&D (8 processes, 11.9%), manufacturing (23 processes; 34.3%), marketing/sales (20 processes, 29.9%), services/support (7 processes, 10.4%), supply chain/logistics (4 processes, 6.0%), finance (3 processes, 4.5%), and HR (2 processes, 3.0%). The problem solving projects focused on key organizational challenges of the subsidiary unit and often of the wider corporation and included replacing legacy processes, replacing legacy products/services, and rejuvenating management/business practices. Table II provides an overview of the sample and offers

descriptive information that illustrates the variation in problem solving projects included in this study.

Insert Table II about here

Data Collection

We collected data from August 2012 till November 2013 via paired surveys to capture information on the problem solving activities and outcomes, and the organization. To encourage participation, subsidiary top managers endorsed the study and we offered to share a feedback report and to invite participants to a workshop. Combined with guaranteeing confidentiality and the anonymity of organizations, a response rate of 100% of the respondents contacted was achieved. To minimise common methods bias, data on the problem solving process was collected from the project leader(s), while information on the outcomes and organizational level variables was collected through a personally addressed email survey of the project leader's senior colleague and/or subsidiary top manager. In total, 72 project leaders participated (two project leaders participated for five projects), 40 managers evaluated problem solving outcomes (some managers rated the solutions of multiple projects), and 28 managers completed the subsidiary organization survey. Before conducting the final surveys, the face validity of the survey items was assessed by a panel of nine experts, comprised of five academic and four subsidiary managers. Necessary amendments were undertaken to ensure clarity of questions.

In contrast to mail questionnaires, our method ensured that the project leaders that were selected had primary responsibility for pursuing the solution finding and intimate knowledge of the process. We also collected data from a senior colleague that was able to

offer an independent evaluation of the problem solving outcomes. Furthermore, the person most knowledgeable about the subsidiary organization provided information about the unit's and subsidiary's behavioural context. To further increase the reliability of responses, the survey for the project leaders was interviewer administered, mostly in face-to-face meetings that lasted approximately one hour, with some lasting close to two hours. This allowed us to provide any clarification required. In the five cases where more than one project leader was appointed, we interviewed both project leaders simultaneously to achieve an agreed answer to our survey questions.

Measures

Table III offers descriptive statistics for all our items and item wording for the latent variables included in our model. The questions for the latent variables were asked using a 7-point Likert scale. We adapted existing measures wherever possible but also found it necessary to create new ones, as outlined below.

Insert Table III about here

Solution creativity. The degree of solution creativity is most accurately assessed in relation to established solutions at the subsidiary level – the most proximate outcome. We used the established creative performance measure developed by Oldham and Cummings (1996). Following the definition of creativity, the item phrasing highlights that newness *and* usefulness are both necessary conditions. We adapted the item phrasing to refer to problem solving.

MNC knowledge transformation. MNC knowledge transformation was measured by three items that capture the collaborators' activities of proposing and synthesising diverse

knowledge from MNC units located in other countries to apply it in new ways for the respective problem solving project. The items were developed with reference to descriptions of boundary spanning knowledge processes in co-located organizations (Carlile, 2002, 2004) and MNCs (Tippmann et al., 2012, 2014) as well as additional interviews to gain insights into typical MNC boundary spanning activities (details available from authors). The respondents were asked to indicate "To what extent did you observe the following activities of the people engaged in the problem solving process?".

Opportunity formation. Following Alvarez and Barney (2007) we adopt a broad definition of opportunity formation. The three items that measure opportunity formation were derived from descriptions of opportunity formation by Alvarez et al. (2013), and Alvarez and Barney (2008). Opportunity formation was measured by asking the respondents: "To what extent did you observe the following activities of the people engaged in the problem solving process?".

Controls. Other factors related to the problem solving and organizational context may influence the degree to which collaborators can achieve creative solutions. We divided our controls into four broad categories consisting of problem characteristics, problem solving group level, subsidiary level, and MNC level controls.

Problem characteristic controls. We controlled for *problem pressure* as decision situations of high pressure intensity increase the likelihood of calling into question the efficacy of the organization's previous responses (Papadakis et al., 1998), and are more likely to allow creative solution ideas to be pursued. The two items were adapted from Papadakis et al. (1998) to suit the problem solving context, and respondents were asked to indicate to what extent the problem exhibited each of two features of pressure. We also examined whether the *problem type*, i.e., replacing legacy processes, replacing legacy products, or rejuvenating business practices, had an effect on our model. When we included two dummy variables for

problem type in our model, we found neither was significant and there was no change to the significance or direction of our variables of interest. Therefore we have presented the more parsimonious model. Additional controls such as *project duration* and *problem complexity* were also examined, but as these had no significant effect they are also omitted from our final model.

Problem solving group controls. More radical creativity, which shows high divergence from a firm's current practices or processes, is fostered by resource availability (Madjar et al., 2011). To account for the availability of resources, we took the objective measure of the number of *people involved* in the project, using its log transformation in our analysis. We also controlled for *functional diversity* because a certain level of diversity in group composition is expected to provide more varied input and hence increase chances of creative output (e.g., Ancona and Caldwell, 1992). Additional controls were considered for inclusion in our model such as the nature of prior relationships, i.e., the proportion of important collaborators that the project leader had known prior to the problem solving (*colleagues previously known*); and the extent of competition present between the MNC units of the project leader and important collaborators (*coopetition*). Neither of these had a significant effect on our variables of interest and are not included in our presented model.

Subsidiary level controls. As the pursuit of creativity entails risk and uncertainty, we control for *unit risk taking propensity*, adapting the measure established by Covin and Slevin (1989). Similarly to the group level, we examined additional controls at the unit level – subsidiary size (*number of employees*), *subsidiary age*, *mode of establishment* (i.e., greenfield vs. acquisition). These variables were not significant and did not change the direction and significance of our variables of interest, and are thus not included in our final model.

MNC level controls. Some MNCs may provide a more supportive problem solving context to help dissipate the negative connotations that facing non-routine problems can

entail. We therefore control for *MNC normalization of problem solving*, adapting Shepherd et al.'s (2011) measure to the MNC problem solving context. We also tested additional controls at the MNC level including logged transformations of the *number of employees* and *turnover* (2012 US\$) as proxies for MNC size, but found these variables were not significant, and they are not presented here.

An additional model that included controls for *problem pressure*, *people involved*, *functional diversity*, *unit risk taking propensity*, and *MNC normalization of problem solving* on both the *solution creativity* and *opportunity formation* variables was also created. As none of the controls had a significant effect on *opportunity formation* or impacted the direction or significance of our variables of interest they are not included in our final model¹.

Data Analysis Method

To analyse our data we used partial least squares (PLS) which is a variance-based structural equation model (SEM) (Hair et al., 2014). We chose this technique because our study is exploratory and PLS has been shown to be appropriate under these circumstances (Hair et al., 2013). In addition, PLS is suitable for small sample sizes of 30 to 100 cases (our data has 67 observations) (Reinartz et al., 2009). We used SmartPLS 3.0 (Ringle et al., 2015) to compute our model. Our analysis was carried out using the path weighting scheme (Henseler et al., 2012).

RESULTS

We followed a two-stage process to assess our data and estimate our model. In the first stage, we examined item reliability and internal construct reliability as well as convergent validity and discriminant validity. The item outer loadings for the measures of our reflective constructs were all above the 0.7 suggested cut-off mark (Hair et al., 2014) (see Table IV). As

indicated in Table IV, our reflective measures all have construct reliability values above 0.830, indicating their internal reliability is acceptable. In addition, we examined the convergent validity of our reflective constructs. The average variance extracted (AVE) values (see Table IV) are 0.635 and higher, which is above the 0.500 critical value (Hair et al., 2014) and provides evidence of convergent validity. To check for discriminant validity, we used the Fornell-Larcker criterion in which the correlations of the variables are compared to the square root of the AVE values (Hair et al., 2014). We detail the correlations (off-diagonal values) and the square root of the AVE values (down the diagonal) in Table V. As can be seen, the AVE square root values are higher than the correlations of the constructs which suggests that our constructs have discriminant validity. In addition, we checked for discriminant validity by examining the cross-loadings of our indicators. We found that no indicator loaded higher with regards to other constructs.

Insert Table IV about here

Insert Table V about here

In the second stage, we created a model to test our hypotheses. To test for the significance of our parameters, we ran a 5000 sub-sample bootstrap with the no-sign changes option. The relationship between *MNC knowledge transformation* and *opportunity formation* is positive and significant ($\beta = 0.594$, $p < .001$), which supports Hypothesis 1. In addition, the relationship between *opportunity formation* and *solution creativity* is also positive and significant ($\beta = 0.363$, $p < .001$), giving support for Hypothesis 2. Overall, the model shows a positive indirect effect between *MNC knowledge transformation* and *solution creativity* via

opportunity formation (total effect, $\beta = 0.216$, $p < .001$). Table VI details the path coefficients between each of our variables and t-values based upon the bootstrapping procedure. The control variable for *problem pressure* is positive and significant ($\beta = 0.288$, $p < .05$), indicating that the more intense the pressure the more creative the solution generated. The control variable for number of *people involved* is negative and significant ($\beta = -0.289$, $p < .05$), suggesting that the more people that are involved in solving the problem the less creative the solution generated. The control variables for *functional diversity*, *unit risk taking propensity*, and *MNC normalization of problem solving* were not significant. The variance explained for *opportunity formation* ($R^2 = 0.353$) and *solution creativity* ($R^2 = 0.300$) suggest that the model has predictive relevance. In addition, we ran the blindfolding procedure (Hair et al., 2014) to obtain Stone-Geisser Q^2 statistics. The positive values of the Stone-Geisser Q^2 statistics (0.234 and 0.146 respectively) indicate that the model has predictive relevance. In addition, to test the significance of the indirect relationship between *MNC knowledge transformation* and *solution creativity* we calculated the Sobel test statistic (2.946, $p < .01$, two-tailed).

Insert Table VI about here

Post-hoc Tests

To account for alternative explanations, we also tested a model that included a direct effect between *MNC knowledge transformation* and *solution creativity* (results available from the authors). As expected, the direct relationship was not significant ($\beta = -0.215$, p ns), and its inclusion in our model does not change the significance and direction of our results.

Robustness checks including creating sub-samples of ICT and pharmaceutical industry cases (i.e., removing the three cases from other industries), of Irish subsidiaries only

(removing the three cases from outside of Ireland), and only those with a U.K. or U.S. parent (removing the four cases where the parent company was from Germany, France and Sweden) respectively, strongly supported our hypotheses (results available from the authors).

As a further test of the effect of *MNC knowledge transformation* on *solution creativity* via *opportunity formation* we conducted the Preacher and Hayes (2004) bootstrap test for indirect effects. The model includes both our variables of interest and our control variables. The results of the analysis indicate a positive and significant direct effect of *MNC knowledge transformation* on *opportunity formation* and a positive and significant direct effect of *opportunity formation* on *solution creativity*. Importantly, the indirect effect of *MNC knowledge transformation* on *solution creativity* via *opportunity formation* is also positive and significant as zero is not included in the bias corrected 95% confidence interval with a lower limit of 0.060 and an upper limit of 0.286 (full results of the analysis are available from the authors). We therefore conclude that our model is robust with regard to both PLS analysis (Hair et al., 2014) and the Preacher and Hayes (2004) bootstrap method of analysis.

DISCUSSION

Despite the importance of boundary spanning for the generation of innovative and creative outcomes, there are still major gaps in our understanding of how MNCs utilise, coordinate and manage knowledge across their geographic locations (Meyer et al., 2011, p. 247; Andersson et al., 2016). We need to understand not just how such firms integrate their diverse knowledge across boundaries but how they can do so in a way which unlocks its embedded value to achieve innovative and creative solutions. In response, our approach to investigating knowledge transformation in MNCs and its impact on solution creativity allows us to advance theory on boundary spanning and creativity in the MNC.

MNC Knowledge Transformation and MNC Boundary Capability

Responding to the need to develop the specificities of boundary spanning in global organizations, we draw on Carlile (2002, 2004) to suggest that the type of boundary faced by subsidiary and headquarters actors when working together for problem solving is often pragmatic in nature, requiring knowledge transformation. Developing the concept of MNC knowledge transformation, as the extent to which collaborators from across subsidiary and headquarters units propose and apply one another's diverse knowledge in new ways, prompts attention to the critical behavioural aspects of boundary spanning collaboration. Specifically, it emphasises how collaborators draw on and synthesise expertise that is not only geographically distributed, but can be highly diverse and invested in practice as MNCs nurture specialised knowledge pockets in different institutional environments. Specifying MNC knowledge transformation, this study gives attention to the types of actions and interactions at a micro-social level that in their combination allow collaborators from various subsidiary and headquarters units to benefit from the diverse knowledge of the organization.

Other research concerned with boundary spanning in the MNC has focused on individual boundary spanners (e.g., Barner-Rasmussen et al., 2014; Schotter and Beamish, 2011) and communities of practice (Tallman and Chacar, 2011). Our paper differs in its approach, examining boundary spanning at the group level. Project groups are an increasingly important form of organizing, especially for performing creative and innovative tasks (Obstfeld, 2012). It is thus critical for our understanding of boundary spanning in global organizations to advance theory in this respect. In these temporary and task-specific collaborative situations, MNCs often purposefully bring together individuals from different country units to benefit from diverse knowledge. These situations, however, put an onus on collaborators to effectively overcome the many challenges of crossing boundaries to achieve the envisaged benefits of realising innovative and creative potential.

In this respect, our findings demonstrate that collaborators' systematic actions can surmount the challenges that spanning pragmatic boundaries in the MNC entails and unleash creative potential. Our interest in collaborators' actions and interactions at a micro-social level thus reveals a collective accomplishment underpinning an organization-level capability (Felin et al., 2012). Building on Carlile's (2004) suggestion that knowledge transformation is the most demanding, yet potentially most value adding boundary spanning activity compared to the less complex activities of knowledge transfer and translation, we propose that MNC knowledge transformation represents one (but not the only) micro-foundation of a MNC boundary capability. Through repeated and iterative actions and interactions, a MNC boundary capability allows the organization to not only access its diverse knowledge but to transform this knowledge across its units to achieve innovative and creative outcomes.

The Value of Boundary Spanning: 'Turning' Problems into Opportunities

Our findings demonstrate that MNC knowledge transformation leads to the generation of creative outcomes, albeit in a more complex way than previously suggested. Prior literature on boundary spanning across functions in co-located settings points to the value of knowledge transformation in allowing collaborators to synthesise diverse knowledge in new ways (e.g., Carlile, 2004; Carlile and Reberich, 2003), but does not typically explore problem formulation actions in detail. Addressing this oversight, we find support for a mediating effect: MNC knowledge transformation can lead to creative solutions when problems are formed as opportunities. Our findings demonstrate that unlocking the creative potential in problem solving requires collaborators to seek out and apply their collective and diverse expertise when framing the problem. Although extant literature on problem solving emphasises problem definition (Lyles, 1981; Lyles and Mitroff, 1980) and points towards the importance of introducing diversity in perspectives during problem formulation to

conceptualise the situation more comprehensively (Baer et al., 2013), our findings suggest that the problem can also be considerably redefined. MNC knowledge transformation can generate creative solutions because it facilitates alternative formulations of the problem; it is a means to break out of ‘habitual’ problem definitions (Ford, 1996) that too often constrain the attainment of truly novel and useful solutions. By revealing this mediating relationship, our findings offer new insights into how the influence of knowledge transformation is transmitted to enable the generation of creative outcomes. For the MNC, this finding offers interesting implications: problem formulations can constrain subsidiary value creation if they are narrow and context-specific. However, MNC knowledge transformation offers the possibility to generate a reframed perspective on organizational challenges, providing previously unforeseen opportunities for not just firm value creation, but potentially for building entrepreneurship across the MNC.

Creativity within the MNC

In environments where competition is increasingly based on novel ideas packaged in innovative products, services or processes, creative solutions are required to rejuvenate and sustain established firms. These solutions can be a source of firm advantage if they unlock unique ideas and value creating responses to usually complex and ill-defined challenges (Kim et al., 2013; Reiter-Palmon and Illies, 2004).

In most firms, creative responsibility is distributed across units and levels. Driven by the geographic dispersion of operations and the need to tap into location-specific advantages, it is recognised that creative potential is highly distributed within MNCs (Cantwell and Mudambi, 2005; Nohria and Ghoshal, 1997) and achieving creative outcomes is a critical subsidiary contribution to rejuvenating the MNC’s sources of advantage. Despite the acceptance that subsidiaries can be engines for the generation of creative solutions due to

their capacity to combine knowledge in unexpected ways (Cantwell and Mudambi, 2005, 2011), there is a paucity of research investigating the different ways such creative solutions are achieved.

Our research addresses this gap, clearly demonstrating how opportunity formation operates as a mechanism to unlock the value of knowledge transformation and enables subsidiaries to generate creative solutions. This sheds valuable light on a previously hidden relationship and shows that creative outcomes in the MNC can be the result of a collective activity spanning different units. The collective framing of a problem as an opportunity for the generation of creative solutions aligns well with suggestions that creativity can be a collective-level phenomenon arising through the interaction between individuals (George, 2007; Hargadon and Bechky, 2006; Sonenshein, 2014). Although competence creating subsidiaries may have a higher potential for creative solution development compared to competence implementing subsidiaries (Cantwell and Mudambi, 2005), our findings demonstrate that the development of creative solutions is not confined to a certain subsidiary type.

Opportunity Formation

Another contribution of our study is to theory on the phenomenon of opportunity. Despite growing recognition that opportunities are the outcome of social construction and are enacted subjectively (Alvarez and Barney, 2007; Alvarez et al., 2013), much of the literature continues to treat opportunity related processes as a ‘black box’ (Alvarez et al., 2013; Hansen et al., 2011). Our research shows that non-routine problems can be used to trigger new ideas and possibilities when knowledge transformation occurs, i.e., collaborators working together can construct an opportunity from what was originally an obstacle. Instead of focusing on individual differences in personality or cognitive abilities, our findings suggest that collective

boundary spanning activities matter, especially collaborators' engagement in knowledge transformation. This substantiates conjectures that knowledge processes are critical to forming opportunities (Lumpkin and Lichtenstein, 2005), suggesting rich potential for future studies to explore problem solving and opportunity formation in a broader entrepreneurial context.

Implications for Practice

Although many managers are aware of the value of boundary spanning in generating creative solutions, they may be less familiar with how to unlock the potential of knowledge diversity. In the context of the MNC, where knowledge pockets are not only distributed but also highly specialised and invested in practice, converting diversity of knowledge into tangible value is especially challenging. Our study provides several valuable insights for managers operating in such contexts.

MNCs rely on their networks of subsidiaries to recognise new opportunities and to bring these to headquarters' attention (Andersson et al., 2007). We show that for subsidiaries, opportunities can arise in unexpected places, when an entrepreneurial approach is taken to shaping challenges. This is a valuable insight into alternative means for subsidiaries to contribute to their MNC, especially for those subsidiary managers operating in competence implementing subsidiaries, with little scope to engage in the autonomous entrepreneurial behaviour typical of strategic initiative generation (Birkinshaw et al., 1998). In a similar vein, developing creative solutions to organizational challenges has the potential to address a key tension within MNCs. On the one hand headquarters expects its subsidiaries to put forward new ideas, but on the other hand each unit is required to focus its resources and capabilities on achieving its specific mandate. Utilising challenging or atypical situations to provide

creative solutions for the organization provides subsidiary managers with a valuable option to demonstrate the value of their unit without moving too far outside of the assigned mandate.

In addition, our findings suggest a critical role for the MNC in setting a context that supports not just the development of a boundary capability and knowledge transformation across its operations but also an entrepreneurial approach to problem solving to encourage creative reshaping or reframing of problems (Hargadon and Bechky, 2006). In this respect, the insight that opportunity formation is an underlying mechanism linking knowledge transformation and the development of creative solutions offers important guidance regarding the problem solving approach to adopt when creative solutions are desired. We contend that how the problem is formulated can impact achievement of creative outcomes. Problem formulation is often superficial and lacks debate (Baer et al., 2013; Lyles, 1981) – solution finding commences in a rush to implement remedies quickly. Early efforts to transform knowledge are advisable as they can lead to new formulations of the problem that open previously unconceived solution ideas.

It is important that executive managers recognise the value of attaining creative solutions. Greater value creation and advantage to the organization can be achieved if problems are approached in a way which encourages the development of not just an effective solution but one that produces a novel and useful outcome. For example, organizations operating in the same industry often face similar business challenges. The capability to generate creative solutions that competitors have not envisioned builds valuable and rare resources (Kim et al., 2013), ultimately strengthening the firm's competitive advantage. In addition, the causal ambiguity of forming opportunities, as implied by the complex pattern and iterative nature of knowledge transformation activities at boundaries, may in itself become a source of firm advantage (Alvarez et al., 2013). In this respect, for MNCs, our results are encouraging regarding the ability of subsidiary driven problem solving,

particularly through boundary spanning, to create solutions that are not ‘just’ workable, but of high creative value.

Last but not least, our work clearly demonstrates the value of boundary capabilities to support knowledge amplification across the MNC. However, managers should not underestimate the efforts required by collaborators to achieve effective knowledge transformation. Understanding the specific expertise, technical language, styles and potentially conflicting views of other collaborators requires both time and considerable effort, but as our results show, it is critical to unlocking the benefits of diverse MNC knowledge.

Limitations and Avenues for Future Research

This study has limitations that create avenues for future research. As our study was concerned with subsidiary driven problem solving processes, our sample does not include problem solving projects initiated at the corporate or headquarters level. It may be the case that problems identified as requiring resolution at these levels exhibit higher pressure and therefore pose more demands on knowledge transformation and opportunity formation behaviours to lead to creative solutions. Future research can meaningfully extend our arguments to these scenarios.

Our interest in examining the links between problem solving activities and creative outcomes required sampling problem solving projects where solutions were implemented. Although our sample exhibits good variation in the level of creative solutions generated, our study may under-represent less formalised problem solving processes and certainly excludes processes that were terminated early. As organizational problems are typically only addressed after undergoing a stage of creeping awareness until a tipping point is reached (Lyles, 1981; Lyles and Mitroff, 1980), more research is needed to understand the influence of knowledge transformation during this very early phase of problem formulation and how knowledge

transformation can help ensure that the ‘right’ organizational challenges are prioritised for resolution. More work is also needed to understand the iterative nature of problem solving.

In relation to boundary spanning in global organizations, our study was focused on MNC knowledge transformation as the most critical boundary spanning activity in atypical situation. As outlined earlier, Carlile (2002, 2004) proposes two other boundary spanning activities – knowledge transfer and knowledge translation. While there is considerable research on knowledge transfer in the MNC, there is considerable scope for research to further examine the translation and transformation of knowledge at semantic and pragmatic boundaries, respectively. In addition, future research could explore alternative mechanisms through which the benefits of MNC knowledge transformation are transmitted. Beyond opportunity formation, this may include the capacity of collaborators from across the MNC to agree on a joint problem definition that avoids the danger of powerful individuals or coalitions to pre-dominate (e.g., Baer et al., 2013) and hence hinder the benefit of knowledge transformation to materialise.

Our sampling strategy was broad as we chose MNCs and subsidiaries that exhibited variation in organizational attributes. We also studied problem solving projects from varied functional areas. This minimises the likelihood that our findings are the result of a certain organizational context, increasing the generalizability of our findings. However, our sample is largely focused on two industries (ICT and pharmaceuticals) and subsidiaries located in one country. Future work can meaningfully extend our findings to other industries and locations. Although our sample size is relatively small, it was still sufficient to provide the necessary power to test our hypotheses and control for important extraneous factors. However, it does not allow us to examine systematically all constellations of extraneous factors.

Although we obtained information on solution creativity from an independent evaluator to reduce common method bias, this information was usually provided by a subsidiary manager. While the subsidiary top managers' relative closeness to current solutions and high international exposure support their ability to answer these questions accurately, corroboration with a headquarters' evaluation, however, may allow an even wider assessment of the newness and usefulness of the solution. We also implemented a range of techniques to limit recall issues in relation to reporting on past projects. These included a 12 months cut-off time-frame to include only processes of the recent past, focusing on specific activities surrounding a concrete event (specific problem solving project), ensuring confidentiality, detailed explanation of study benefits and researcher administration of the survey to ensure respondents reflected carefully on each question.

Conclusion

As the MNC represents an organizational setting characterised by high levels of knowledge diversity, developing a boundary capability is not only critical for the generation of creative solutions but also for MNC advantage. By showing that MNC knowledge transformation can give rise to opportunity formation for the attainment of creative solutions, this study advances our understanding of how to liberate the often untapped potential of diverse knowledge within the MNC.

NOTES

¹ When including the additional controls in the model the effect of our control for problem pressure on solution creativity was no longer significant.

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Table I. Summary of characteristics of subsidiary units selected for study

<i>MNC level (N = 27)</i>	
Industry	ICT = 16 (59%) Pharmaceutical = 8 (30%) Social media = 2 (7%) Building materials = 1 (4%)
Size (turnover in US\$)	Average = 33.4 bn (SD = 37.5 bn)
Size (employees)	Average = 74,400 (SD = 103,860)
Country of origin	U.S. = 21 (78%) U.K. = 2 (7%) Germany = 2 (7%) France = 1 (4%) Sweden = 1 (4%)
<i>Subsidiary unit level (N = 29)</i>	
Location	Ireland = 26 (90%) U.K. = 2 (7%) France = 1 (3%)
Age (years)	Average = 13 (SD = 10)
Size (employees)	Average = 410 (SD = 660)
Mode of establishment	Greenfield = 24 (83%) Acquisition = 5 (17%)

Table II. Description of problem solving projects

<i>Problem solving project type</i>	<i>Typical examples</i>	<i>Proportion in sample</i>
Replacing legacy processes	<p>A need to reduce costs or increase efficiency/ quality through:</p> <ul style="list-style-type: none"> • Redesigning/creating new processes • Standardizing current processes • Developing automated processes and required tools 	41.8%
Replacing legacy products/services	<p>A need to respond to shifting market needs through:</p> <ul style="list-style-type: none"> • Updating products/services • Designing/developing new market solutions 	19.4%
Rejuvenating management/ business practices	<p>A need to increase efficiency/ speed to market/ quality through:</p> <ul style="list-style-type: none"> • Transforming practices/routines • Renewing/developing new competences 	38.8%

Note: N = 67

Table III. Operationalization of variables and descriptive statistics

<i>Construct and indicators</i>	<i>Mean</i>	<i>SD</i>	<i>Label</i>
<i>Solution creativity</i> ^a	5.85	0.75	SC
"How ORIGINAL and PRACTICAL was the work of the people involved in the problem solving? Original and practical work refers to developing ideas, methods, or products that are both totally unique and especially useful to the organization"	5.75	1.01	SC1
"How ADAPTIVE and PRACTICAL was the work of the people involved in the problem solving? Adaptive and practical work refers to using existing information or materials to develop ideas, methods, or products that are useful to the organization"	6.10	0.70	SC2
"How CREATIVE was the work of the people involved in the problem solving? Creativity refers to the extent to which the employees developed ideas, methods, or products that are both original and useful to the organization."	5.70	1.09	SC3
<i>MNC knowledge transformation</i> ^a	5.10	1.31	KT
"Explaining the meaning of technical knowledge to colleagues from other units"	4.84	1.40	KT1
"Sharing unit-specific knowledge to establish a shared meaning with colleagues from other units"	5.21	1.38	KT2
"Making efforts to integrate knowledge from different units"	5.27	1.55	KT3
<i>Opportunity formation</i> ^a	5.63	1.01	OF
"We used the problem to explore or build new possibilities."	5.28	1.26	OF1
"We used the problem to construct new ideas."	5.61	1.14	OF2
"We saw the problem as an opportunity to improve and innovate."	5.99	1.04	OF3
<i>Problem pressure</i> ^a	4.50	1.33	PP
"To what extent did the problem exert pressure on the subsidiary."	4.99	1.39	PP1
"To what extent did the problem exert pressure on the wider (MNC) organization."	4.01	1.76	PP2
<i>People involved</i> ^b	2.83	0.96	People
<i>Functional diversity</i> ^c	0.42	0.35	FuncDiv
<i>Unit risk taking propensity</i> ^d	3.54	1.39	Risk
"Low risk projects with normal and certain rates of return vs. High risk projects with unpredictable rates of return."	3.15	1.40	Risk1
"A cautious wait and see posture in order to minimize the probability of making costly decisions when faced with uncertainty vs. A bold aggressive posture in order to maximize the probability of exploiting potential when faced with uncertainty."	3.73	1.57	Risk2
"Owing to the nature of the environment, it is best to explore gradually via cautious behaviour vs. Owing to the nature of the environment, bold wide-ranging acts are necessary to achieve the firm's objectives."	3.75	1.61	Risk3
<i>MNC normalization of problem solving</i> ^e	4.98	1.46	NormPS
"Organizational communications signal that non-routine problems are considered an ordinary occurrence."	4.33	1.59	NormPS1
"The organization takes non-routine problems in its stride."	5.33	1.32	NormPS2
"As far as the organization is concerned, non-routine problems are not seen as anything extra-ordinary."	5.27	1.76	NormPS3

Note: N = 67.

^a Assessed on 7 point Likert scale, ranging from 1 = "to a very small extent", to 7 = "to a very large extent". ^b Log transformation of number of people involved. ^c % people in different function. ^d Assessed on a 7 point semantic differential scale, ^e Assessed on a 7 point Likert scale, ranging from 1 = "strongly disagree", to 7 = "strongly agree".

Table IV. Measurement model evaluation results

<i>Constructs</i>	<i>Loading</i>	<i>Composite reliability</i>	<i>AVE</i>
<i>Solution creativity (SC)</i>		0.839	0.635
Original & practical work (SC1)	0.845		
Adaptive & practical work (SC2)	0.747		
Creative work (SC3)	0.796		
<i>MNC knowledge transformation (KT)</i>		0.933	0.822
Explain meaning of technical knowledge (KT1)	0.897		
Sharing unit-specific knowledge (KT2)	0.896		
Integrate knowledge from different units (KT3)	0.925		
<i>Opportunity formation (OF)</i>		0.908	0.768
Used problem to explore new possibilities (OF1)	0.878		
Used the problem to construct new ideas (OF2)	0.925		
Problem was an opportunity to innovate(OF3)	0.823		
<i>Problem pressure (PP)</i>		0.830	0.710
Problem exerts pressure on subsidiary (PP1)	0.891		
Problem exerts pressure on organization (PP2)	0.791		
<i>Unit risk taking propensity (Risk)</i>		0.927	0.809
Low vs. high risk projects (Risk1)	0.800		
Wait and see vs. aggressive posture (Risk2)	0.953		
Cautious behaviour vs. bold wide-ranging acts (Risk3)	0.936		
<i>MNC normalization of problem solving (NormPS)</i>		0.931	0.820
Non-routine problems are considered ordinary (NormPS1)	0.758		
Takes non-routine problems in its stride (NormPS2)	0.966		
Non-routine problems are not extra-ordinary (NormPS3)	0.977		

Table V. Discriminant validity assessment

<i>Construct</i>	1	2	3	4	5	6	7	8
1 Solution creativity	0.797							
2 MNC knowledge transformation	0.111	0.907						
3 Opportunity formation	0.409	0.594	0.876					
4 Problem pressure	0.226	0.272	0.134	0.843				
5 People involved	-0.223	0.176	-0.026	0.364	1.000			
6 Functional diversity	0.099	0.098	0.044	-0.107	-0.095	1.000		
7 Unit risk taking propensity	0.128	0.145	0.098	0.156	-0.091	-0.306	0.899	
8 MNC normalization of problem solving	0.109	0.014	-0.055	0.085	-0.176	-0.364	0.611	0.906

Note: Diagonal elements are square roots of AVEs, other elements are latent variable correlations.

Table VI. Structural model assessment

<i>Endogenous constructs</i>	<i>R²</i>	<i>Stone-Geisser Q²</i>
Opportunity formation	0.353	0.234
Solution creativity	0.300	0.146

<i>Relation</i>	<i>Path coefficient</i>	<i>t value (bootstrap)</i>
MNC knowledge transformation → Opportunity formation	0.594***	6.340
Opportunity formation → Solution creativity	0.363***	3.337
Problem pressure → Solution creativity	0.288*	2.090
People involved → Solution creativity	-0.289*	2.226
Functional diversity → Solution creativity	0.122	0.942
Unit risk taking propensity → Solution creativity	0.002	0.011
MNC normalization of problem solving → Solution creativity	0.099	0.554

Note: * p < 0.05, ** p < 0.01, *** p < 0.001