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**How Early Entrants Impact Cluster Emergence:
MNEs vs. Local Firms in the Bangalore Digital Creative Industries**

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Forthcoming in *Management and Organization Review*

RUNNING TITLE

Early Entrants in the Bangalore DCI Cluster

ABSTRACT

In order to understand how the emergence of a cluster in a global innovation system is influenced by early entrants, the paper presents an explorative study of the emerging digital creative industries cluster in Bangalore. We find that MNE entrants develop production and technological capabilities comparatively fast within a narrow range of value chain activities with limited spillovers to the cluster. In comparison, local entrants develop such capabilities more slowly, but within a broader range of value chain activities and with higher spillovers of skills and knowledge, as well as higher participation to building a local entrepreneurial ecosystem. We propose that these effects are moderated by the size of national consumer markets as well as industry context in the guise of project lengths and technological modularity. We also point to the role of global connectivity, proposing that local entrants, in particular, leverage international personal relationships for development of not only relational, but also production capabilities.

KEYWORDS

Cluster emergence, MNE entry, capability development, connectivity

INTRODUCTION

While industrial clusters often constitute vital local entrepreneurship ecosystems, entrepreneurship plays a central role for their early emergence (Klepper, 2006; Boschma, 2015). Extant research on this association between early entry and cluster emergence has focused predominantly on the role of local firms. Less attention has been paid to clusters that are part of global innovation systems and where, consequently, early entrants include MNE subsidiaries. Recent research suggests that MNEs and local firms play different roles in global innovation systems (Mudambi, 2008), but how remains poorly understood. To add to this understanding, this paper asks the research question *Do MNEs and local firms develop capabilities differently as early entrants to a cluster, and how does this influence cluster emergence?*

In order to address this question, the paper undertakes a comparative analysis of early entrants in an emerging cluster. More specifically, we compare how entrants with different characteristics develop capabilities and influence the emergence of a cluster in Bangalore, India, within the digital creative industries (DCI): Animation, visual effects (VFX) and games. This sector is young and its innovation system is global. Thus, our empirical setting not only constitutes a unique opportunity to study the emergence of an Indian knowledge-based cluster, it also allows us to sample data across different ownership types and industry contexts. Because the Bangalore DCI cluster emerges as part of a global innovation system, early entrants encompass local firms as well as MNE subsidiaries, working in different digital creative industries. To take advantage of this, our study is designed as a comparative multiple case study of early entrants based on self-collected interview data, triangulated with key informant interviews. Given the scale and scope of the study, it is explorative, and we use it to develop theory propositions.

Our empirical results first identifies the emergence of a DCI cluster in Bangalore. We point out that concomitant with firm entry, Bangalore is growing a labor pool skilled not just in an artistic and technical, but also cultural sense: Local DCI labor is learning to understand the necessary content quality levels and the aesthetics, customs and consumer preferences on international markets. Furthermore, we find that the cluster is building a local entrepreneurial ecosystem in the guise of an industry association undertaking political lobbying, promoting international-grade animation courses, arranging conferences and fairs, and establishing a startup incubator.

Second, the case study compares how different early entrants, in the guise of local firms and MNE subsidiaries, develop capabilities. Fundamentally, we find that capabilities are developed particularly rapidly by MNE subsidiaries, through transfers from parent firms. Subsidiaries operating in animation and mobile games industries, where Indian and East Asian markets are sizeable, obtained an early mandate from their parents to develop final products. We find that local firms and MNE subsidiaries develop production capabilities through different processes: Local firms disseminate cultural skills to their creative staff through executives and managers who obtained it through their personal and often-trust-based relationships to former employers, early customers, friends or family in Europe and North America. MNE subsidiaries make their staff grasp the cultural aspects of international markets by transferring of personnel and cultural knowledge from parent firms.

Third, we investigate how differences in firm characteristics and processes of capability development impact cluster emergence. Concerning knowledge spillovers, we find these are lower from MNE subsidiaries: They refrain from using local suppliers due to tight integration into their parents' value chains and strong concerns of safety and security. Furthermore, changes in MNE corporate strategy, revoking competence-creating mandates for local subsidiaries, lead these to close their innovation to local suppliers. By contrast, local firms' use of local suppliers varies with industry context: Whereas in animation and VFX industries, the use of local suppliers is modest, in the games

industry, task modularity facilitates use of local suppliers as well as spin-offs of new firms. Concerning spillovers of skills between firms, we find that they are overall limited by the presence of the rapidly expanding MNE subsidiaries: Offering attractive good career opportunities, these entrants currently appropriate an increasing share of the skilled DCI labor in Bangalore. Hence, the growing skill levels in Bangalore's labor pool is mainly due to collective investments in education. Local firms participate most to this process. Whereas these are highly incentivized to participating to building a local entrepreneurial ecosystem through participating to the local industry association, several of the MNE subsidiaries are not, as they entered Bangalore in a low-commitment mode, through 'dedicated units' hosted by an incumbent MNE subsidiary. The low commitment of this entry mode was accentuated by the sudden exit from the cluster by one of these units due to global restructuring of its parent MNE.

On the basis of these findings, we develop theoretical propositions and relate them to extant research. Whereas our findings on the comparative speed of capability development by MNE subsidiaries align with extant theory, other findings, on how firm characteristics impact cluster emergence and of the role of personal relationships in the development of production capabilities, complement and extend theory. Thus, we complement extant International Business (IB) research by suggesting that MNEs that enter a cluster early may postpone building local embeddedness, rendering the investments of local firms to invest in cluster emergence crucially important. Furthermore, we tie to the emergent theme *connectivity* in the intersection of IB and Economic Geography research, providing evidence for how the different connection types of MNE subsidiaries and local firms influence their impact on cluster emergence.

THEORETICAL BACKGROUND

Industrial Clusters

Clusters are geographical agglomerations of economic activity within closely related industries (Porter, 2000; Bresnahan et al., 2001). They are characterized by high innovation and export rates, and particularly knowledge-based clusters play increasingly important roles in global innovation systems (Mudambi, 2008). The reason for the competitiveness of clusters is that geographical agglomeration not only raises local levels of competition (Shaver and Flyer, 2000), but also allows for flexibly specialized local value chains (Piore and Sabel, 1984), dynamic local innovation systems (Maskell and Lorenzen, 2004), and vibrant local entrepreneurship ecosystems (Spigel, 2017; Malecki, 2018).

Cluster research identifies three types of positive economic externalities in clusters. The first and most cited is *knowledge spillovers* between firms agglomerated in related industries (first pointed to by Marshall, and later formalized by Arrow (1962) and Romer (1986) (Mudambi and Swift, 2012). Geographical proximity of specialized firms with related knowledge bases facilitates technology spillovers in the guise of user-producer innovation or observation and imitation (Glaeser et al., 1982; Henderson, 1988). There may also be local spillovers of knowledge of the entrepreneurial process, and local entrepreneur role models are often renowned (Lafuente et al., 2007). The second type of externality arises from specialized *skills* in the local labor pool (Marshall, 1920). The availability of highly skilled labor is, of course, an advantage to all firms in a cluster, but high mobility and multi-firm experience is particularly important for project-based industries relying on freelancers and temporary employment of project workers (Grabher, 2002). A final type of externality is a local *institutional environment* of specialized services and agencies targeting the needs of local industry: Local educational institutions are crucial for local value chains, specialized universities and other

knowledge institutions are often partners in local innovation ecosystems (Breschi and Lissoni, 2001; Dahl & Pedersen, 2004). In some clusters, professional associations, clubs, venues and festivals and other events also serve as an institutional environment that facilitates local interaction between the commercially mainstream and the technologically or artistically ambitious ‘underground’ (Cohendet and Simon, 2013). Furthermore, specialized business services, finance, and incubators, along with shared norms (‘an entrepreneurial mindset’) contribute to local entrepreneurship ecosystems (Malecki, 2018).

Cluster Emergence

Clusters have life cycles and go through phases of emergence, growth, maturity, and decline or restructuration (Menzel and Fornahl, 2010; Martin and Sunley, 2006). Even if policymakers often hope to plan clusters, cluster emergence is typically an organic process, arising through activities and interactions of local firms. After cluster emergence, there is typically a growing value chain disaggregation amongst local firms (Storper and Christopherson, 1987), providing impetus for shifting technological specialization and position in global innovation networks (Awate and Mudambi, 2017). Whether such value chain disaggregation gives rise to knowledge spillovers hinges upon whether local firms’ innovation strategies are “open” (Laursen and Salter, 2014) as well as their level of mutual trust (Maskell and Lorenzen, 2004). Additionally, while denser value chains in local industry provides impetus for specialization of labor, whether firms add to the general level of skill on the local labor market depends on whether they use freelancers and propagate mobility of trained workers (Marshall, 1920). Furthermore, the building of local innovation and entrepreneurial ecosystems necessitates collective action by local firms (Schmitz, 1995).

Entrepreneurship and Capability Development

Thus, early entrants to a cluster play a crucial role for its emergence. Extant research provides us with a rich theoretical framework for understanding the activities of such entrants. Fundamentally, entrepreneurship is a process of developing organizational capabilities (Dosi et al., 2000; Zahra et al., 2006). The capabilities of a firm are a combination of organizational routines and resources that facilitate the firm’s production function (Winter, 2003) and a strategic outcome (Amin & Cohendet, 2004). Literature identifies several main types of capabilities. *Management capabilities* refers to a firm’s ability to efficiently assemble, deploy and bundle various resources, such as logistics, financial systems, human resources, forecasting and planning (Ethiraj et al., 2005). *Technological capabilities* denote the technical, managerial or organizational knowledge that firms require to utilize equipment and information technology and adapt to any changes in technology. *Production capabilities* are the routines and resources necessary for the efficient operation of a plant with a given technology, and its improvement over time, including the quality control and productivity. *Relational capabilities* capture the ability of a firm to establish and manage collaborations, and includes how a firm understands and responds to its clients and how it holds down transaction costs in projects with its partners and suppliers (Ethiraj et al., 2005). Finally, *innovation capabilities* relate to a firm’s ability to solve problems, learn and recombine knowledge (Grant, 1996; Henderson, 1994; Kogut and Zander, 1992). It is closely tied to absorptive capacity, i.e. a firm’s ability to transfer knowledge within the organization and structure its network and communication with its surroundings (Cohen and Levinthal, 1989).

The development of capabilities is a process of strategic investment in organizational structures and systems (Zollo and Winter, 2002) combined with learning through trial and error (Cyert and March, 1963). As such, it is subject to high path dependence (Lane and Lubatkin, 1998; Sirén, Kohtamäki and Kuckertz, 2012; Sydow, Schreyögg, and Koch, 2012).

Capabilities in Global Innovation Systems

In developing capabilities, some entrepreneurial firms re-use routines and resources from earlier ventures (Helfat and Lieberman, 2002). However, international entrepreneurship, i.e. firms that start up to serve export markets and/or global innovation systems, is a process subject to high uncertainty, largely due to liabilities of foreignness, i.e. the costs of operating across geographical, institutional and cultural distance (Hymer, 1976; Johansson and Vahlne, 1977; Kogut and Singh, 1988; Agarwal, 1994). Consequently, entrepreneurship in global innovation systems involves the development of new capabilities (Knight and Cavusgil, 2004; Zahra et al, 2006).

Arguably, the process of capability development in global innovation systems is contingent upon firm characteristics as well as value chain governance (Gereffi et al, 2005). While a subsidiary of a MNE is a part of a network of ownership that shifts resources across borders and often acts as an international client in a global innovation network, an independent local firm typically acts as a supplier, exporting from its single location. In producer-driven global innovation systems, both types of firms need capabilities that allow them to compete. MNE subsidiaries entering into a cluster need to develop management and production capabilities of standardizing the interface between parent and subsidiary and establishing procedures to deal with unforeseen contingencies and coordination needs in the new location (Manning et al., 2010). Local firms, on the other hand, need capabilities to understand requirements of quality levels of clients abroad and delivering outputs in a timely and efficient manner. Suppliers typically face different tasks of such coordination dependent on whether value chain governance is relational or captive governance (Gereffi et al., 2005). Even if a MNE entrant into a cluster largely relies on hierarchical governance, it also needs to develop relational capabilities to lower transaction costs in its subsidiary's negotiations with local firms, because culturally distant firms will need to renegotiate deals and find it more difficult to share tacit knowledge (Shenkar, 2001) and take longer to establish mutual trust and relational contracts (Baker, Gibbons, & Murphy, 2002; Sako and Helper, 1998). On the other hand, a local firm faces a challenge of developing relations to clients abroad (Vivek et al., 2009), and the complexity of this challenge will again depend on governance mode. Finally, concerning innovation capabilities, both types of firms need to develop capabilities of upgrading their position in global value chains: acquiring the ability to move into more sophisticated product lines, improving the efficiency of transforming inputs into outputs, and focusing on higher value added activities (Gereffi, 1999).

Extant research has shown that MNE subsidiaries develop capabilities by leveraging the knowledge residing in the parent company (Argote and Ingram, 2000; Kogut and Zander, 1993) and transferring personnel (Grant, 1996). While the literature on offshoring has mostly regarded local firms as subordinate in supplier relations (Lewin, Massini and Peeters, 2009; Luo, Wang, Zheng and Jayaraman, 2012), recent international business literature has shown that local firms can develop capabilities and slowly catch up to global competitors (Ge and Ding, 2008). This development takes place through repeated interactions with existing clients abroad and forming new relations with new clients. For instance, whereas MNE subsidiaries are likely to develop managerial, technological and production capabilities by design and direct transfer from parent firm, local firms are likely to develop their practices through two processes: Deliberate investments in infrastructure and training to improve technical processes and staff competences (Ethiraj et al., 2005), and client-specific learning through repeated interactions with a client across multiple projects over time. As demonstrated by D'Agostino et al. (2012), a local firm interacting with a client located in a more technologically advanced market may develop the capability to reconfigure resources to meet client requirements, leading to an efficient use of resources. Regarding innovation capabilities, extant literature typically assumes that MNE subsidiaries have more scope for development, given their parent company's strong resource base. Local firms, by contrast, are found to lag behind in innovation capabilities, compensating by

focusing on developing capabilities in delivering specific outputs and catching-up in terms of end-product delivery rather than in innovation (Awate, Larsen and Mudambi, 2012).

Given the organic nature of cluster emergence and the central role of early entrants, how they will impact a cluster depends on the process through which they develop their capabilities, and how this affects their local activities. While extant research, as outlined above, identifies differences in how MNE subsidiaries and local firms build capabilities, we still lack knowledge on whether and how such differences impacts the emergence of clusters in global innovation systems. Will MNE subsidiaries and local firms systematically differ in how they enter into local value chains, use freelancers, allow for local labor mobility and spin-offs, and join collective action to build local ecosystems? Furthermore, will entrants' impact on cluster emergence also be influenced by industry factors, e.g. demand and technology? In order to address this research gap, we now turn to our empirical study.

METHOD

The Digital Creative Industries as Empirical Setting

Our empirical setting is the digital creative industries (DCI): Animation, visual effects (VFX) and games. The sector is young: Digital games are half a century old, and digitalization of animation and VFX only gained speed since the 1990s. The DCI innovation system is currently globalizing: DCI consumption as well as production originated in Western Europe, North America and Japan, but is spreading to new markets, coinciding with new patterns of outsourcing and MNE entry to different DCI clusters where local firms are also present. Thus, DCI as empirical setting allows us to sample across firm ownership type.

Furthermore, this setting allows us to sample across industry contexts with technological differences. At the heart of the DCI is animation. This is a century-old art form, and even with its current digitization (also called computer generation of images, CGI) and knowledge codification, it remains labor intensive and revolves around the creative (aesthetic and narrative) skills of trained animators. While animators use digital tools and have some level of technical competence, they are typically trained in art, design, or dedicated digital arts colleges, combined with significant on-job training.¹ Given this very specific skill profile, animators remain a scarce resource in the DCI.

Some DCI firms specialize in the core process, *animation*. While a few of these specialized animation firms are producers (and IP holders) of end products such as filmed entertainment or Internet content, the majority are service providers, i.e. suppliers of partial content (jingles, advertisements, episodes, or segments). Since most clients outsource relatively large projects (for feature films or long-running TV-shows), and because modularity is low in animation (the handover from one process to the next demands very intricate coordination), the animation industry has notable scale economies. As a result, specialized animation firms often employ hundreds of artists organized in large teams. The capabilities of such firms hinge on being able to hire and organize animation artists and direct them to customize animated content to the exact quality levels and aesthetics expected by consumers or clients (Yoon and Malecki, 2010; Yoon, 2015).

The second main DCI, *VFX*, is more diversified, combining animation with matte (background) painting and other creative digital skills, such as real photos or live action. VFX firms

¹Because animation is a creative rather than ICT-focused process, a result, there are few production synergies between DCI clusters and ICT clusters (for example, regardless of the significant DCI activities in Hollywood, this cluster has been described as "insular" and "essentially distinct" from Silicon Valley (Levie, 2012; Metcalf, 2012)).

are suppliers to film, TV, and advertising clients, and given the shorter duration of projects and lower scale economies in other processes than animation, VFX firms are typically organized in shorter projects and smaller teams compared to specialized animation firms, and the industry is more disintegrated with very specialized producers.

Firms in the third DCI, *games*, also includes ICT processes and skills. They combine animation with and other creative processes involved in game development (concepts, narratives, and designs) with technology-intensive processes (sequencing of games, the coding of engines and the technology aspect of user interfaces). Hence, while games firms need IP management as well as marketing and distribution prowess, their capabilities ultimately hinge upon their ability to combine different types of creative skills with different types of ICT skills. This means that they typically balance in-house production with the use of external suppliers of animation as well as coding and other ICT services, made possible by modularity in the development of games.

All three DCI remain highly labor intensive. Animation of content and production of VFX takes thousands of man hours, most for blockbuster films or long-running TV shows. While mobile and social games, popular on Asian markets, can developed in short projects, console games, dominant on Western and Japanese markets, are content-intensive and technologically advanced and hence, the cost of developing them sometimes match that of blockbuster films. Not only is animation labor a cost driver, many expanding DGI clusters (such as London, Vancouver and Tokyo) also suffer from labor shortages. Like other creative clusters (Lorenzen and Frederiksen, 2008; Florida et al., 2015), such DCI clusters now compete to attract mobile creative talent from a growing global market of experienced animators. Furthermore, firms here offshore the most labor-intensive processes, in a largely producer-driven global innovation system (Gereffi, 1994). Early (2D) animation outsourcing focused on the Philippines, but CGI (including 3D animation) has brought about knowledge codification, facilitating finer slicing of value chains and allowing for entry of new firms. This has made Taiwan, South Korea and India today's key outsourcing destinations (de Graf, 2004; Tschang and Goldstein, 2004; Westcott, 2011) in a global innovation system dominated by relational governance, but with MNEs increasingly introducing hierarchical governance by locating subsidiaries in Asia (Gereffi et al., 2005).

Table 1. The main characteristics of the digital creative industries

<i>Industry</i>	<i>Examples</i>	<i>Main activities</i>	<i>Project duration</i>	<i>Technological modularity</i>	<i>Main capabilities</i>
<i>Animation</i>	TV episodes, feature films, animated web content	Graphical design, 2D and 3D animation, matte painting	Long	Low: Creative tasks with high task interdependencies and reciprocal coordination	Management capabilities (hire and organize skilled labor) Production capabilities (on-time delivery, meeting expected quality levels)
<i>VFX</i>	Special effects inserted in films and TV shows and advertising, post production such as color grading and backgrounds	Live action (keying), motion capture Animation, as above Digital effects	Short	Low: Creative tasks with high task interdependencies, reciprocal coordination and time pressure	As above, plus Technological capabilities (combining animation with a range of specialized technologies)
<i>Games</i>	Console games, PC games, mobile games, games sequences at web pages	Concepts, narratives, designs Sequencing, coding of engines, developing user interfaces Animation, as above	Console games: Long Mobile games: Medium	High: Creative and ICT tasks with sequential coordination	As above, plus Relational capabilities (using external suppliers)

A Comparative Case Study of Early Entrants to the Bangalore DCI Cluster

Only 15 years old, the Indian DCI sector is a late mover. However, it is rapidly growing. In 2011, it had an estimated size of 300 companies, 12,000 employees and a market value of USD 685 millions (NASSCOM, 2015). Since then, annual growth rates have been as high as 20 percent, enabled by government training initiatives and incentives, co-production treaties, and new tax regulations (KPMG, 2013). The well-established Indian filmed entertainment industry contributes to driving particularly VFX industry growth, and a range of local firms, and later also subsidiaries of major DCI MNEs, are located in the filmed entertainment clusters in Mumbai (Bollywood), Hyderabad (Telugu films) and Chennai (Tamil films). However, only the few largest Bollywood and Telugu film productions use VFX, and the Indian home market for animated films and TV is still insignificant. Hence, like for other Indian boom industries (Lewin et al., 2009; Manning et al., 2008; Manning et al., 2010), foreign markets remain the major driver of Indian DCI. The majority of Indian animation, VFX and games firms are suppliers at the lower end of value chains in the global DCI innovation system (KPMG, 2013), and rather than being driven by local demand, the most significant cluster of DCI is emerging not in Mumbai or Hyderabad, but in Bangalore.

In Bangalore, the south Indian city of 8.5 million inhabitants, digital industries and international business has been present for almost half a century. Since the 1980s, the city has developed into one of the world's largest ICT clusters, employing more than 150,000. With the global boom for ICT services (growing since the 1980s but booming with the millennium scare), the cluster

attracted MNE subsidiaries on a large scale, subsequently grew local firms targeting international clients, and during the last two decades, the growth of a home market in India for ICT services has facilitated the emergence of very large local service providers such as Infosys and Wipro. While the ICT cluster continues to boom and attract international investments, the last ten years have seen the emergence of a small new digital industries cluster in Bangalore: That of the DCI. With no notable local filmed entertainment or advertising industry in Bangalore, the DCI cluster, like the ICT cluster, focuses almost exclusively on supplying international clients. Compared to the latter cluster, it is much smaller. ABAI (see below) estimates that in 2015, around 50 well-established animation, VFX and games studios were based in Bangalore (Government of Karnataka, 2017), and aidb.com (accessed April 8, 2018), lists 120 Bangalore firms active in animation activities.

A latecomer to the DCI, Bangalore is in the process of stimulating new entrants, growing a skilled labor pool, and building supporting institutions. Choosing a cluster at such an early stage as empirical setting makes it easier for us to collect relevant data that allow us to discern mechanisms and causalities and enhance internal validity (Stake, 1995). Furthermore, as Bangalore is a part of a global innovation system and consequently experiences MNE entry in different DCIs, the setting facilitates purposive sampling on the basis of extant theoretical categories of interest (George and Bennett, 2005): Ownership types and industry context. As sketched out above, research on how entry, capability development and cluster emergence relate is at an intermediate stage of development, with scarce extant research on the process of capability development and no extant theory on how MNEs differ from local firms in impacting cluster emergence. A suitable empirical strategy to enrich theorizing in such research fields is case studies (Yin, 1984). The case study method is typically to undertake a rich description of particular empirical cases, using extant theory categories to make sense of data while acknowledging uncategorized themes and allowing new categories to emerge (Eisenhardt, 1989). Multiple comparative case studies hold the highest potential for generalization: Comparing across cases that share some but differ in carefully selected characteristics, we can meaningfully discuss what the necessary condition may be for, *ceteris paribus*, a phenomenon to occur (Dul and Hak, 2008). For our purpose, we undertake a comparative case study of firms in the same sector that enter early into Bangalore, but differ in terms of ownership and industry.

Study Design

We based our comparative case studies on extant secondary data combined with primary self-collected data. Access to informants in Bangalore was difficult, and we used referrals from industry contacts obtained during earlier field work in Mumbai. Given our limited data access, we aimed to raise internal validity by purposive sampling and triangulating statements from informants with different positions and backgrounds, including several having worked in different Bangalore firms and organizations. We halted our data collection after 19 interviews, when our sampling categories were covered and no further themes emerged from data coding (Guest et al., 2006). Given the explorative nature of the study, this was an acceptable level of data saturation, providing enough information to replicate the study in a future in-depth study (Gerring, 2007). Our data collection proceeded as follows (see Table 2 below).

Table 2. Data sources

	<i>Data set</i>	<i>Data collection</i>
<i>A</i>	Government reports on the Indian DCI industry Focus: Bangalore setting	Secondary data. Full sample of all relevant reports published by CII; FICCI; IBEF; KPMG; PWC; and USIBC in the period 2005–2015. Summarized.
<i>B</i>	Newspaper articles and literature on Bangalore's development Focus: Bangalore setting	Secondary data. Composite sample, by searching for newspaper articles and adding relevant journal articles and book publications.
<i>C</i>	Key informant interviews: Observers of the Bangalore DCI cluster Focus: Bangalore setting	Primary data. 9 interviews with 7 informants. Purposive sample of observers with knowledge of the cluster's development: The former chairman of NASSCOM, the chairman of NASSCOM's Gaming Forum, the former head of NASSCOM Events Partnership, a journalist, a project broker, and a startup entering from outside the cluster. Open-ended, short unstructured protocol (Stake, 1995). Undertaken face-to-face in Bangalore in 2015, 2016 and 2018, and on phone in 2016. Lasted between 35 and 90 minutes. Taped and summarized.
<i>D</i>	Role informant interviews: Administrators, educators Foci: Bangalore setting, entrant firms	Primary data. 6 interviews with 6 informants. Purposive sample of administrators and educators affiliated to ABAI and GAFX. Semi-structured interview protocol. 4 undertaken face-to-face in Bangalore in 2016 and 2018, one on phone in 2018. Lasted between 70 and 190 minutes. Taped and summarized.
<i>E</i>	Role informant interviews: DCI firms in Bangalore Focus: Entrant firms	Primary data. 14 interviews with 10 informants. Purposive sample of Bangalore's largest DCI firms, covering 3 local and 4 MNE subsidiaries. Replicated design, semi-structured interview protocol. Undertaken in 2016 and 2018, 11 face-to-face in Bangalore and 3 on phone. Lasted between 36 and 130 minutes. Taped and transcribed. Triangulated with annual reports, online sources, and cross-referencing information from informants who had worked in several of the sampled firms.

Note: Some interviews are listed in more than one category. The total number of interviews is 20.

First, we built two sets of secondary data on DCI in India and Bangalore (A and B in Table 2). This was done through library searches and through accessing government and consultancy reports through DCI contacts obtained during earlier field work in India. Next, in order to triangulate these data sets with primary data (data set C), we arranged new field work in India, undertaking key informant interviews with industry observers. These interviews were set up partly drawing upon our extant industry contacts, partly through cold calls. Two of the interviewees used in this phase of our field work were also used at a later stage to discuss our data interpretations. Together, these sets of data pointed to a growing pool of skilled labor and the building of a local entrepreneurship ecosystem in Bangalore. In order to investigate these aspects of cluster emergence more closely, we then arranged a second phase of field work in India. Here, we undertook role informant interviews on site in Bangalore with focal administrators and educators (data set D). We interviewed three different members of the executive committee of the local DCI association, two teachers (one central to the development of the association's activities, one responsible for the implementation of its educational initiatives), and the former responsible for the development of the local DCI festival and training event.

Our final phase of field work in India was undertaken to undertake the comparative case studies of early entrant firms, and resulted in a set of primary data of role informant interviews with

executives and managers in DCI firms in Bangalore (data set E). To construct this data set, we sampled purposively. First, we sampled on firm characteristics in the guise of ownership type, including all MNE subsidiaries as well as the largest local firms. Then, we sampled on industry context, including firms from the all three DCIs of animation, VFX and games. In combination, these sampling principles yielded a data set with all MNE subsidiaries across all industry segments, plus the three largest local firms, one in each industry segment (during our field study, one of these became an EMNE by acquiring a Filipino firm and another was acquired by a MNE). To triangulate statements made by local firms, we cross-referenced with annual reports and online sources, asked firms about each other, and in two cases, undertook brief phone interviews with their clients in Europe for clarification.

Table 3. Overview of sample of DCI early entrants in Bangalore

<i>Firm</i>	<i>Ownership</i>	<i>Industry</i>	<i>Market</i>	<i>Entry in Bangalore</i>	<i>Number of employees (2018)</i>	<i>Interviewees</i>
<i>Xentrix Studios</i>	Local	Animation	TV production companies in Europe and North America	2010 as greenfield investment	500	1) Former CEO and co-founder; 2) Current CEO
<i>Prime Focus Bangalore</i>	Local (branch of Mumbai-based Prime Focus)	Technology services	DCI companies in India and abroad	2008 as greenfield investment	1,100	1) Chief Creative Officer and co-founder
<i>Dhruva Interactive</i>	Local until 2017, acquired by Starbreeze Studios (Sweden)	Games	Games production companies in Europe and North America	1997 as greenfield investment	325	1) CEO and co-founder
<i>Technicolor India</i>	MNE subsidiary of Technicolor (France)	Animation and games	Film, TV and games production companies in all markets	2009 as acquisition	1,300	1) CEO and Country Head
<i>MPC Bangalore</i>	MNE subsidiary of Technicolor (France)	VFX (films)	MPC (UK), serving film and TV production companies in all markets	2010 as dedicated unit	1,400 (employed by Technicolor India)	1) CEO and Country Head of Technicolor India; 2) General Manager of MPC Bangalore
<i>The Mill India</i>	MNE subsidiary of Technicolor (France)	VFX (advertising)	The Mill (UK), serving advertising agencies in Europe and North America	2017 as dedicated unit	125 (employed by Technicolor India)	1) CEO and Country Head of Technicolor India; 2) Operations Director of The Mill India
<i>MR. X Bangalore</i>	MNE subsidiary of Technicolor (France)	VFX (films and TV)	MR. X (Canada), serving film and TV production companies in North America and Europe	2018 as dedicated unit	150 (employed by Technicolor India)	1) CEO and Country Head of Technicolor India
<i>Dreamworks Dedicated Unit</i>	MNE subsidiary of Technicolor in	Animation	Dreamworks Animation (USA), serving	2007 as dedicated unit, exited 2017	225 (employed by Technicolor India)	1) CEO and Country Head of Technicolor India

	exclusive agreement with Dreamworks Animation (USA)		consumer markets			2) Former General Manager; 3) Former Studio Manager
Rockstar Dedicated Unit	MNE subsidiary of Technicolor India in exclusive agreement with Rockstar Games (USA)	Games (all platforms)	Rockstar Games (USA), serving consumer markets	2012 as dedicated unit	375 (employed by Technicolor India)	1) CEO and Country Head of Technicolor India 2) Asset Manager
Zynga India	MNE subsidiary of Zynga (USA)	Games (mobile)	Zynga (USA), serving consumer markets	2010 as greenfield	450	1) Country Manager

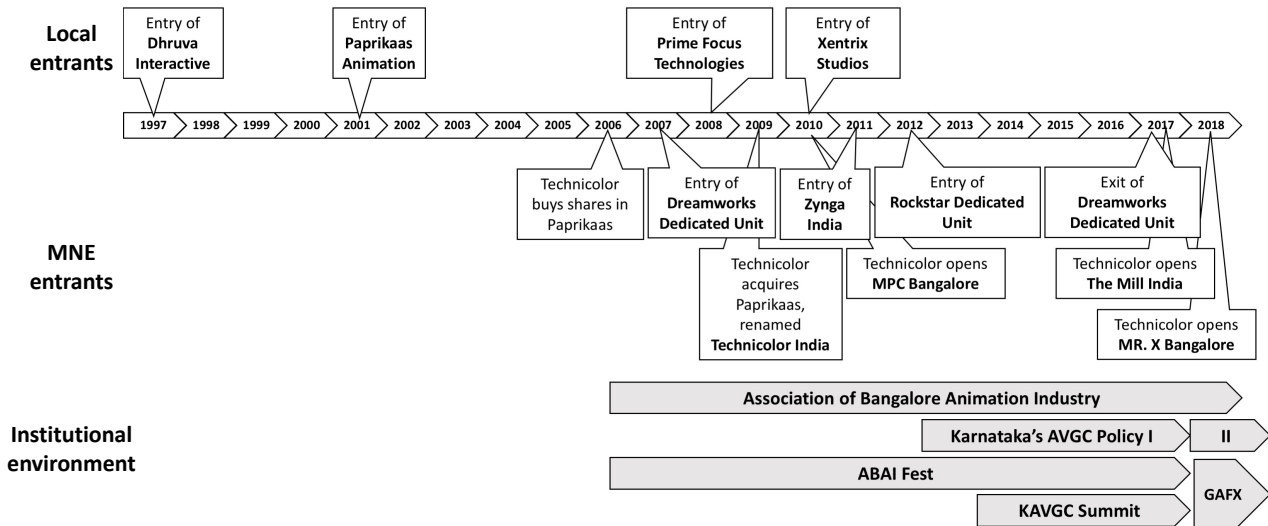
In our coding of data, we took departure in extant theory constructs with the aim of allowing new empirical themes to arise, i.e. a structured middle position between open and theory-determined coding (Dey, 1993). After a first process of sorting data into empirical categories (technologies, products, markets, ownership), we aggregated data into interpretative categories (capabilities, skills, personal relationships, demand size, technological modularity). To enhance external validity (Numagami, 1998), we discussed our coding with several of our original interviewees, as well with industry observers in two additional interviews (data set C).

RESULTS

Cluster Emergence

It was a shared opinion by all interviewees that with more than 50 active firms, a DCI cluster is currently emerging in Bangalore. Contrary to many investors' expectations, the DCI cluster does not piggyback on the extant ICT cluster. As explained by one of the interviewed executives, a veteran in the cluster, during the early years entrepreneurs tried to project the nascent DCI cluster as Bangalore's 'next big ICT miracle'. However, the fluctuating growth rates of the DCIs disappointed investors and the hiring of local ICT-trained staff proved unsuccessful. It turned out that, serving different client types and based on creative rather than ICT skills, DCI firms do not benefit from training or education investments sunk by ICT firms and policymakers. Furthermore, DCI firms have no scope for supplier relations to or from local ICT firms, even if they are all international service providers occupying the same Bangalore technology parks (often the same office blocks). As there are no skill and supplier spillovers from the ICT cluster to the DCI cluster, the current emergence of the latter is driven by entrant firms. However, the majority of interviewees pointed out that these entrants do benefit from spillovers from the extant ICT entrepreneurship ecosystem: The abundant local venture capital, the availability of office infrastructures, an entrepreneurial mindset, and shared norms of export orientation of new ventures. Figure 1 provides a timeline of major events in the Bangalore DCI cluster's emergence, including the most prominent firm entries and the development of local institutions (for details, see below).

Figure 1. A time line of major events



Several interviewees suggested that since the DCI cluster is export oriented, its emergence is driven by entrants' focus not on local demand, but on another dimension of cluster emergence, namely the growing local *animation skills*. Akin to what happened earlier for the local ICT cluster, Bangalore is becoming able to attract new labor to the DCI. Since Indian labor is risk-averse and conservative, it takes a local labor market with abundant employment opportunities to convince job-seekers that emerging industries such as DCI offer a realistic career prospect.² Even if Bangalore does not yet offer a vibrant underground of creative labor and activities comparable to more developed DCI clusters (Cohendet and Simon, 2013), it is becoming sufficiently specialized in DCI to be able to attract labor from across India: Even if Mumbai or Delhi may offer greater overall employment opportunities, among Indian animators, Bangalore is unchallenged as the Indian city with the best DCI job prospects and entrepreneurial opportunities. It is not just the capacity, but also the skill levels that are on the rise in the local labor market. As pointed out by a local educator, technical skills among Bangalore animators are in the process of being upgraded from low-end to encompassing mastery of state-of-the-art CGI and knowledge of the quality standards that apply on international markets. Another educator suggests that another important dimension of the current skill upgrade is *cultural*: Bangalore animators, who often come from a local arts or crafts background, are currently acquiring a sensitivity of aesthetics, customs and preferences at international markets. She exemplifies: Bangalore artists are learning to animate figures doing tasks with both hands, Western style (rather than avoiding the left hand, considered unclean in India) and paint mattes in colors acceptable to international audiences (rather than the tropical colors common in India).

² Bangalore educators and employers are also careful to project the DCI to young job-seekers (and, not the least, their parents) as serious, skill-based, industries unrelated to the glamor and stigma of Bollywood and other Indian entertainment industries.

There are two drivers of the rising level of animation skills. In the first ten years since the emergence of DCI activities in Bangalore, the cluster's firms have undertaken substantial in-house training. In DCI clusters in Western Europe and North America, project-based freelancing is high, and even full-time employed animators tend to move between firms. By contrast, given the early state of the Bangalore cluster, there is a lack of experienced local animators and the scope for freelancing is low. Hence, most firms offer long-term employment and invest in training their staff, incidentally for years. A second and more recent driver is a notable growth in the quality of animation courses. The first interviewed educator points out that while the Bangalore region has a sizeable pool of creative talent with an arts and crafts background, the offer of animation courses (mostly from small, independent schools) has hitherto been insufficient. The second educator added that upon the advent of the DCI in Bangalore, local youth was lured into expensive but low-grade animation courses, spending their savings without obtaining job opportunities. Now, the course offer is being upgraded. Certifications are being promoted across local educational institutions, and a handful of larger colleges are modelling their curriculums on leading international animation schools, employing foreign faculty, and offering guest lecturers and workshops by top international animators. A new internship and placement program, in collaboration between colleges and local DCI firms, also aims at increasing the capacity of the educational offer. In 2017, the state of Karnataka had an estimated 10,000 animation students in its more than 80 DCI-related educational institutions (Government of Karnataka, 2017).

Interviews with observers suggested the crucial role of the local non-profit *Association of Bangalore Animation Industry* (ABAI) for developing a local entrepreneurship ecosystem. Interviewing role informants at ABAI, we found that while the association's scope is to promote the DCI across India³, its impetus is local: From its initiation in 2006, ABAI succeeded in obtaining support and part funding from the local state government, inspiring the introduction of Karnataka State's Animation, Visual Effects, Gaming and Comics (KAVGC) policy in 2012.⁴ One leg of the KAVGC policy is education, funding for which can also be obtained under the National Skill Development Policy. Acting as a facilitator connecting local industry with such public funding opportunities, ABAI is hands-on involved in investing in the upgrade of the local animation courses and negotiating their internship and placement program. Notably, ABAI has multiplied the number of government Digital Arts Centers, combining Fine Arts and DCI training, to more than 20 across the state.

A second activity of ABAI, also supported by the Karnataka government, is an annual combined festival and training event for the DCI, the GAFX (Gaming-Animation-Visual FX) Conference. Held annually in Bangalore since 2006⁵, GAFX is India's prime industry convention for the DCI, attracting industrialists and investors from India and abroad, and is playing an increasing role for attracting international clients. GAFX targets animation students and offers screenings, master classes and panels with international animators and clients, and career and networking activities. As pointed out by all three interviewed members of ABAI's executive committee as well as several interviewed executives and managers, GAFX is invaluable in connecting local executives to clients abroad, and educating creative staff about technologies and quality standards on international markets. Bringing staff labor up close and personal with foreign animators is, as expressed by one of the executive committee members of ABAI, an effective way of obtaining cultural skills of preferences and styles on international markets.

³ A goal akin to that of NASSCOM for the national ICT and BPO industries. NASSCOM, focused on technology, has a "Games Division" promoting this DCI as it incorporates ICT, but has no activities targeting animation and VFX.

⁴ Karnataka was the first Indian state to introduce a policy for the DCI. The second iteration of KAVGC came in 2017.

⁵ GAFX was formerly known as *ABAI Fest & KAVGC Summit*.

The current third main activity of ABAI is lobbying for infrastructures facilitating DCI startups. While DCIs are labor-intensive, entry to these industries also incurs substantial costs in terms of office space and ICT infrastructures. On behalf of local firms, ABAI has signed a 3-year agreement with the local government for funding a Center of Excellence for DCI, an incubator with office space and state-of-the-art technology infrastructures (e.g., render farm and game testing facilities) available for smaller companies.

In the following, we turn to our sample of DCI firms, comparing their processes of developing capabilities and the way this impacts cluster emergence. Table 4 below provides an overview of the findings from the comparative case studies.

Table 4. Early entrants' capability development and impact on cluster emergence

Ownership Industry		
	Local firms	MNE subsidiaries
Animation	Slow capability development Leverage of personal relationships of CEO No use of local suppliers No spin offs of new firms No use of freelancers High participation to ABAI and GAFX	Fast capability development Transfer from parent No use of local suppliers No spin offs of new firms No use of freelancers High participation to ABAI and GAFX
VFX	Fast capability development Transfer from parent No use of local suppliers No spin offs of new firms No use of freelancers Low participation to ABAI and GAFX	Fast capability development Transfer from parent No use of local suppliers No spin offs of new firms No use of freelancers Low participation to ABAI and GAFX
Games	Slow capability development Leverage of personal relationships of CEO Use of local suppliers Spin-offs of new firms Some use of freelancers High participation to GAFX	Fast capability development Transfer from parent No/some use of local suppliers No/some spin-offs of new firms No/some use of freelancers Low participation to ABAI and GAFX

Local Firms' Capability Development and Impact on Cluster Emergence

We investigate local firms first, sampling the three largest. First, we studied *Xentrix Studios*, the largest local animation firm. Founded in 2010 and with near 600 employees today, this privately held firm is one of the largest specialized animation suppliers in Asia. Supplying clients in the European and North American TV industry, the firm follows a scale-based scale model with single projects occupying up to a fifth of its staff at a given time, and with emphasis on retaining and renewing deals with its major clients. In 2017, in order to tap into the labor pool in neighboring South Indian state Kerala (already a major supplier of talent moving to Bangalore), Xentrix opened a studio there jointly with Epica Studios. The same year, in order to add 2D animation to its offer, Xentrix acquired a subsidiary in the Philippines.

Second, we studied *Dhruva Interactive*, the largest local games firm. Founded in 1997, it is India's oldest games developer and currently employs 325. Focusing on console games for a Western audience, the firm focuses entirely on supplying content for games producers of console games producers in Europe and North America. In 2017, Dhruva Interactive was acquired by Swedish game producer Starbreeze, formerly a major client.

Third, we studied *Prime Focus*. With 5,500 employees, this is one of the world's largest independent providers of technology infrastructures (content management platforms) and services (digitization, conversion) for the DCI. Originated and headquartered in Mumbai, the firm now also produces VFX for the Bollywood filmed entertainment cluster as well as international clients. The firm is becoming an EMNE: Apart from establishing a studio in Hyderabad, Prime Focus acquires studios abroad to grow its VFX capacity. However, its subsidiary set up in Bangalore in 2008, *Prime Focus Technologies*, does not undertake any VFX activity yet. Employing around 1,000, this Bangalore firm remains technology-focused, servicing Bangalore firms as well as international clients with digitization, conversion, and content management.

Comparing these local firms, we find a range of similarities in their processes of developing capabilities and how they spill over to the Bangalore cluster. These arise mainly as a result of local ownership: The autonomy to pursue different clients and to engage with other local stakeholders, as well as the local embeddedness and leverage of the personal relationships held by their executives. We also find important differences, arising mainly due to differences in technologies between the different DCI industries.

One similarity is that these local firms *develop notable production capabilities* through supplying international clients. One dimension pertains to scale and speed. An interviewee in Xentrix Studios explained how clients had pulled the firm into a steep learning curve of task pre-production planning and project management, necessary to retain large international clients (in his example, supplying animated content for TV shows with many episodes). The interviewee in Dhruva Interactive explained that due to the abundance of ICT-based tasks (such as coding) in games production, it is a huge advantage for a supplier to access an ongoing development project on the client's cloud server directly, interacting with the client's own developers in real time. From one of its major clients, the firm has now obtained permission for such access and is in the process of learning the necessary procedures and technologies. Another dimension of capability development pertains to quality. Xentrix Studios experiences very strict quality control from its clients and has developed its own quality management procedures. In all three local firms, production quality is boosted not through just by clients' feedback to supplied work, but also through their personal visits to Bangalore. In Xentrix Studios, personal visits happen regularly, sometimes monthly. We contacted the CEO of an European client of Xentrix Studios and the creative director of the European client of Prime Focus Technologies. They concurred that since Indian DCI suppliers are scale-intensive, clients need to invest in coordination, mainly in the guise of frequent personal visits to Bangalore, to ensure communication and consistent quality.

Another similarity is that *international personal relationships* play a role for how the firms develop relational as well as production capabilities. In all three firms, CEOs (the interviewees) have been trained and worked in Europe or North America. In particular, for Xentrix Studios and Dhruva Interactive, personal relationships of the CEOs (at the time of the interviews) to friends and family in these locations continue to play an important role for business. The interviewees leveraged such relationships when obtaining their first international clients and founding their firms, and even if sales have since been professionalized in agents and foreign sales offices, international personal relationships of sales staff remain important for obtaining clients and getting contracts renewed.

Interviewees in both these firms remain personally involved in the coordination of projects and in visits by clients in Bangalore. The interviewee in Dhruva Interactive also explained how relational and production capabilities were intertwined: the firm's online access to a client's projects was only possible due to a high level of person-based trust. Furthermore, a long-standing relationship between this firm's CEO and the management of its major client in Sweden was also leveraged when the client firm acquired a majority share of Dhruva Interactive in 2017. The CEO expressed optimism that a high level of trust in this personal relationship will allow Dhruva to continue to operate as an independent local company after the acquisition. A final effect of the personal experiences abroad of the executives of the local firms, and the personal relationships they still maintain in Europe and North America, is that it provides them with knowledge of quality levels and cultural preferences on international markets for animation. Interviewees stressed the crucial importance of disseminating such cultural skills to their creative staff, many of whom had not travelled abroad. They constantly explain their cultural reference points to staff, and the interviewee in the games firms also voices his personal feedback to content and inputs his knowledge to training of his staff.

In terms of *knowledge spillovers* to the Bangalore cluster, there are notable differences between the firms. Using no local suppliers and with no employees spinning off to form own firms, Xentrix Studios and Prime Focus Technologies have modest technological knowledge spillovers. By contrast, Dhruva Interactive uses occasional local suppliers of particular services that can be separated from its main workflow. The reason was mentioned by the interviewees in both Dhruva Interactive and a MNE subsidiary games firm (see below): Compared to animation and VFX, games development has higher modularity due to its combination of animation-based and ICT-based processes. Dhruva Interactive has seen several employees spinning off forming their own local firms, the company has supported several other startups, and also created an incubator to stimulate the emergence of new DCI firms. Whereas some of the incubated firms are suppliers to Dhruva Interactive, others are now independent local competitors.

Concerning *skill spillovers*, they are modest for all three firms. As Bangalore's DCI labor market institutions are still underdeveloped, all our sampled local firms are weary of using freelancers, and focus on long-term employment and in-house training. For technology reasons, Prime Focus Technologies and Xentrix Studios do not use freelancers at all, and Dhruva Interactive uses them only rarely. However, the latter arranges a training academy and tournaments for local talent, and since it does not hire all attendees, it has some local skill spillovers. For all three firms, labor turnover is low. However, it is noteworthy that managers and creative staff that do leave the three firms are routinely picked up by the rapidly expanding DCI MNE subsidiaries in Bangalore. Some creative staff has even been poached by one of these, contacting staff in local firms and urging them to leave for a better salary the after finishing their training.

Finally, there is a difference in the firms' *local participation* to the industry association ABAI's activities. The reasons are partly to do with ownership, partly with technology: Prime Focus Technologies is a local branch of a Mumbai-headquartered technology-focused firm. Developing technological capabilities fast, by transfer of assets from Mumbai, and serving the DCI industry rather than producing DCI content, it participates little. By contrast, Xentrix Studios and Dhruva Interactive are headquartered in Bangalore and more based on animation skills. Hence, these two firms are dedicated and active ABAI members, and the latter is also a former chairman of NASSCOM's Gaming Forum. In particular, one of the interviewees in Xentrix Studios expresses his firm belief that ABAI's political lobbying, education activities and the GAFX Conference are central to the development of the DCI cluster, and stresses his firm's dedication to participating to the internship and placement program developed by ABAI and local animation colleges.

MNE Subsidiaries' Capability Development and Impact on Cluster Emergence

We now investigate MNE subsidiaries, including all seven currently having entered the Bangalore DCI cluster. Most of these are connected to Technicolor, the 100-year old MNE (current global employees: 15,000). Holding patents for many core technologies involved in filmmaking, Technicolor remains technology-focused, but after its acquisition by the French Thomson Group it has diversified into, amongst other activities, DCI services. After having built a portfolio of large, mainly North American, clients in the film, TV and games industries, Technicolor needed to expand capacity, and in 2006, it bought a majority share of Bangalore then largest local animation studio Paprikaas (of then 350 employees) and set up an department here undertaking animation and games services. In 2009, Technicolor fully acquired Paprikaas, changing its name of the subsidiary to *Technicolor India*. After the acquisition, Technicolor India invested on a major scale in physical and technical infrastructures and increased the capacity of its Bangalore facility. Today, Technicolor India is the world's largest service provider of animated content for TV, and together, its Animation and Games departments employ 1,300. In 2010, Technicolor India set up *MPC Bangalore* in its new campus, a subsidiary dedicated fully to supplying the global value chain of Technicolor-owned (and UK-headquartered) Moving Picture Company, an industry leader in supplying major films with VFX. Experiencing rapid growth (and winning several film industry awards in the process), MPC Bangalore today employs 1,400. In 2015, Technicolor acquired London-headquartered The Mill, the world's largest VFX-for-advertising firm (800 employees in the UK and USA), and in 2017, opened a third subsidiary, *The Mill India* on Technicolor India's campus in Bangalore, currently employing 125. In 2014, Technicolor acquired Canadian VFX company Mr. X (with 200 employees in Toronto and New York) and in 2018 established a fourth subsidiary on Technicolor India's campus, *Mr. X Bangalore*, rapidly grown to 150 employees in its first four months of existence. As a result of these substantial investments, Technicolor employs a notable share of Bangalore's DCI workforce, particularly in VFX, with a staff of almost 1,700, and games, where it (together with Rockstar Dedicated Unit, see below) has a staff of around 1,000.

The fifth MNE subsidiary we investigate also connects to Technicolor: *DreamWorks Dedicated Unit* was the first large-scale foreign subsidiary of DreamWorks Animation (spun off from in 2004 from DreamWorks, the major US film production company, current global employees: 2,000). Dreamworks Dedicated Unit entered in Bangalore in 2007 with the exclusive aim of supplying its parent with animated content, mostly for films, and used a particular hybrid entry mode. While it operated like a DreamWorks subsidiary, the Dedicated Unit was legally owned by Technicolor India, which also provided all physical and ICT infrastructures and took care of security, the unit's legal and administrative obligations (e.g. audits, compliance and employment contracts) as well as interaction with local authorities. However, DreamWorks Animation designed the majority of procedures, managed all tasks, and owned all IP. This dedicated unit entry mode, with rapid entry yet low commitment, leveraged Technicolor India's existing animation workforce, and, through aggressive expansion and hiring of animators, allowed DreamWorks Animation to upscale its Bangalore operations fast, quickly reaching 225 employees. Since 2015, however, Dreamworks Animation shifted its focus from films to TV. As a result, following the company's 2016 acquisition by Universal (Comcast), a surprise announcement was made that Dreamworks Dedicated Unit would be terminated. With its new focus on TV, upon the exit of its Bangalore subsidiary, Dreamworks Animation increased its orders to Technicolor India for TV content, and consequently, some former Dreamworks Dedicated Unit staff was able to transition into new employment at Technicolor India's Animation department.

Sixth, we studied *Rockstar Dedicated Unit*, the Bangalore subsidiary of US Rockstar Games (established 1998, global employees: 1,200). This MNE also entered Bangalore using the dedicated unit entry mode. Founded in 2012 and currently employing 375, the unit is also owned by Technicolor, taking care of its daily management and administration, but is fully integrated into Rockstar Games' global value chain.

Finally, we studied *Zynga India*, the seventh MNE having entered Bangalore. Established in 2007 (current number of employees: 1,500), US-based Zynga was one of the fastest-growing games companies and in 2010, it expanded capacity dramatically with acquisitions and new plants, including a greenfield investment with 30 employees in Bangalore, the first and largest of Zynga's foreign subsidiaries. Zynga India since expanded to 450 employees. Fluctuating global demand has made Zynga reduce its operations by 25% since 2013. However, given its high productivity and a growing Indian home market, Zynga India has had layoffs of less than 10%.

We identify a range of similarities in these MNE subsidiaries' development of capabilities and spillovers to the Bangalore cluster, as well as differences arising mainly as result of disparate home market potential and industry effects related to technology.

The most fundamental similarity is that MNE subsidiaries *develop management, production and technological capabilities* planned, at a large scale, and fast: Parent firms transfer personnel, standard operating procedures, and entire ICT infrastructures and layouts, and run year-long, specialized training programs for local staff. For instance, Technicolor India employs what it calls "artists" (creative staff) as well as "researchers" (developers, managers, and technology-focused staff), and the entire 350-strong group of the latter was transferred to the Bangalore subsidiary from abroad. This process also develops cultural skills. Training is not merely technical, but also aims at making Bangalore creative staff understand the needed quality and aesthetics in the content they produce for parent firms and their international clients. The international managers and creative staff placed in Bangalore (some on a project basis, some for extended periods), bring with them a high level of cultural knowledge, making the subsidiary able to plug into the MNE global value chain with few cultural glitches. The capability development of MNE subsidiaries is focused on a small part of the value chain: Five of the seven MNE subsidiaries focus largely on animation, with parent firms undertaking pre-development, planning, design and coding activities. Zynga India, one of the two MNE subsidiaries specialized in games production was allowed to develop capabilities in comparatively more value chain activities. The parent firm serves the social gaming market, and since this type of games (played online and on mobile phones) can be developed in relatively short projects, Zynga India originally undertook not just animation, but also more ICT-based value chain activities. In addition, since a sizeable local market for social games is emerging in India (console games are comparatively expensive), Zynga India was given mandate by its parent to develop new prototypes of games targeting the local market. However, in 2016, Zynga refocused its global operations, downscaling and withdrawing its investments in new markets for social games. Abandoning its earlier strategy of giving competence creating mandate to its Bangalore subsidiary, this was refocused as purely a specialized supplier to its global value chain.

In developing capabilities, we noticed that the interviewees in MNE subsidiaries, by contrast to those in local firms, did not mention *international personal relationships* as valuable. Since the subsidiaries rely on their organizational belonging to parent firms, the family and friendship ties of managers and creative staff are not leveraged for business purposes. The interviewed executive of Dreamworks Dedicated Unit even mentioned that such relationships could be problematic, since they afflicted his staff with 'The American Dream' and inspired them to seek career opportunities abroad.

Concerning *knowledge spillovers*, the MNE subsidiaries' use of local suppliers is extremely limited: Only Zynga India, given higher modularity and outsourcing in the games industry, mentioned the use of local suppliers – a use that has recently been cut back with the change of corporate strategy. A central reason is the subsidiaries' tight integration into the global value chains of parent companies, based on daily communication and real-time online access. Combined with strict procedures of security for the animation and VFX subsidiaries (their clients are the major international film and TV production companies, highly concerned with preventing piracy and hacking), this leaves little scope for outsourcing tasks to other Bangalore firms.

Skill spillovers are also limited: Only Zynga India informed us that prior to the change of corporate strategy, it made use of local freelancers and that employees moved on and sometimes spun off new ventures. One reason is that security procedures and focus on integration with parent firms' value chains mean that MNE subsidiaries prefer to hire on a permanent basis rather than using freelancers. Like the interviewees in local firms, our interviewees in MNE subsidiaries also mentioned that the local labor market is insufficiently developed to allow for freelancing. Another and more fundamental reason is that labor moves into, but not out of, the MNE subsidiaries: Due to the capacity needs of their parent firms, the subsidiaries expand by hiring new talent as well as trained labor from other Bangalore firms. It remains disputed among local animators whether working conditions and pay of MNE subsidiaries are at par with local firms, but MNE employment is far more attractive in terms of training as well as internal career opportunities. Upon Dreamworks Dedicated Unit's exit from Bangalore, some of its former creative staff leveraged their training and status to seek employment in Dreamwork's USA branch or with other MNEs abroad.

Generally, their size and local impact considered, MNE subsidiaries' *local participation* to the industry association is modest. Their aggressive hiring and internal training activities mean that their involvement in the improvement of local education institutions is less than the size of their labor force warrants. Offering year-long in-house training programs at a scale and level far surpassing local firms, they have comparatively less need for participating to the internship program developed by ABAI and local education colleges, and do not always offer their agreed number of placements in the program. Technicolor India, present in Bangalore for more than 10 years and having sunk significant investment into its campus, and Dreamworks Dedicated Unit undertaking animation for feature films, entailing projects of significant length, operate(d) with the longest planning horizon of the MNE subsidiaries. Both these subsidiaries invested and participated actively to ABAI and GAFX in order to secure long-term supply of animation talent. However, Dreamworks Dedicated Unit's participation was disrupted by the subsidiary's exit, and the continuous rapid growth of Technicolor means that it has limited capacity to contribute to local educational infrastructures activities. The two games subsidiaries remain fully focused on its parent's global value chain and participate very little locally. The subsidiary entered in the low-commitment dedicated unit mode leaves all interaction with cluster institutions, including ABAI, to Technicolor India, their local host. A final point, raised by key informants, is that while the MNE subsidiaries are all formally enrolled in ABAI's efforts of creating the local Center of Excellence DCI incubator, this involvement disincentivizes local entrepreneurs from participating, because they are weary of having business ideas appropriated by foreign-owned firms.

DISCUSSION

Our sample of interviewed firms covers the core of a small cluster and represents firms across theoretical (local firms vs. MNE subsidiaries, covering the largest of both categories and all of the latter) as well as empirical categories (all the three DCI industries). However, the sample is still small,

biased toward the largest firms, and even if it is triangulated with a sample of administrators, educators and key informants as well as secondary sources, it only allows for explorative theory development in what follows. Discussing our findings, we now offer propositions for future testing.

Capability Development

Our findings align with extant research on capability development: MNE subsidiaries have access to their parent's organizational capabilities and repository of knowledge (Bartlett and Ghoshal, 1989; Birkinshaw, 1997; Kogut and Zander, 1996). Not unexpectedly, we find that MNE entrants in Bangalore are faster than local firms in developing capabilities. The MNE subsidiaries are solely reliant on their parents for this process: They entered to leverage low costs of Indian labor, not to collaborate locally.

Our findings also align with extant research of local firms as developing capabilities through client relations. We find that while repeated interactions with core clients provide our studied firms with impetus for developing technological capabilities, it also develops production capabilities through transfer of knowledge of planning and management. Challenging extant IB theory, we find that the capability development by local firms involves a broader range of value chain activities compared with MNE subsidiaries. The latter are designed to undertake a focused set of activities in the global value chains of their parents, who adhere to a comparatively closed innovation regimen (Laursen and Salter, 2014) with focus on speed, secrecy and in-house production. Given the high growth rates of their parents, the turnover is fast and projects run on short deadlines. Given the tight coordination with parent firms to avoid slack, there is little scope for subsidiaries to experiment with and develop capabilities in a broader set of value chain activities. By contrast, local firms are also highly specialized to deliver particular services to their clients, but this specialization has the possibility to change over time. New clients and markets exert a pull to gradually move into new value chain activities, leading them to develop new capabilities. In two cases, local firms also built additional relational capabilities, allowing one to acquire a subsidiary in the Philippines, and another to partnering with, and eventually being acquired by, a client. The finding that firm characteristics in the guise of ownership influence capability development leads to the following proposition.

Proposition 1: Compared to a local firm, a MNE subsidiary is likely to build technological and production capabilities more rapidly, but in a more narrow range of value chain activities.

The process of capability development of MNE subsidiaries may be influenced by changing local needs (Luo and Park, 2001; Ghoshal and Nohria, 1993). All Bangalore subsidiaries had the typical mandate of an offshore subsidiary, specializing in a narrow range of value chain activities (Cantwell and Mudambi, 2005). However, one of the games subsidiaries obtained competence-creating mandate from its parent because of a change of perception of local consumer market opportunities. Before it exited, the animation subsidiary was also eventually giving such a mandate because of the growth of the Indian market for animated films. Such local development projects use local teams to target the growing local demand for animated content represent autonomous subsidiary entrepreneurial initiatives (Birkinshaw, 2000). This attempt at mastering the challenge of serving the Indian market with locally produced content (for a general discussion, see Saranga et al., 2017) are more explorative (and less risky) than the largely unsuccessful attempts made earlier by Hollywood to serve the Indian market by co-productions and acquisitions (Lorenzen and Taube, 2008). The finding that national market size moderates the influence of ownership on capability building leads us to proposing the following.

Proposition 2: The greater the national consumer demand, the more likely a MNE subsidiary is to get obtain a competence-creating mandate from its parent.⁶

Connectivity

We find a significant difference in the role of international relationships of MNEs and local firms when developing capabilities. As mentioned, subsidiaries take advantage of MNE ownership. We find that in lieu of this opportunity, local firms take advantage of personal relationships to develop capabilities. Such relationships have arisen through executives' past experience of working in Europe and North America, and are carefully nurtured and supplemented as valuable resources, not just as relational capabilities, but to deepen collaboration and transferring knowledge. The understanding of personal relationships, including how they compare with connections in the guise of ownership, is a new agenda in International Business and Economic Geography research under the heading *connectivity* (Beaverstock et al, 2002; Lorenzen and Mudambi, 2013; Cano-Kollmann et al, 2016). This research agenda compares different types of international connections between firms and clusters and investigates how the nature of these connections affects international business strategy as well as, in turn, the connected clusters. It points to personal relationships, in the guise of family and friendship ties, as complementary to organizational pipelines, in the guise of MNE ownership. Due to their (relative) autonomy from business strategy, person-based relationships between firms are vehicles for knowledge transfer and trust. This has the potential to spill over to business. For instance, International Business research has documented that MNE entry to a cluster often follows pre-existing personal relationships (Saxenian and Hsu, 2001; Qui, 2005; Zaheer et al., 2009). The importance of personal relationships has grown tremendously during the last decades, given growing diasporic communities and developments in communication and transportation technologies (Agrawal, Cockburn and McHale, 2006). Furthermore, these technological developments also mean that personal relationships between clusters can be reinvigorated even after years of being dormant (Levin et al., 2011). In a description perfectly fitting the executives and some of the managers of the Bangalore local firms, Saxenian (2006) describes how specialized migrant labor is today's 'Global Argonauts', developing personal relationships between the locations they have lived and worked.

Focused on the innovation impact of international connections, Lorenzen and Mudambi (2013) suggest that since organization-based connections are strategic and align with business firms' relatively short-term profit focus, they facilitate focused search and innovation with a narrow scope. By contrast, since personal relationships are emergent and have many potential objectives, they provide the impetus for more diverse search and broader innovation. This comparison offers a potential explanation for our finding that while Bangalore local firms build capabilities more slowly than MNE subsidiaries, they search broader and seek wider opportunities, and have the scope for developing more diverse capabilities. It is noteworthy that the GAFX Conference, like other festivals and fairs, can be seen as an infrastructure boosting international connectedness, since it facilitates personal meetings between local DCI labor and foreign experts.

The finding that firm characteristics in the guise of international connectedness influences capability building leads us to propose the following.

Proposition 3: While a MNE subsidiary is likely to rely on an international organizational pipeline, a local firm is likely to leverage international personal relationships.

⁶ Since our study has not sampled across different national market sizes, this proposition remains speculative.

Impact on Cluster Emergence

Our findings suggest that there are noteworthy industry effects in entrants' impact on cluster emergence. The first is length of projects in an industry. In animation and (console) gaming, projects typically last longer than in VFX, and this allows for longer time horizon in planning, including a focus on investing in securing access to skilled labor in the longer run. In Bangalore, both the local animation firm and the two animation subsidiaries undertook long animation projects and both were involved in developing the local skill offer, including investing in the GAFX Conference as well as the ABAI education institutions. Needing to constantly secure new projects and serve clients with tight deadlines, VFX firms refrained from such local participation, focusing on aggressive hiring (and occasional laying off) of labor instead. This leads us to the following proposition.

Proposition 4: The greater project lengths in an industry, the more likely a firm operating in this industry is to participate to the development of local supporting institutions.

We also find that another aspect of an industry's technology plays an important role. Games firms, both local and MNE subsidiaries, use more local suppliers, more freelancers, and see more employees spinning off new firms than firms specializing in animation and VFX. The reason is that there is a greater diversity of both animation and ICT-related tasks in the gaming segment of the DCIs. This finding connects to literature on modularity, arguing that the greater the decomposability of value chain activities (component standardization, interface specification), the higher the scope for outsourcing (Sanchez and Mahoney, 1996). In the International Business literature on the implications of value chain disaggregation for offshoring, this argument is echoed in the observation that highly modular interfaces are easy to outsource due to lower uncertainty (Mikkola, 2003; Sako, 2006). Hence, *ceteris paribus*, the higher the modularity of processes, the greater their potential for spillovers to cluster emergence. When a MNE or international client offshores processes with high modularity to a firm in a cluster, this firm may outsource further to local suppliers, disseminating knowledge and impetus for other firms' capability development. Furthermore, it creates incentives for its employees to becoming local suppliers by spinning off their own firms. Further tiers of local outsourcing entails increasingly specialized tasks and less scope for capability development. However, local outsourcing is a seedbed for the start-up of new firms, who might, in time, step up to directly supply international clients and embark on a process of developing broader capabilities. The finding that industry context in the guise of technology influences local spillovers is summed up in a fifth proposition.

Proposition 5: The higher the task modularity in an industry, the more likely a firm operating in this industry is to use local suppliers and freelancers and spin off new firms.

The effects of project length and task modularity withstanding, our study showed that ownership by far had the strongest effect. In several cases, corporate strategy annulled the effects of local demand size as well as industry effects. One of the MNE subsidiaries in games where modularity should allow for local spillovers never had any competence creating mandate and remains closed to local suppliers. The other MNE subsidiary in games formerly utilized its high task modularity in games production to involve local suppliers, but a change in MNE strategy away from focusing on local market opportunities withdrew the local competence-creating focus, and it is currently closing its innovation model. One of the animation subsidiaries which, given its long animation projects, was growing its participation to the development of local skills and the entrepreneurial ecosystem, was forced to exit the cluster altogether by corporate restructuring in USA. When such a large player exits a cluster, its former employees often spill over to the local labor market and stimulate new local firm start-ups (Maskell and Lorenzen, 2004; Feldman et al., 2005). However, this was not the case after this subsidiary's exit, since the majority of its former creative staff was transitioned to other jobs

inside the local host MNE, or used their MNE employment experience as a stepping stone to careers abroad. Hence, our findings suggest that MNEs do not always heed the advice in International Business literature of providing their subsidiaries with mandate to participate to local ecosystems through local formal and informal connections to other firms and organizations, i.e. business and technical embeddedness (Andersson et al., 2002) as well as institutional embeddedness (Johanisson et al., 2002). According to extant research, interacting with local managers and governmental authorities (Xin & Pearce, 1996) and connecting with local suppliers, distributors, buyers and competitors facilitate local responsiveness (Luo, 2001), and local participation is a way of developing capabilities to counteract liabilities of foreignness. However, what we find aligns better with Shaver and Flyer's (2000) argument that firms with comparatively strong extant capabilities benefit comparatively little from knowledge and skill spillovers. In Bangalore, local firms benefit from each other as well as the local entrepreneurial ecosystem and consequently engage in collaborating and building the ecosystem, including education infrastructure and international connectedness infrastructure in the guise of the festival and training event. By comparison, MNE subsidiaries are in less need of such infrastructures. Following a comparatively closed innovation strategy, they entered the cluster for wage arbitrage, and potentially to gain first-mover advantages in accessing the rapidly expanding Indian animation market in the future. If they chose to stay in the DCI cluster at all, they are likely to bide their time until the cluster has built stronger skills and suppliers to consider participating more locally. Entry mode matters here: The hybrid entry mode we identified, that of dedicated units, may entail a low level of embeddedness. One MNEs that entered as a dedicated unit continues to leave administration, legal work and hiring to the local host, using this entry mode to achieve rapid scale of the labor force while almost entirely avoiding local collaboration with other firms and involvement with building the local entrepreneurship ecosystem. As evidenced by the other of the dedicated unit's sudden closure, this entry mode's low level of embeddedness also facilitates rapid exit from a cluster. By contrast, the games subsidiary that entered as greenfield had, for a period, comparatively higher commitment to participating to building the local ecosystem. For acquisition, the evidence is more mixed. The VFX subsidiary entered through acquisition, but has had low local spillovers. The recent acquisition of the local games firm by its Swedish client preserves some autonomy for the local firm, including its local spillovers. Thus, the effects of ownership on acquired firms are, as mentioned, moderated by project length and task modularity: The VFX subsidiary undertakes short VFX projects for its parent's global value chain, while the local games firm undertakes longer projects of producing games for a host of different international clients. The finding that firm characteristics in the guise of ownership influences local spillovers and participation to building a local ecosystem leads us to our final proposition.

Proposition 6: Compared to a local firm, a MNE subsidiary is less likely to use local suppliers and freelancers, spin off new firms, and participate to the development of local supporting institutions.

We have summed up how the paper's propositions combine in Figure 2 below.

Figure 2. Main argument of the paper

	Local ownership	MNE ownership	
Speed of capability building	Low	High	
Focus of capability building	Broad	Narrow	The greater the national demand, the broader the focus
Connectivity	Person-based	Organization-based	
Knowledge spillovers	Large	Small	The higher the task modularity, the larger the spillovers
Skill spillovers	Large	Small	
Local participation	High	Low	The longer the projects, the higher the participation

CONCLUSION

By studying early entry to an emerging Indian knowledge-based cluster, the paper investigated how firm characteristics and industry context relate to the emergence of a local entrepreneurship ecosystem. The paper found that MNE subsidiaries and local firms develop capabilities differently as early entrants to an emerging cluster, and that this has notable impacts on cluster emergence. Thus, the paper contributes to extant IB research by suggesting that MNEs that enter a cluster early may postpone building local embeddedness until the cluster is more developed, leaving processes of investing in cluster emergence largely in the hands of local firms. Furthermore, it adds to the growing literature on cluster connectivity by providing evidence of different types of international connections.

From a strategy perspective, it is relevant for MNEs to know how early cluster entry relates to the local competitive environment and how it may change the local factors that attracted entry in the first place. From a policymaker perspective, it is relevant to know how different types of entrants contribute to local development, and how the capabilities represented by MNE subsidiaries can be embedded in a cluster, so technologies and skills do not vanish if the MNEs relocate.

Both these sets of questions are highly pertinent for the Bangalore DCI cluster. Still emerging, the cluster remains largely skill-based. Since the international connectedness of Bangalore firms may limit their local connectedness in terms of value chains and openness of innovation strategy, how will current firm entry impact the cluster's ability to develop into a full-blown knowledge cluster with dense local spillovers? Our study suggests that attracting MNE investment is not a silver bullet. With around 4,000 employees and a high-value portfolio of the world's largest clients, the MNEs dominate the Bangalore DCI cluster. As they continue to grow, the MNEs' impact on cluster emergence is

getting still stronger. We point to challenges of incentivizing MNE subsidiaries to participate to the building of local institutions, and the importance of national demand size, project length and technology modularity for such incentives. On the other hand, our study points to the high potential of local firms for contributing to cluster emergence, and the role international personal relationships play for this process. Public policies that promote such person-based connectedness, such as fairs, conferences, and student exchanges, are already being explored in Bangalore to positive effect. Furthermore, while there are limited spillovers of technology and skills from the well-established Bangalore ICT cluster to the emerging DCI cluster, the former cluster has greatly boosted Bangalore's general international connectedness. How the fact that Bangalore is one of India's most internationally connected cities will impact the emergence of the DCI cluster is an interesting question for future research.

The Bangalore DCI cluster is still modest in size and in an early stage of emergence. Our study, the first of this cluster, is itself small and exploratory. Our conclusions may prove less relevant in more developed clusters, in less rapidly globalizing innovation systems, in capital-intensive industries where (creative) skills are less important, or in national settings where executives and managers hold fewer international personal relationships. Presenting new evidence of an important phenomenon in the Indian context, our study offers propositions that complement extant theory. It is our hope that these might lend themselves to future empirical testing.

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