The evolution of R&D capability in multinational corporations in emerging markets: evidence from China

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Abstract: This paper presents a longitudinal case of Motorola’s R&D subsidiary in Beijing over the period 1998–2008. Through the construction of key events and changes, the paper unfolds the evolutionary process of Motorola’s R&D capability in China, and explores the mechanisms driving that evolution. We find that this R&D subsidiary evolved through four stages: from a local adoption unit performing adaptive, peripheral tasks for the local market; to a local development unit, undertaking independent product development tasks for the local market; to a global R&D centre, being a module of global projects for the global market; and finally, to a global integration centre, playing a leading and centrally-coordinating role in global projects for the global market. A balance between exploitation and exploration was achieved through temporal and domain separations, which, in turn, drove the development of the dynamics of component competences and architectural competences in the evolution.

Keywords: global R&D; R&D capability; MNCs; emerging markets; mobile communications; evolution.

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1 Introduction

Innovation from the Brazil, Russia, India and China (BRIC) countries and other emerging economies in East Europe is increasingly being integrated into the global R&D system. Multinational corporations (MNCs) are a driving force for the globalisation of R&D (i.e., the dispersion of R&D laboratories globally) (Un and Cuervo-Cazurra, 2008). The investment of MNCs in global R&D in emerging markets often has a spillover effect that not only helps host countries build their R&D capability, but also enhances MNCs’ R&D capacity globally (Cantwell and Piscitello, 2005).

One approach to studying global R&D, at the industry level, looks at aggregated statistical data, trying to map patterns of knowledge transfer from MNCs to local R&D
units (Medcof, 1997; von Zedtwitz and Gassmann, 2002; von Zedtwitz et al., 2004). Such studies have focused on the outcomes of R&D capability development, yet paid little attention to investigating the process of that development. Another approach from a more micro-level or firm level, seeks to answer such questions as how MNCs’ investment in global R&D adds to their global portfolio (Ambos, 2005; Belderbos et al., 2008; Ito and Wakasugi, 2007). However, both approaches discuss the issues from the perspective of home countries.

Despite scholars from diverse fields studying global R&D capability development in emerging markets, it remains unclear how MNCs develop their R&D capabilities in those countries, and integrate such capabilities into their global R&D networks. In recent years, there has been broad consensus that China is becoming a new centre of gravity for global R&D activities (Chen and Vang, 2008; Li and Yue, 2005); however, little attention has been given to investigating how MNCs develop their R&D capabilities in China, especially from a micro perspective or at the firm level.

Our paper aims to fill this gap in the literature. We use a process-oriented case study to investigate the process of how an MNC – Motorola PCS (personal communications system) R&D centre in Beijing – developed its R&D capability in China and integrated such capability into its global R&D system. By unfolding this process, we identified key driving forces that shaped the evolutionary pattern of the MNC’s R&D capability development in China.

Managing global R&D in emerging markets is a socially complex, multilevel and dynamic task. In this study, we address two key issues MNCs face in developing local R&D capability: first, what capabilities – component competence (CC) vs. architectural competences (AC) (Henderson and Cockburn, 1994) – to develop in the context of balancing the need for global integration/efficiency with the need for local adaptability/sensitivity; and second, how to balance exploitation and exploration (March, 1991) strategies in their R&D capability development.

This paper makes three contributions to the literature of global R&D in emerging markets. First, we map an evolutionary pattern of an MNC’s R&D capability in China; second, we identify two mechanisms – temporal separation and domain separation – which are effective for the MNC to achieve balance between strategies of exploitation and exploration in R&D capability development; and third, we posit that the host country perspective is important in seeking to understand the dynamics and complexity in global R&D in emerging markets.

The remainder of the paper is organised as follows: Section 2 builds a theoretical framework through reviewing the literature on R&D capability development and global R&D in emerging markets. In Section 3, we outline the methods used in this study, of which a process-oriented case inquiry is central. Section 4 presents the key findings of our case study. We construct a detailed case in chronological order, describing the evolutionary path of an MNC’s R&D capability development in China. Finally, in Section 5, we summarise the research, discuss the implications of the study, and posit several conceptual constructs for future study.
2 Theoretical framework

Two streams of literature are reviewed which enables us to develop the conceptual framework we use to analyse our data.

2.1 R&D capability development

According to Pisano (1990), R&D capability refers to a firm’s ability to develop and exploit technological know-how, or the application of scientific knowledge for commercial purposes, such as the development of new products or processes. Henderson and Cockburn (1994, p.65) propose two broad categories of competences in R&D: ‘component competences’ (CC) referring to local abilities and knowledge that are fundamental to routine problem-solving tasks, and ‘architectural competences’ (AC) referring to abilities to integrate CC effectively and to develop new CC. The concepts of CC vs. AC are an extension of the work on architectural innovation by Henderson and Clark (1990).

Two strategies are often used in developing a firm’s R&D capability, one focusing on the exploitation of the firms’ existing knowledge and capabilities, the other on the exploration of new knowledge and capabilities (March, 1991). According to March (1991, p.71), exploitation is defined as “refinement, choice, production, efficiency, selection, implementation and execution”, contrasting with exploration as “search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation” in organisational learning, knowledge development, innovation and R&D capability building. Both activities are vital for firms’ survival and prosperity. However, pursuing two strategies simultaneously entails inherent contradictions for organisations by splitting limited resources (Tushman and O’Reilly, 1996). To manage such contradictions, organisations need to consider trade-offs between the two strategies (March, 1991; Ambos and Schlegelmilch, 2008).

Though there exists little agreement on how firms achieve such a balance (Adler et al., 2009), there are important lessons in doing so. Building upon prior research Lavie et al. (2010) identified four modes through which organisations achieve the balance between exploitation and exploration and resolve the paradox: contextual ambidexterity, organisational separation, temporal separation and domain separation. According to these authors, contextual ambidexterity refers to the ability to maintain exploitation and exploration activities simultaneously at any given organisational level. Organisational separation is a form that allows exploitation and exploration activities to occur in parallel, but in different spaces in an organisation. Temporal separation allows both types of activities to coexist in the same organisational unit but at different points of time. Domain separation suggests that exploitation and exploration activities can be carried out in separate domains simultaneously.

2.2 Managing global R&D in emerging markets

Global R&D of MNCs plays a significant role in the globalisation of innovation (Un and Cuervo-Cazurra, 2008). In recent decades, an increasing number of MNCs from industrialised countries set up their global R&D subsidiaries in emerging markets. By doing so, MNCs can meet the requirements for technology transfer from the host
countries, gain access to local talent, and, more importantly, develop local R&D capability and integrate it into their global R&D networks.

This phenomenon has drawn a lot of academic attention in recent years. The research covers such issues as the patterns and taxonomy of global R&D activities (von Zedtwitz et al., 2004); innovation capability development of MNCs in the global market (Lukas and Bell, 2000; Subramaniam and Venkatraman, 2001); the motivations of MNCs in setting up R&D subsidiaries in emerging markets (von Zedtwitz et al., 2007); the integration of innovation capabilities from emerging markets into the global system (Subramaniam et al., 1998), and so on. These studies recognise that MNCs have played a critical role in helping emerging countries upgrade their innovation capability; but also realise that managing and integrating dispersed global R&D units into a global innovation system remains a challenging task (von Zedtwitz et al., 2004). This is because the full integration of globally dispersed R&D activities is socially complex. According to von Zedtwitz et al. (2004), the difficulties in relation to such complexity in coordinating and achieving desired synergistic effects are due to geographic, cultural and organisational distance between headquarters and host-country subsidiaries. These barriers can lead to inefficiency in the exchange of tacit knowledge, often caused by a lack of trust and shared values.

This body of literature represents, however, largely a home-country perspective of MNCs, especially those in the traditional triad of North America, Europe and Japan, in managing global R&D effort (Chen, 2008). This perspective answers such questions as what impact local R&D capability has on MNCs’ global capability portfolio. However, there exists disparity between the perspectives from home vs host countries regarding the global R&D. This is because the notion of R&D capability is subject to relativity as it must be defined from the viewpoint of a given organisation (Lavie, et al., 2010). Due to differences in bounded conditions (e.g., developmental stages, organisational structures and resources) of operations at different levels or geographic locations of a single organisation, especially between the headquarters and their subsidiaries in emerging markets, the evolutionary paths of R&D capability development in divergent subsidiaries can be diverse and also be different from the expectations of the headquarters. For instance, a routinised process of developing AC and CC in a headquarters often needs a substantial period of time for a subsidiary in a less developed country to be internalised in its R&D capability portfolio. In fact, with a few exceptions (e.g., Hobday and Rush, 2007), little is known about how MNCs develop their local R&D capability and integrate it into their global R&D systems under those different conditions.

### 2.3 Research questions

Our literature review pinpoints one obvious gap in the body of knowledge about developing global R&D capability in emerging markets: in the context of MNCs’ global R&D effort, it remains unclear how local R&D capability is developed in emerging markets and integrated into the global R&D networks. To fill this gap, this paper aims to answer the following questions:

Q1 How does a local R&D subsidiary in an emerging market develop its unique R&D capability over time?

Q2 What is the process for such local R&D capability to be integrated into and make a contribution to the global R&D system?
3 Methods

This section outlines the research design, the choice of the case in point, data collection and analysis methods used to investigate the research questions.

3.1 Research design: a process-oriented case study

We used a process-oriented method to investigate the phenomenon of interest, because process is the focal point of our investigation, which cannot be isolated from actors, context, and outcomes when studying a social phenomenon. As Van de Ven (1992) argues, innovation development needs process theory to explain its complexity. A process theory provides explanations of the temporal order and sequence in which a discrete set of events occur based on a story or historical narrative (Abbott, 1988). This method allowed us to capture hidden issues, delineate the complexity of interactions among multiple actors, and unfold the evolutionary process of local R&D capability development of the subject company.

The process in this case study is, therefore, treated as a higher level of analysis, which allows us to examine the interactions of lower levels of analysis over time (Langley, 1999). The unit of analysis in this paper is, then, the process.

3.2 The choice of Motorola PCS R&D centre in Beijing

We chose Motorola PCS (personal communications system) R&D centre in Beijing (hereafter referred to as MRDB or the Centre) as the focal case in our study for three reasons.

First, the case is situated in the mobile communications industry, one of the most globalised industries, especially in terms of R&D. Given the significance of emerging markets in the global value chain in this industry, R&D units in those places have played multiple roles such as manufacturing base, product adaption unit and supply source for global talents. Therefore, the mobile communications industry provides an interesting contextual environment in which to explore the evolutionary path of, and driving forces behind, R&D capability development of an MNC.

Second, with more than 900 million mobile users, China’s mobile communications industry is significant in the global market, and it has developed in a relatively short space of time driven by global R&D. What happens there can be developed into a point of reference. Through this in-depth case study, we were able to generate conceptual constructs that can be further tested in empirical studies in similar contexts.

Third, MRDB was the first R&D centre established by an MNC in the mobile telecommunications industry in China. It has been an active participant throughout the short developmental history of this industry. In response to the booming growth of the country’s mobile communications, MRDB was set up in Beijing in 1998 as a technical support centre to service Motorola’s mobile phones sold in the Greater China region. Over a decade, the Centre developed into a major product development unit, serving not only the Chinese market, but also the global market. Within the course of its lifetime, MRDB developed into a full-scale (and one of the most successful) R&D institute, and became an integral part of Motorola’s global R&D system. The Centre provides a unique
case by which we can unfold the evolutionary path of MNCs’ local R&D capability development from market-driven to resource-leveraged and technology-driven (von Zedtwitz et al., 2004).

3.3 Data collection

The data was collected through both secondary and primary research. Our secondary research involved examining a large array of openly available publications about Motorola, including academic papers, consulting reports and newspaper articles, as well as a number of Motorola’s internal documents in relation to its R&D activities. These secondary sources enabled us to form a preliminary understanding of the trajectory of MRDB’s development.

We gathered the primary data following a ‘snowballing’ technique (Andriopoulos and Lewis, 2009). We identified a few key personnel who were directly involved in the setup, development and upgrading of the Centre, and, through their introductions, we reached out to more people who were familiar with this Centre. This method enabled us to obtain critical expert opinions, which allowed us to reconstruct this longitudinal case. For example, we approached one key person in HR in MRDB. Through this person’s records and recollection, we identified a group of ten key personnel in software development, hardware design, quality control, process control and project management, who worked for the Centre or Motorola for between nine and fourteen years. We interviewed eight such people1 based on semi-structured questionnaires. Two or more of the authors conducted most interviews. Each interview lasted between one and three hours. We interviewed several key people more than once, including verifying our previous transcripts for accuracy. We tape-recorded all of the interviews and transcribed them verbatim subsequently. This helped us clarify meaning by identifying different ways in which the process had been unfolded (Yin, 1984).

Because events represent changes in variables and they are the building blocks of process, our interviews focused on critical events or changes. For example, we asked the interviewees to identify any critical events/changes, which they believed played a significant role in the organisation’s capability development, and to recall the impact of such events/changes on the transitions of capability development. We used many open-ended questions to explore the interviewees’ cognitive development in their reconstruction of case. This method allowed us to collect specific details as well as recognise emerging themes (Subramaniam et al., 1998).

3.4 Analysis

The data collected for this study represented a chronological sequence of events/changes that occurred in MRDB over the period of a decade, meaning that the data provided sufficient time span to form the basis for a longitudinal analysis. Data from real-life contexts have some unique characteristics that make them difficult to analyse (Langley, 1999). In order to retain the real meaning or thick description in our analysis, we built a database to sort, classify and code the data. Three of the four researchers in this study independently analysed the data and then compared their notes before the findings were built into the case construct.
4 Results

This section reports the key findings of our case study.

4.1 The evolutionary trajectory of MRDB’s R&D capability

MRDB experienced four major stages on the evolutionary trajectory of its R&D capability development.

4.1.1 Stage I: a local adaption unit

In 1998, when mobile phones started to be used by more people in China, the market for mobile terminals was dominated by multinational firms, including Motorola, Ericsson, Nokia, and Siemens, among others, and Motorola held the largest market share. At the time, voice communications over mobile phones was very expensive; SMS (short text messages) provided a cheaper alternative. The fundamental differences in input methods between a character-based language such as Chinese and an alphabet-based language such as English make mobile phones without a language input module for Chinese less attractive in China. Therefore, one of the critical tasks for MRDB at the time was to develop Chinese Keyboard Entry (CKE) software for Motorola’s mobile phones sold in China.

At the time of its establishment, MRDB was very small, headed by an expatriate Motorola veteran and staffed by four local software engineers. The managing director for Motorola in Greater China at the time realised the significance of the Chinese market for Motorola’s mobile phone business (China was the second largest market for Motorola mobile phones after the USA). He proposed setting up an R&D subsidiary in China and recommended the appointment of an overseas Chinese, who had worked in many positions in Motorola, including being a technical adviser to Motorola’s semiconductor business based in Austin, Texas, as its first director. The local engineers, though lacking direct R&D experience in mobile phones, had sufficient technical knowledge and experience in software development. After one year, the CKE team expanded to 20 staff and the Centre had a total of 40 people. Most local engineers were graduates of top-tier universities in China.

The CKE enabled Motorola to serve the local market with an easy method of inputting Chinese language, which enhanced Motorola’s market leadership in China. The software development capability on CKE became MRDB’s key capability, serving not only local but global market. This also contributed to Motorola’s profitability as a mobile phone with a CKE module was sold for 300 RMB yuan more than the ones without the input software (3–4 million such mobile phones were sold in China in 1998.).

The market and financial success of CKE endowed MRDB with slack resources and, more importantly, the confidence, to develop mobile phones catering to the needs of the local market. One of the earliest-hired engineers recalled the situation: “…Motorola headquarters allowed us to pursue our dream as long as we made a profit.”

4.1.2 Stage II: a local development unit

To overcome the difficulties of inputting Chinese language to keyboards based on ‘pin yin’, MRDB started to look for a different (i.e., non ‘pin yin’ based) input method. In
doing so, starting from 1999, MRDB began to develop its first mobile phone with handwriting-recognition based on touch screen technology, a much more convenient input means for those who found ‘pinyin’ difficult or impossible to master.

Based on touch screen for handwriting recognition, MRDB developed its first mobile phone, the A6188, in a series named ‘Taiji’. ‘Taiji’ ( 太極 ), literally means ‘great ridgepole’, and is a Chinese cosmological term for the ‘Supreme Ultimate’ state of undifferentiated absolute and infinite potentiality. The ‘Taiji’ series of mobile phones was a type of all-in-one smart terminal that included functions such as communications and personal digital assistants (PDAs).

One of the managers commented:

“We didn’t have to be too fancy when we were designing ‘Taiji’ series. At the time, Palm [a PDA], were hugely popular in the US, so we thought, “why can’t we put the PDA function and handwriting recognition inside the Motorola 998 mobile phone?” That was how the A6188 was conceived.”

The design of the A6188 was the result of local development capability. In fact, the touch screen for handwriting recognition was a disruptive innovation, which eventually became a dominant design (Anderson and Tushman, 1990) for mobile phones for many years to come. To some extent, the A6188 was the archetype of today’s smart phones based on multi-touch screens (such as Apple’s iPhone). One engineer, who was the project manager at the time, commented:

“Although CKE was a big improvement in Chinese language input technology, we felt it was not an ideal solution. So we started to search for a better method for Chinese language input. At that time, the touch screen for handwriting recognition technology came into our sight.”

The engineering manager of the project team said:

“It [the A6188] was different from any previous models. It had a large screen…and from the standpoint of interaction, it offered a brand new experience of interaction between the user and the device. Users could touch the screen and choose any command from the pull-down menu. The interaction was pretty direct and the 2.4 inch black and white screen was a super size at the time.”

At the release of the A6188, Motorola’s headquarters did not think this model could be sold outside China, because keyboard-based entry was the dominant design for text input in mobile phones globally, especially in countries that use alphabet-based languages. Input methods based on a numeric keyboard or a QWERTY keyboard allow users to use a single hand to effectively input alphabet-based languages, which was highly popular among users in countries such as the USA and Europe. However, at the time, the advantage of single-hand entry was not appreciated by many Chinese mobile phone users. The China market welcomed the A6188 with great enthusiasm, especially the high-end market. It quickly became the choice of business phones in China. The engineering manager said:

“You could see the A6188 everywhere on board of airplanes before take-off and after landing. Its success can be matched only by that of today’s iPhone…More importantly, users of A6188 phones had strong loyalty to the model. It provided unmatched convenience and a brand new experience [for users].”
As the result of the huge success of the A6188, Motorola headquarters gave MRDB more autonomy and resources to continue its R&D projects. One engineer in the Centre said:

“Touch screen for handwriting was so advanced at the time, because it solved the real problem for many users who could not use numeric or QWERTY keyboards to enter Chinese based on ‘pin yin’. Another advantage was the touch screen technology also simplified the operations by offering pull-down menus.”

The success of the A6188 enabled MRDB to become a local development unit which was driven by the Centre’s local R&D capability in product development. This unit started to leverage the resources of Motorola’s global R&D network to serve the local market in China. Subsequently, the Centre developed the A6288, A388 and A388c in the ‘Taiji’ series.

4.1.3 Stage III: a global R&D centre

The software platform for the ‘Taiji’ series was personal portable system manager (PPSM). MRDB realised the limitations of expanding functionalities on this platform. The idea of developing a new platform using Linux open-source software on which new features could easily be added emerged within MRDB. This idea was very advanced at the time; it was similar to today’s open platform and application stores. Because of the financial endowment brought in by the success of the ‘Taiji’ series, MRDB was allowed by the headquarters to pursue this open-platform project.

The new software was named the ‘EZX’ platform. The A760 was the first mobile phone model developed on this platform. Subsequently, MRDB developed the A768, A680, A780, A668, E668, E2, A1200 and A1600 (‘Ming’ series), and E6 on this platform. Some of these models achieved market success not only in China, but also in the global market. In the ‘Ming’ series models, more innovative technologies, such as the interaction between user and device, integrating other features (e.g., MP3 player) into the phone, add-on features through an open platform and so on, were used. For example, the A1200, the flagship product based on the ‘EZX’ platform, integrated many features in one device, providing a brand new design, multi-functionality, and unique user experience. Many people considered that the A1200 might have represented the best design of all Motorola’s mobile phone products. One senior engineer in the project team commented:

“Starting from the A780, the ‘Ming’ series became well accepted in markets outside of Asia, including Europe and America. Because of its easy Chinese language input method, this series was already very popular in many Asian markets. In fact, some models were modified to cater to non-Asian markets by, for example, replacing touch-screen with traditional keyboard setting.”

At that time, MRDB was included in Motorola’s global product line management (PLM) system. In other words, as a global R&D centre, MRDB was accepted as an important R&D module for Motorola’s product portfolio in the global R&D network. But the Centre still played a rather passive role in this system, supplying its R&D outputs to Motorola’s global market, coordinated by the headquarters or other R&D centres.
4.1.4 Stage IV: a global integration centre

In 2003, before the advent of Android\textsuperscript{4}, Motorola’s headquarters was actively searching for a new software platform for the next generation of smart phones. Initially, the headquarters appointed the global R&D centre in the USA to lead this task – to develop a new platform, GUIX. However, after two years, this project did not achieve its desired goal and the headquarters decided to pull the plug. Meanwhile, the ‘EZX’ platform and the ‘Ming’ series developed by MRDB became an unusual success globally.

This led MRDB to stand out for its R&D capability in Motorola’s global network. The headquarters started to pay attention to MRDB. In 2005, MRDB was made the global centre to lead and coordinate the project of a new open-platform R&D project. This task initially included upgrading ‘EZX’ into a global platform. Subsequently, the ‘EZX’ platform was replaced by a new technology based on Linux and Java – the ‘LJ’ platform’. By then, MRDB became an active player in Motorola’s global R&D system, integrating global resources to complete R&D projects for the global market.

As a global integration centre, MRDB is an integral part of Motorola’s global R&D network, working together with other R&D centres to undertake the company’s global R&D projects. For example, the A910 based on the ‘LJ’ platform was the result of such a global effort. The A910 was customised specifically for France Telecom. This was the first model developed by Motorola’s global R&D network, coordinated by MRDB, for a non-Chinese market.

The time line of products developed by MRDB on different platforms is depicted in Figure 1.

Figure 1 The product line of MRDB

4.2 The driving forces for MRDB’s R&D capability development

Organisations that possess a distinct portfolio of competences [architectural competences (AC) vs component competences (CC)] have different yet enduring impacts on their R&D performance. Specifically, while both AC and CC are critical in R&D capability development, the balance between the two can create different competitive advantages for an organisation. Along the trajectory of MRDB’s R&D capability development, it was the dynamics of AC and CC that drove the evolution of the local R&D unit. Building upon Henderson and Cockburn’s (1994) definition, we classify the capabilities in
hardware design, software development and testing as CC; and the capabilities in process improvement (PI), quality assurance (QA), and project management (PM) as AC for MRDB.

On the trajectory of MRDB’s R&D capability development, the transitions between different stages were driven by strategic choices of developing CC and AC.

4.2.1 Transition A: from a local adaption unit to a local development unit

At Stage I, MRDB’s capability portfolio was incomplete. Its key CC was emerging mainly in software development, especially for CKE input software. The key AC was to facilitate the local unit to localise Motorola’s global products. MRDB played a peripheral role in the global system, drawing the resources (CC and AC) it required from Motorola’s global network. At this stage, the local unit was following the global protocols. This experience helped the unit accumulate its AC with a much higher starting point compared to domestic R&D labs in the industry. For example, the engineers at MRDB were trained to understand and execute the processes and protocols of quality assurance developed by the global system.

4.2.2 Transition B: from a local development unit to a global R&D centre

At Stage II, MRDB was able to develop products for the local market. This was partly in response to the booming mobile phone market in China at the time and partly a reflection of the natural evolution of MRDB’s R&D capability. At Stage III, MRDB’s product development capability enabled the Centre to become a global centre of R&D excellence in the global network. The product developed in this Centre became a supply source for Motorola’s global PLM. At this stage, MRDB upgraded its capability in both CC and AC. As a result, after MRDB completed the development of its ‘EZX’ series, it transformed itself into a global R&D centre.

4.2.3 Transition C: from a global R&D centre to a global integration centre

At Stage IV, MRDB fulfilled the function of a global coordination and integration centre serving the global market. By doing so, MRDB became an integral part of Motorola’s global R&D system. This transition occurred after the success of the ‘EZX’ platform. As a result, MRDB fully integrated its PM tools into Motorola’s global PM system. For example, in the product development of the A910, MRDB worked together with the global hardware team using the protocols from France Telecom; the project was reviewed by supervisors in the USA; and the project meetings were attended by project leaders from the R&D units in Beijing, Taiwan, Singapore and the USA. Similarly, MRDB followed the global QA and PI protocols to standardise global coordination. These standardised protocols were critical in coordinating different R&D teams from different countries and cultures.
### Table 1  The dynamics of CC vs. AC of MRDB’s R&D capability development

<table>
<thead>
<tr>
<th>Capability transition</th>
<th>Transition A</th>
<th>Transition B</th>
<th>Transition C</th>
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<tbody>
<tr>
<td><strong>Hardware design</strong></td>
<td>Recruited talents with strong learning ability; training in global system; trial and error; support from global R&amp;D network</td>
<td>Accumulating sufficient capability as developing products, able to undertake more sophisticated hardware design tasks for the global product line</td>
<td>Remaining local HW team to refresh global products; developing better communication skills and coordination ability</td>
</tr>
<tr>
<td><strong>Software development</strong></td>
<td>Accumulation from CKE project; collaborating with R&amp;D units in other areas; access to the database of global R&amp;D historical documents; mechanism for internalising learning</td>
<td>Developing capability in integrating software to meet users’ requirements, which is critical in architectural design for mobile phones, especially global products</td>
<td>Reporting line moved from China to the USA; developing better communication skills and coordination ability</td>
</tr>
<tr>
<td><strong>System testing</strong></td>
<td>‘Borrowing’ testing processes and protocols from others in the global resource pool; developing its own testing protocols and accumulating knowledge and experience afterwards</td>
<td>Undertaking all the initial testing for the products developed on the EZX platform for the global market</td>
<td>Reporting line moved from China to the USA; developing better communication skills and coordination ability</td>
</tr>
<tr>
<td><strong>Process improvement (PI)</strong></td>
<td>Establishing a special division of process management, including both global experts from other R&amp;D units and the local engineers; developing local standards to guide local practices; knowledge and experience passed on through internal training</td>
<td>Enhancing the efficiency of utilising the global protocols; exporting its product knowledge to the global network facilitated by the PLM scheme</td>
<td>Following the global PI protocols to standardise the global coordination</td>
</tr>
<tr>
<td><strong>Project management (PM)</strong></td>
<td>Using global PM tools; all documents related to a project stored and managed according to specific protocols; knowledge well internalised and accumulated</td>
<td>Enhancing the efficiency of utilising the global protocols; exporting its product knowledge to the global network facilitated by the PLM scheme</td>
<td>Fully integrated its PM tools into the global PM system</td>
</tr>
<tr>
<td><strong>Quality assurance (QA)</strong></td>
<td>Internal training and global QA protocol, helping the engineers to understand and execute QA requirements</td>
<td>Enhancing the efficiency of utilising the global protocols; exporting its product knowledge to the global network facilitated by the PLM scheme</td>
<td>Following the global QA protocols to standardise the global coordination</td>
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</table>
As recalled by one engineer, the development of PI, PM and QA capability [AC] transformed the way MRDB worked. The central task for MRDB at Stage IV was to find the most efficient way to integrate the global resources and effort. For instance, the local staff needed to seek feedback from their supervisors in the USA, instead of getting direct feedback from their managers in the office next door. The staff had more opportunities to go abroad to work or attend trainings in other R&D units. The new way of working at MRDB required local staff to develop better communication skills and coordination ability. The driving capability at this stage was AC.

Table 1 summarises the transitions of MRDB’s R&D capability, driven by the balance between CC and AC.

5 Discussion and conclusions

From the case, we can see that MRDB, led by three transitions, experienced four distinctive stages of R&D capability development in China. Along this trajectory, the organisation and R&D capability of the unit developed accordingly.

5.1 The evolutionary path of R&D capability development

The evolutionary path of MRDB’s R&D capability between 1998 and 2008 comprised four stages:

1. A local adaptation unit
2. A local development unit
3. A global R&D centre
4. A global integration centre.

MRDB’s role in Motorola’s global R&D system, its position in its organisational structure, and the link between the host and home country R&D functions followed a dynamic pattern along the four-stage process. Building on the taxonomies of Chiesa (1996, 2000) and Gassmann and von Zedtwitz (1999), we propose an evolutionary path of global R&D of MNCs in China (see Figure 2).

**A local adaptation unit:** the major task at this stage is to adapt global products to local markets. The geographical focus of this unit is local, or regional at best. Organisationally, this unit is still funded by the host-country (local) office and the link between the host and home country R&D activities is weak. At this stage, this unit is in a peripheral position in a global R&D network.

**A local development unit:** the major task at this stage involves relatively long-term oriented R&D projects such as the development of new products or processes for local markets. Activities carried out include single-product development projects. Though organisationally this unit is still under the umbrella of the management of local operations, it has more autonomy in decision-making and budgeting due to its contribution to global R&D activities. The link between the host and home R&D activities is still weak, though the contribution made by the host country R&D, especially the insights into understanding local users, becomes vital for the global R&D. This unit is
located in a local system but has access to global resources if needed in order to develop new products/processes for local markets.

Table 1: The evolution of R&D capability development for MNCs in China

<table>
<thead>
<tr>
<th>Market Exposure</th>
<th>Global R&amp;D Centre</th>
<th>A Global Integration Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive</td>
<td>A Local Adaption Centre</td>
<td>A Local Development Centre</td>
</tr>
<tr>
<td>Active</td>
<td></td>
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</tr>
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</table>

Role in a Global R&D Network

*A global R&D centre*: the major task at this stage is to build a locally-based centre of excellence in special areas. Part of its functions is integrated into the global R&D operations (e.g., budgeting is a global function, but HR remains local). The link between the local and global R&D becomes stronger. The objective of running such a unit is to enhance R&D efficiency at the global level by building specialised R&D capabilities in targeted markets. The unit is embedded in a global system, but plays a passive role. This form allows such global R&D centres to develop module-based products locally but serving global markets.

*A global integration centre*: the major task at this stage is to coordinate and integrate global R&D efforts to accomplish globally based R&D projects for the global market. The local unit is integrated into the global R&D networks and the locally developed R&D outputs serve the global market. The decision-making and R&D operations are centrally coordinated from the headquarters. The unit is embedded in a global R&D system and plays a central role in the network. This type of local R&D is an integral part of a global R&D system.

5.2 The dynamics of CC and AC

The case also demonstrates that it was the dynamics of CC and AC that drove the evolution of MRDB’s R&D capability. At different stages, the local R&D centre had a different portfolio of CC and AC. At Stage I, the local adaption tasks were mainly...
undertaken by local staff who were familiar with the local market, but drew limited resources from the global network. The Centre, therefore, accumulated both CC and AC, but principally CC. It was the CC that led the organisation to Stage II. At Stage II, while MRDB continually accumulated its AC, it was the CC that was greatly enhanced during the local project development and eventually led the organisation to Stage III. At Stage III, while MRDB continually accumulated its CC, it was the AC that was greatly upgraded through working on global projects and eventually led the organisation to Stage IV. Organisational development and upgrading follow a certain evolutionary pattern; and it is the dynamics of different capabilities, namely CC and AC, that drive the evolutionary process.

Figure 3  The mechanisms driving the evolution of local R&D capability development for MNCs in China (see online version for colours)
5.3 The balance of exploitation and exploration activities

Exploitation strategy helps organisations develop reliable experience through refinement, production and focused attention, which is likely to guarantee short-term improvement in productivity or efficiency or both. Exploration strategy, on the other hand, enables organisations to create variety in their experience through experimentation, trialing, and free association, which may support the organisations’ longer-term competitiveness (Lavie et al., 2010; March, 1991). Firms often face a dilemma when allocating limited resources in making a trade-off between those two strategies — exploitation and exploration — in their organisational learning, knowledge management or R&D activities, given the intrinsic in congruences embedded in those two strategies. It has long been recognised that the balance between the two is vital for the firm’s long-term prosperity, even survival.

As discussed in the literature review, previous studies found four modes — contextual ambidexterity, and organisational, temporal and domain separations — by which firms could achieve such a balance. Our case, however, confirmed only two modes: temporal and domain separations. In our case, CC and AC are different domains for MRDB to develop its R&D capability. In each domain, the capability development followed a temporal sequence utilising either exploitation or exploration strategies. AC was developed from exploitation to exploration; CC was developed following the sequence from exploitation to exploration, then to exploitation.

We did not find evidence of the other two modes. MRDB did not create an organisational barrier to create separated spaces for the unit to pursue exploitation or exploration strategies, nor was the unit was able to achieve organisational ambidexterity to pursue the two strategies simultaneously. In fact, as suggested by Lavie et al. (2010), the issue of how to achieve organisational ambidexterity in organisational learning and R&D strategies remains untested, given the dynamic and multilevel nature of organisational learning and R&D capability development.

Figure 3 illustrates the modes we found, through which MRDB achieved its balance in R&D capability development.

5.4 Implications

It is difficult to construct any causal relationship between the R&D capability and an MNC’s overall competitive advantage, especially in fast-changing industries such as mobile communications. This is because a firm’s competitive advantage can be easily destroyed by disruptive technologies or shifts of platforms (Christensen, 1997). This is especially true if the R&D capability is from emerging markets, as demonstrated in our case. Another point worth mentioning is that it is debatable whether the success of a local R&D subsidiary should be measured from the home country or the host country perspective. From a host country (local) perspective, MRDB was a huge success — the spillover effect enabled critical R&D capability to be disseminated in the national/regional innovation systems in China’s mobile communications industry by the mobility of manpower trained and developed in MRDB. However, MRDB was not able to change the downward trend of Motorola’s mobile phone businesses as a whole. We can, however, draw three major practical implications for MNCs investing in their local R&D capability in emerging markets.
First, MNCs often encounter the challenge of integrating locally-developed R&D capability in emerging markets into their global R&D networks. In this process, as demonstrated in the case, the development of AC (abilities and soft skills such as project management, process improvement, quality assurance) plays a critical role in achieving a full integration of the CC (abilities such as product development skills) from the local R&D units into the global system. Henderson and Clark (1990) point out that the disparity between the development of product architecture and organisational architecture within an organisation may lead to a failure in the firm’s R&D effort. This situation is especially true for MNCs managing their global R&D in emerging markets. In other words, the failure to develop sufficient AC for local R&D units to integrate their CC in a global R&D system will not completely upgrade the R&D capability of the local units. This conclusion is in accordance with the challenges faced by global R&D activities posited by von Zedtwitz et al. (2004).

Another challenge MNCs often face in their R&D subsidiaries in emerging markets is how to manage their key R&D manpower. To develop local R&D talent is one of the objectives for MNCs to invest in global R&D. However, MNCs found it hard to retain such talent. The challenge in emerging markets is that the labour market for top R&D talent is highly mobile and there is a severe shortage of such manpower. More importantly, MNCs do not have an effective mechanism to capitalise on their investment in R&D manpower. Following the logic of maintaining a balance between AC and CC, a firm’s management systems and the cultures or dominant values – ‘static’ architectural knowledge (which can also be considered as AC) (Henderson and Cockburn, 1994) – are critical in helping MNCs realise value from their local R&D manpower. On the other hand, dynamic capabilities – the organisational competences of creating architectural innovation – are perhaps more important for firms to develop R&D capability in fast-moving environments. Dynamic capabilities include a firm’s ability in redeploying existing knowledge or the ability to update its routines in a systematic but dynamic way (Sirmon et al., 2008; Thomas et al., 2005).

The third challenge for MNCs in their global R&D in emerging markets is to shift their strategic viewpoint from headquarters to host countries. The unique characteristics in markets, talent and institutions in emerging countries pose both challenges and opportunities for MNCs. To understand that uniqueness will help MNCs to better capture the R&D capability from those countries and, therefore, more effectively integrate it into the global systems. From this case, we can see that MRDB was successfully transformed in the period of ten years from a local supporting unit to a global integration centre for Motorola PCS. It seems that the closer this R&D unit got to the core of its global R&D networks, the less autonomy this unit had for its R&D projects. In other words, the insights into understanding the local markets in the R&D subsidiaries in emerging countries can easily get lost in the global R&D system. As a consequence of failing to take into consideration the perspectives of host countries, MNCs are often blind to emerging disruptive technologies from those host countries, especially in emerging markets. “If, for example, the archetype design of multi-touch screen technology developed in MRDB was given a fair chance to be further developed, it might be Motorola who led today’s smart phones based on this technology,” commented by one of the software directors. It needs to be recognised that some of the best practice in business, especially in R&D, is now coming from emerging markets.
5.5 Conclusions

Through this case study, we have developed the following propositions for the evolution of local R&D capability of MNCs in emerging markets.

Proposition 1 The evolution of R&D capability in emerging markets could follow the path
1 a local adaption unit
2 a local development unit
3 a global R&D centre
4 a global integration centre.

Proposition 2 Balance of exploration and exploitation (E&E) in the capability development of an MNC’s R&D unit can be achieved by managing a mix of temporal separation and domain separation; balance of exploration and exploitation within one competence domain (CC or AC) can be achieved via temporal separation and balance of exploration and exploitation between CC and AC can be achieved via domain separation.

In concluding the paper, we emphasise the contributions we made to the understanding of global R&D in emerging markets. First, we constructed taxonomy of MNCs’ R&D capability development in China. Second, we confirmed two modes of mechanisms through which to achieve balance between strategies of exploitation and exploration in R&D capability development in China. Last, but not least, we identified the host country perspective is a promising research area in seeking to understand the dynamics and complexity in global R&D in emerging markets.

That said, this paper is based on a single case study, the limitations of which have been well documented. Our objective has not been to generalise the findings beyond geographic and industry boundaries. On the contrary, the process-oriented methods used in this paper allowed us to explore many hidden issues in the evolution of global R&D activities in emerging markets. We hope that our findings will provide some directions for further research in global R&D in emerging markets, as well as provide useful implications for practitioners.

References

The evolution of R&D capability in MNCs in emerging markets


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**Note**

1 For confidentiality reasons, the true identities of the interviewees were disguised, but a coded list is available from the authors upon request.

2 ‘Pin yin’ (音) is the official system to transcribe Chinese characters into the Roman alphabet used in China, as well as in other Chinese speaking countries/regions such as Hong Kong, Malaysia, Singapore and Taiwan. It is also often used to spell Chinese names in foreign publications and, recently, has been used as an input method to enter Chinese characters into computers or mobile phones. The system was first published by the Chinese Government in 1958 and revised several times. The younger generation, who speak Mandarin Chinese, is proficient in using ‘pin yin’; however, the older generation (above the age of 40 in 1998) and people who speak Chinese with local dialects often find it difficult to use ‘pin yin’ as an input method.

A mobile operating system, developed by Google, open to all mobile phone manufacturers free of charge.

It is not the focus of our paper to track and measure the spillover effects of R&D subsidiaries from MNCs in China. However, the rapid growth of local players in the mobile communications industry, especially the large market share of those non-branded mobile phones based on commoditised chipsets, suggest that such effects may have helped the fast accumulation of skill sets and know-how in this industry.

In fact, as we finalised this paper, Motorola mobility was acquired by Google Inc. for US$12.5 billion.

The authors are listed in alphabetical order; all authors made equal contributions to this paper.