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The Dynamics of Capabilities in the Transition to Telecommunications Next Generation Networks

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Abstract
This paper examines the dynamics of capabilities in the transition to the so-called Next Generation Network (NGN), in the telecommunications industry. This transition is occurring in major incumbent fixed telecommunications operators like BT (British Telecom), France Telecom and Deutsche Telekom, among others, where the innovation gap seems to be more challenging compared to mobile operators and cable TV companies. We analyze the capabilities development of BT in the United Kingdom, using documentary and interview data. The main conclusion is that, during the transition, capabilities vary rapidly in intensity: at the very beginning, strategic capabilities influence the decision-making and define the transition, and then project capabilities are put in place to deploy the strategy, until functional capabilities take over and maintain the evolutionary path of the technology until a next major transition may occur.

Keywords: Telecommunications; Next Generation Network; Large Technical Systems; Complex Products and Systems; Capabilities.

INTRODUCTION

This paper is about how capabilities evolve in the transition to Next Generation Network (NGN) of incumbent fixed telecommunications operators. The context is represented by the network owned by incumbent fixed telecommunications operators

(e.g., BT (British Telecom), Deutsche Telekom and France Telecom), usually known as PSTN (Public Switched Telecommunications Network), which has more than 100 years of history and is based on the circuit-switched technology. This huge and traditional network is under transition, which consists of replacing the circuit-switched technology and adopting a new one, based on packet-switched technology. After some years of battle among packet switched technologies, mainly the ATM (Asynchronous Transfer Mode) and IP (Internet Protocol) and the advent of the public Internet, it seems clear now that the IP technology is a consensus in the market. This paper concentrates on the period of 1995 to 2005 of this transition. Major incumbent telecommunications operators around the world are deploying the so-called Next Generation Network (NGN), based on the IP technology.

By 2005, major incumbent fixed telecommunications operators have already announced plans to migrate to the Next Generation Network (NGN), an all-IP platform which enables them to deliver a whole range of new services, besides the voice-only services. A major announcement is the BT 21st Century Network (BT 21CN) in the UK, a £10 billion programme established to switch-off the PSTN and switch-on the all-IP NGN in five years.

Having the concepts of LTS (Large Technical Systems) and CoPS (Complex Products and Systems) as the background, this paper investigates capabilities development in the transition to NGN, using resource-based and strategic views to explain the capability evidences.

METHODOLOGY

The research was conducted through interviews and analysis of documents such as reports, newspaper articles and official Internet websites. The reports included annual reports of suppliers and incumbent service providers, and documents of regulators. The interviews were conducted with senior managers, managers and other practitioners of incumbent telecommunications service providers and suppliers, regulators, consultants and market research analysts.

The unit of analysis is a complex system: the telecommunications network in transition to NGN in the context of incumbent fixed telecommunications operators. The context of incumbent fixed telecommunication operators was chosen because it seems to be where the innovation gap is bigger. They come from a traditional and secular voice-only service and they are losing space to mobile and cable TV operators, which are able to provide more advanced and interactive services. Also the Internet is having a major impact on the fixed operators, regarding its network architecture and business models. The transition of BT was chosen because it seems to be, at the time of this research, the most influential and radical approach in the global telecommunications market.

LITERATURE REVIEW

This literature review is comprised of the concepts of Large Technical Systems (LTS), Complex Products and Systems (CoPS) and capabilities.

Large Technical Systems (LTS) and Complex Products and Systems (CoPS)

The aim of this paper is to examine the transition to NGN of telecommunications networks viewed as what Hughes (1983; 1987; 1992) calls Large Technical Systems (LTS), whose main components are Complex Products and Systems (CoPS), such as defined by Hobday (1998, p.690) as 'high cost, engineering intensive products, systems, networks and constructs'. In LTS, the unit of analysis is a complex system, defined as 'coherent structures comprised of interacting, interconnected components [ranging from] relatively simple machines to regional electricity supply networks' (Hughes 1983, p. ix). Davies (1996) argues that this definition is different from the concept of complex systems offered by Miller et al.(1995), where 'the unit of analysis is the product and the nature of its production: that is the supply of large, complex, customized, engineering-intensive products or systems, in which production is of "one-off" kind, usually on a project basis, to meet the requirements of individual customers' (Davies 1996, p. 1145-1146). Some related researches (Rycroft and Kash 1999; Prencipe 2000; Hardstone 2004) investigate the context of Complex Products and Systems (CoPS), as categorized by Hobday (1998), from the supplier perspective. Davies and Brady (2000) also approach the organisational capabilities in CoPS from the supplier perspective. Little attention is given to the user perspective. In fact, Prencipe, Davies and Hobday (2003, p.11) affirms that 'currently research barely scratches the surface of systems integration from the user perspective'. In this research, the incumbent telecommunications service providers are users of CoPS, and in the transition process they need to develop new capabilities to adopt CoPS, and at the same time, make old capabilities that are not useful anymore go away.

Complex systems have been studied by several authors (Miller, Hobday et al. 1995; Davies 1997; Hobday 1998; Rycroft and Kash 1999; Hobday, Rush et al. 2000). The category of Complex Products and Systems (CoPS) is used to distinguish from the mass production industries. Usually, they require a high variety of distinct knowledge bases, intense user and other supplier involvement, stretching the boundaries of the organisations involved in the production and delivery of CoPS.

Davies and Hobday (2005) show how capabilities evolve in the supply of CoPS. The transition to NGN is an opportunity to study capabilities development in the adoption of CoPS by incumbent telecommunication fixed operators.

Capabilities

In order to make the transition to NGN, incumbent fixed telecommunications operators need to make not only technological, but also organisational transitions.

Several organisational capabilities depicted in the literature are necessary for an operator to succeed in this transition. The concepts of core competence, core rigidity and routines emphasize the internal side of the firm, with low emphasis to the relationship with the environment. The dynamic capability approach started to consider the external environment more emphatically.

Prahalad and Hamel (1990) diffused the concept of core competence as a way to rethink the corporation. As firms diversified and grew in size and complexity, 'the diversified company became a large tree.[...] The root system that provides nourishment, sustenance, and stability is the core competence' (Prahalad and Hamel 1990, p. 82). They defined core competencies as 'collective learning in the organization especially how to coordinate diverse production skills and integrate multiple streams of technologies' (p. 82) and as 'communication, involvement, and a deep commitment to working across organizational boundaries' (p.82). It is interesting to note that these definitions of core competence refer to 'integrate' and 'work across organizational boundaries', which are characteristic of systems integration and project management activities. Most importantly, although the firms may have a huge and diversified portfolio of projects and business, they share a few core competencies (Prahalad and Hamel 1990).

When core competencies are too entrenched within the firm, they may create inertia to change and may be transformed into core rigidities, an expression used by Leonard-Barton (1992; 1995). As changes occur faster and more frequently, core rigidities become more salient and exposed. Core rigidity may not only be in technology, but in attitudes and actions that were successful in the past, but are not valid anymore or are counterproductive in the present but managers find it difficult to change. At times of transition, when old ways of doing things need to be abandoned or replaced, core rigidities may play a significant role.

Nelson and Winter (1982) proposed that 'the routinization of activity in an organization constitutes the most important form of storage of the organization´s specific operational knowledge'. More than twenty years after writing that, it is important to point out the issue of routines, as change is now a dominant topic, and it seems that routine and change are antagonistic. Even when dealing with projects as one-off activities, it is possible to have gains on 'economies of repetition', where learning from one bid/proposal can be used in others, and also routines used in one project can be replicated in others (Davies and Brady, 2000). The search of patterns and principles in the midst of apparent disordered situations is the challenge. At times of transition, where the old is abandoned and the new is adopted, routines within the firm seem to have a major transformation.

Teece and Pisano (1994) used the expression 'dynamic capabilities' to address the 'key role of strategic management in appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional

competences toward changing environments' (p. 538). They use the strategic dimensions of the firm 'as organizational processes, its present position, and the paths available to it' (p. 541). Processes can be understood also as 'routines', as defined by Nelson and Winter (1982), including the learning and current practices within the firm. The position refers to the relationship with customer and suppliers and its internal conditions in terms of technology and intellectual property. Paths refer to the strategic alternatives which are available to the firm and which the firm is more attracted to (Teece and Pisano 1994).

It is important to notice that Teece and Pisano (1994) emphasize the strategic and functional capabilities within the firm and its ability to cope with changing environment. Davies and Hobday (2005) build upon resource-based theories of the firm (Penrose 1959; Nelson and Winter 1982; Teece and Pisano 1994) and highlight the project capabilities, along with strategic and functional capabilities, as shown in fig. 1, in order to survive and grow in rapidly changing technologies and markets.

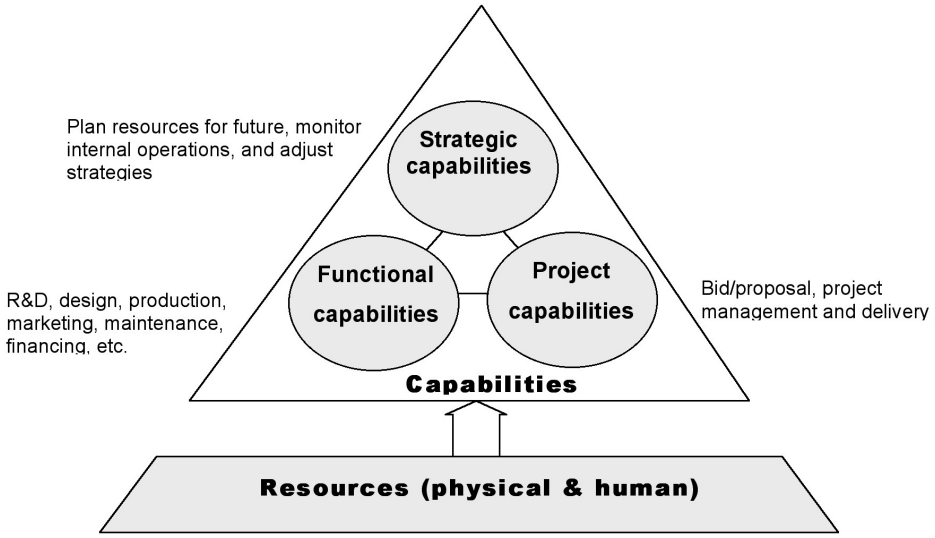

Fig. 1 – Resources and Organizational Capabilities Source: Davies and Hobday (2005).

The resource-based theories of the firm (Penrose 1959; Nelson and Winter 1982; Wernerfelt 1984; Teece and Pisano 1994; Teece, Pisano et al. 1997) provide a good explanation for the firms growth and competitive advantage when they are in periods of incremental innovation and accumulation of capabilities, where a major 'equilibrium state' is identified. However, it provides less insight in situations of transitions from one technology to another, where the knowledge base is being changed and not only the firm but all the actors of the innovation value chain are being repositioned.

Taking into account the Penrose (1959) resource-based view of the firm, Davies and Hobday (2005) argue that this approach ignored the project as an organisational capability and source of competitive advantage. The project is largely recognised nowadays as the most appropriate organisational form to address change and to conduct business. It seems that this is occurring because the customer-focused or customer-centric approach is now dominant in the dynamic market and is a necessity in order to remain competitive. Then, project capability has acquired momentum in daily business.

BT CAPABILITIES IN THE TRANSITION TO NGN

BT was the first major incumbent fixed telecommunications operator to announce the transition to NGN and establish a deadline to switch-off the PSTN. BT created a project called 21st Century Network or 21CN to make this transition. At the time of the project announcement in 2004 about 300 firms expressed their interest in supplying to BT. In 2005, BT announced the eight preferred suppliers for the 21CN: Siemens, Alcatel, Cisco, Fujitsu, Huawei, Ciena, Ericsson and Lucent.

BT decided to divide the network into five parts and chose at least 2 suppliers for each part, except the I-node, which is the intelligence of the network, granted only to Ericsson. Although the tendency would be to work with one prime contractor acting as the system integrator, no single vendor would take the risk to supply the whole network. So, a considerable work of project management and systems integration needs to be done within BT.

The BT 21CN represents, in terms of services, a transition from commodity (or capacity) to capability. The PSTN network is largely known for its robustness and provision of voice-only services. And it has around 100 years of history. The fact is that voice-only services are becoming a commodity. And if in the past the focus of the network was in provisioning capacity to a large number of users to communicate with each other effectively and reliably through voice-only services, the transition represents a shift from capacity provision to the provision of capabilities: flexible services which conforms to customers needs at a specific moment. With 21CN, it seems that BT intends to be the leader of a movement, not the commander of a structure.

The success of 21CN depends not only on BT´s capability to build the convergent network but also on what Mansell and Steinmueller (2000) call 'understanding the factors influencing the rate of market development' (p. 103) and how to address it: once the network is built, how to make the customers adopt the new services and how BT and its ecosystem generate new services for the market.

The core competence of BT seems to remain the ability to build and maintain networks and provide services, as BT has the vision of becoming a 'Global Networked IT Services Company'. In other words, the core competence is and will continue to be

focused on the network, not on content. With convergence, meaning here industry convergence of content providers, telecommunications companies and IT firms, there is a speculation that BT could be also a content provider, becoming a competitor of firms like Sky or BBC, for example. However, BT seems not be going in that direction. At least for BT, the transition and the phenomenon of convergence is not changing its core capability. At this point, the phenomenon of convergence does not seem to be if one company will be a direct competitor of another company in another industry, like BT becoming a competitor of Sky, but how both companies will cooperate together to address the market, and prepare its infrastructure to do so.

The period of transition offers a space to 'core rigidities' to flourish, as new processes and institutional changes are being developed and old processes are being dismissed or reformulated. Core rigidity involves not only the change of internal processes per se, but also the people involved. The transition to NGN involves not only technological, but also cultural change within BT.

Routines, understood as processes inside companies, are certainly changed during a major transition like this. One interviewee said that the real challenge is not the technology itself, but what takes time in the transition is to change the internal processes set for PSTN which are being reinforced for many years.

In BT transition to NGN, routines are being changed due to technological change, from circuit-switched PSTN base to packet-switched IP (Internet Protocol) base. These routines are related to the operation of the network. However, the transformation of the network implies in modifying also current relationship with customers and the provision of services. Thus, routines are not only changing for internal operations, but also to address the interface with customers and third party firms which may use BT infrastructure to provide new services.

As long as old routines are dismissed, new routines are created. And these routines are more related to the platform for creation of new services from third parties and from BT itself. Many new routines are being created or redesigned in order to address the creation of new services and the more intense relationship with partners (or ecosystem). One example is the common capabilities approach (Levy 2005), where BT is identifying common elemental building blocks to be used in a variety of services, thus reducing time to market and cost to develop new services.

The objective of the BT 21CN is to create a common platform to address the changing needs of customers. Customers can be end customers or other firms which use BT network to provide services. From this perspective, the transition to NGN, and the 21CN in particular, increases BT dynamic capabilities to address the changing communications market, enabling BT to respond faster and more flexibly to demands from customers. More external relationships and the capability to establish and maintain those relationships seem to be more and more important as long as 21CN evolves. This is a situation different from previous technological changes suffered by

the incumbent fixed telecommunication operators, more focused on expanding and improving their network capacity.

Taking into account the framework of strategic, functional and project capabilities proposed by Davies and Hobday (2005) and transporting into BT´s context, these three capabilities are very strongly present in the transition to NGN and it seems that they have different intensities over time. First, the decision making of the transition needs a strong strategic capability. The decision to invest £ 10 billion in a relatively short period of time (about 5 years) was certainly not an easy one. Coincidentally, the announcement of the BT 21CN was made after some few years the top management (CEO and CTO) of BT was changed, and top managers outside BT took over. This certainly had an impact on BT´s top management dominant logic and influenced the decision to approve the 21CN project.

The project capability is formalized through the establishment of the BT 21CN Programme. Davies and Hobday (2005, p. 77) point out the project as the basic unit for a firm to survive, grow and achieve its strategic objectives. As revenues from its traditional services are declining, BT is addressing, through 21CN, its strategic objectives for survival and growth: keep a relentless focus on improving customer satisfaction, put broadband at the heart of BT, create mobility services and solutions, transform the network for the twenty-first century, achieve competitive advantage through cost leadership, lead the world in network-centric ICT solutions, reinvent the traditional business, motivate people and live the BT values (BT 2005b). During the transition, 'BT needs more than ever some world-class project management skills, followed closely by some world-class communication skills' (Communications News 2005). The 21CN certainly moves BT into a new technology base, however it does not seem to move to a new market base in its domestic market, as major customers being addressed are still the mainstream customers. The way to approach customers changes significantly though. BT 21CN makes it possible for BT to expand its market base globally from a common and robust network.

Along the transition, capabilities are transferred to functional departments, which will carry out the daily activities of maintaining and upgrading the network, following an evolutionary way. Of course, projects of a smaller scale may be set up to address specific problems, but not at the same scale and scope of 21CN. The lean operator which is expected to emerge after the end of the BT 21CN project is due to a major optimization of BT´s functional capabilities, where is expected cost reductions in operational expenditures of about £ 1 billion from 2008/2009.

In summary, the strategic, project and functional capabilities interact during the transition, but they are required with different intensities over time: at the beginning of the transition, strategic capabilities need to be strong in order to decide to make the transition and set the goals and principles of the transition strategy; once decided to make the transition, it is necessary to implement the strategy, and

that is where project capabilities become more important or 'intense' (BT established the BT 21CN Project for the transition); at the final stages of the transition project, functional capabilities become again more intense, and new capabilities are transferred to existing and new functional activities.

CONCLUSIONS

In this paper, we examined various concepts of capability and its application to the recent transition to Next Generation Networks (NGN) being undertaken by incumbent fixed telecommunications operators. Having the concepts of Large Technical Systems (LTS) and CoPS (Complex Products and Systems) as the background context, we used the concepts of the resource-based view to analyze the complex system in transition, which is an interesting unit of analysis, as major studies concentrate on the evolutionary period between such transitions.

For the transition to occur, it is necessary to overcome the innovation level which the decision makers accept and the level of risk and uncertainty which the organisation tolerates. The transition represents the battle between the innovative and the conservative organisations.

The main conclusion is that, during the transition, capabilities within the incumbent telecommunication operator vary in intensity: at the very beginning, strategic capabilities influence the decision-making and define the transition, then project capabilities are put in place to deploy the strategy, until functional capabilities take over and maintain the evolutionary path of the technology until a next major transition may occur.

The main implication of this technological transition is building a 'flexible factory of services', where the network is able to adapt to the customer and not the opposite. The most competitive service providers will be those able to provide flexibility to adapt to changing customers needs and retain those customers. This flexibility involves the combination and recombination of voice, data and video to satisfy customer needs at the right time.

Of course, there are limitations in this research. Analyzing just the case of BT (British Telecom), for example, is not possible to make more generalizations. Initial industry analysis indicates that the transition to NGN is undertaken in very different ways by the various incumbent fixed telecommunications operators. However, the innovation principles seem to be the same. Comparisons with other incumbent fixed telecommunications operators, like Deutsche Telekom and France Telecom would be helpful.

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