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## **ADAPTIVE REPLICATION: KNOWLEDGE REUSE IN FAST-PACED INDUSTRIES**

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### **Abstract**

Knowledge reuse is crucial to organizational life and growth. As organizations strive to transfer and reuse knowledge across time and space, they have to deal with two opposing forces: while the advantages of replication push for reproducing exactly tangible and intangible assets, capabilities and resources that embed organizational knowledge, exogenous changes impose forms of adaptation of those assets, capabilities and resources to changing external conditions. This qualitative study analyzes two large firms that have been dealing with replication and adaptation for decades relatively to the provision of ICT products and services. The research relied on qualitative data collected and analyzed reiteratively through constant comparison methods at multiple levels (firm, unit, product, and project) over a time span of three years (2007-2010). Findings show that both firms treat replication and adaptation as mutually reinforcing and complementary rather than opposed and contradictory. To do so, they build and maintain complex systems of interdependent knowledge assets that are replicated and adapted selectively, depending on the characteristics of the underlying knowledge. The new concept of 'adaptive replication' is then introduced to explain the close interplay between replication and adaptation of knowledge.

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**ABSTRACT**

Knowledge reuse is crucial to organizational life and growth. As organizations strive to transfer and reuse knowledge across time and space, they have to deal with two opposing forces: while the advantages of *replication* push for reproducing exactly tangible and intangible assets, capabilities and resources that embed organizational knowledge, exogenous changes impose forms of *adaptation* of those assets, capabilities and resources to changing external conditions. This qualitative study analyzes two large firms that have been dealing with replication and adaptation for decades relatively to the provision of ICT products and services. The research relied on qualitative data collected and analyzed reiteratively through constant comparison methods at multiple levels (firm, unit, product, and project) over a time span of three years (2007-2010). Findings show that both firms treat replication and adaptation as mutually reinforcing and complementary rather than opposed and contradictory. To do so, they build and maintain complex systems of interdependent knowledge assets that are replicated and adapted selectively, depending on the characteristics of the underlying knowledge. The new concept of ‘adaptive replication’ is then introduced to explain the close interplay between replication and adaptation of knowledge.

## INTRODUCTION

Knowledge reuse is crucial to organizational life and growth (Grant, 1996; Kogut and Zander, 1992, 1996; Moran and Ghoshal, 1996). Precondition for its effective reuse is the transfer of knowledge across and between organizations, as it occurs, for example, with the adoption of new technologies (e.g., Cool et al., 1997; Garud and Nayyar, 1994; Rosenberg, 1982), the diffusion of innovation (e.g., Argote and Ingram, 2000; Dixon, 2000; Rogers, 1995), or the deployment of operations in multiple locales (e.g., Buckley and Casson, 1976; Hymer, 1976; Dunning, 1977; Kogut and Zander, 1993).

Over the past decade, management scholars have paid increasing attention to two different approaches to knowledge transfer: *replication*, which entails copying or reproducing exactly assets and resources that embed organizational knowledge (e.g., Rivkin, 2001; Winter and Szulanski, 2001); and *adaptation*, which involves altering those assets and resources to fit local conditions (e.g., Szulanski and Jensen, 2006; Williams, 2007). With just a few exceptions (e.g., Williams, 2007), students of the dynamics and economics of knowledge replication have focused on multiunit firms *a la* McDonalds, Walmart, or Mail Boxes Etc. to ascertain whether those organizations grow more successfully by replicating or by adapting (e.g., Winter and Szulanski, 2001; Winter et al., 2011), or whether adaptation should be carried out straightaway, at the outset of a process of knowledge transfer, or rather pursued “cautiously and gradually in carefully designed steps that ideally involve only a single change at a time” (Szulanski and Jensen, 2006: 937-938). Such speculation builds on the particular experience of replication-based businesses like fast foods, hotels, banks, and franchise and chain companies in general (e.g., Winter and Szulanski, 2001). These organizations share the fortunate circumstance of operating in relatively stable environments, where the non-problematic nature of transactions, the homogeneity of demand and supply, and a moderate rate of technological innovation pose little pressure for change (Duncan, 1972). Moreover,

the kind of knowledge transfer studied in these firms occurs within the boundaries of the organization; recipients are newly established units that, although located in different geographic locations, have limited exchanges with the external environment and are faced with a relatively low variation of contextual conditions (typically, customer preferences). Not surprisingly, recent empirical findings have reinforced that in this kind of industries, after a template has been carefully defined, its exact replication is critical to successful expansion and growth (Jensen, 2007a; Szulanski and Jensen, 2008; Winter et al., 2011).

Although chain organizations represent an important economic phenomenon and provide useful insights on the dynamics of knowledge transfer, their experience is of little help when it comes to faster environmental change and/or higher context variation. In fast-paced settings, in fact, factors such as complexity of business processes and transactions, volatility and differentiation of market demand, uncertainty of the supply landscape, and relentless technological innovation hinder the reiterated application of existing knowledge and reduce the value of the underlying assets. In conditions of fast change and high variation, not only do firms find it impossible to pursue strategies of exact replication, but they may not even be able to define a comprehensive, ready-to-use template. For example, in the capital goods sector, highly differentiated and ever-changing customer requirements make strategies of pure reutilization largely impracticable. Similarly, in project-based businesses, existing bases of knowledge can be reused and leveraged across projects only to a certain extent, whereas the specificities of each project (e.g., market-, customer-, or location-related peculiarities) entail considerable adjustments to match the new, often unique setting. For these organizations replication and adaptation are not a matter of choice, but rather imperative responses to simultaneous and opposing needs that constrain their strategic decision making: on the one hand, vital advantages associated with the reproduction and full exploitation of existing knowledge push firms to replicate as much as possible (replication is indispensable!);

on the other hand, the compelling need to ensure ongoing fit with fast-paced settings pushes them to adapt as much as possible, regardless of any template (adaptation is inescapable!).

This work seeks to understand on the grounds of empirical data how firms cope with the tension between the opposing needs for replication and adaptation in fast-changing conditions. To do so, it delves into the hectic reality of two multinational firms that have been dealing with such a tension for decades relatively to the provision of ICT products and services. The study has found inspiration and guidance in the most recent streams of literature on knowledge transfer that focuses on replication and adaptation as alternative ways of leveraging knowledge for corporate expansion. In particular, it has taken up the recent calls for an investigation of the dynamics of replication and adaptation in firms different from chain organizations (Szulanski and Jensen, 2008), and for a more fine-grained analysis of the interrelationships between replicated and adapted knowledge assets within overall processes of knowledge transfer and reuse (Williams, 2007).

## **THEORY AND RESEARCH PROBLEM**

Knowledge is a fundamental resource of organizations (Barney, 1991; Drucker, 1995; Wernerfelt, 1984). Its transfer and reuse within firms underpins the realization of sustained competitive advantage (e.g., Argote, 1999; Spender, 1996; Spender and Grant, 1996; Zander and Kogut, 1995). However, the causal relationship between organizational knowledge and superior performance is not always fully understood (e.g., Amit and Schoemaker, 1993; McEvily and Chakravarthy, 2002). When it does not reside within individuals, this resource is often embedded in assets intrinsically difficult to imitate (e.g., Reed and DeFilippi, 1990; Winter, 1987, 1995), so that its effective exploitation can only be achieved by reproducing the underlying asset. Hence, studying knowledge transfer and reuse has essentially coincided

with analyzing the transfer and reuse of different categories of tangible and intangible knowledge assets, such as physical artifacts (e.g., McDonald, 1998), technologies (e.g., Kogut and Zander, 1992), business models (e.g., Winter and Szulanski, 2001), organizational routines (e.g., Jensen, 2007a; Szulanski, Cappetta, and Jensen, 2004), and practices (e.g., Jensen and Szulanski 2006; Kostova, 1999; Morosini, 1998; Rivkin, 2001; Szulanski, 1996, 2000; Teece et al., 1997).

A crucial problem tackled by this stream of research is whether the transfer and reuse of knowledge in different times and/or locations should adhere faithfully to a working – albeit often imperfectly understood – example, or depart from it in consideration of temporal and/or spatial specificities (e.g., Winter et al., 2011). Such question originates from the ambivalent nature of knowledge – *causally ambiguous* and *context-dependent* at the same time (Williams, 2007) – and entails a comparison between replication and adaptation as different responses to such ambivalence and alternative approaches to knowledge transfer. It is worth analyzing in detail the logic behind the two.

### **Replication**

Replication is a form of knowledge exploitation obtained by copying or reproducing exactly tangible and intangible assets that embed organizational knowledge (Nelson and Winter, 1982; Rivkin, 2001; Williams, 2007; Winter and Szulanski, 2001).

When carried out systematically, replication reduces uncertainty and risk (Nelson and Winter, 1982), enhances efficiency and profitability (Winter, 1995), sustains competitive advantage (Argote and Ingram, 2000; Bradach, 1998; Jensen and Szulanski, 2007; Kostova, 1999; Rivkin, 2001; Szulanski and Jensen, 2006; Teece et al., 1997; Winter, 1987, 1995; Winter and Szulanski, 2001), and accelerates organizational growth (Buckley and Casson, 1976; Hymer, 1976; Kogut and Zander, 1993; Szulanski and Jensen, 2008; Zaheer, 1995).

Apart from these intuitive economic and strategic gains, another important advantage associated with replication pertains to the intrinsic nature of organizational knowledge. In fact, a dominant tenet among scholars is that firms pursue replication because organizational knowledge is often complex (Szulanski and Jensen, 2006; Rivkin, 2000), sticky (Szulanski, 1996; von Hippel, 1994), and ultimately, causally ambiguous (Lippman and Rumelt, 1982). As Szulanski and Jensen (2006) explain, causal ambiguity means that the relationship between use of knowledge and associated outcome is not always well understood. For example, neither a parent organization nor its recipient subsidiary may be able to codify a transferred organizational practice or a given configuration of knowledge assets and predict their impact on performance. Subtle changes of a given asset could modify the cause-effect relationship exponentially, making it “difficult to attribute specific effects to their specific alterations” (Szulanski and Jensen, 2006: 938). Thus, replication allows overcoming the causal ambiguity of knowledge through the avoidance of hazardous alterations. But how strict should such avoidance be?

The argument of *exact* replication (i.e., the precise reproduction of a knowledge asset without any alterations) has proved useful to theoretical reasoning around the concept (Nelson and Winter, 1982). However, overwhelming evidence shows that, although undesirable in the replicator’s view (Szulanski and Jensen, 2006; Winter et al., 2011), at least some alterations almost inevitably accompany the reproduction of knowledge (e.g., Douglas and Wind, 1987; Onkvisit and Shaw, 1987; Robert et al., 2000; Rosenzweig and Nohria, 1994). According to Baden-Fuller and Winter (2007), the depth and breadth of the adjustments necessary to match the characteristics of new settings may justify the choice of replicating by principles rather than by templates. The difference between principles and templates is vividly rendered:

“The guidance provided by Principles has the flavor “Let us explain *why* this works and the *reasons why* it should be done this way and then try to make it work yourself – we will comment on any mistakes we see.” The Templates approach is suggested by “Watch very carefully *how* this is done; then try hard to copy it exactly – but don’t ask *why*.” (Baden-Fuller and Winter, 2007: 4)

In other words, principles do not provide detailed implementation instructions, but merely outline the logic behind implementation choices. They unveil causal relationships much more than templates and offer a deeper understanding of why specific combinations of factors produce certain results. Templates are detailed representations of how knowledge assets have to be reproduced and deployed to work together effectively; they ensure internal coherence among those assets, especially when their interactions and interdependences are too numerous and complex to be clearly understood. But relying on templates in settings that are very different from the original may be too costly and difficult, if not impossible. In such cases, principles allow for higher flexibility.

### **Adaptation**

The exploitation and reutilization of existing knowledge assets have been described above as a crucial element of successful management. At the same time, however, the essence of management is coping with variation and change (e.g., Lawrence and Lorsch, 1967; Thompson, 1967). As a result of the constant interaction between the organization and its environment, chances and effectiveness of knowledge reuse depend not only on the speed and scope of change but also on the firms’ ability to anticipate, control for, and adapt to such change. In fact, research in organizational theory (Kostova, 1999; Kostova and Zaheer, 1999; Scott, 2001) and international business (Bartlett and Ghoshal, 1989; Prahalad and Doz, 1987; Griffith, Hu, and Ryans, 2000; Yan, 1994) has underlined the importance of adaptation as an

approach to organizational growth that ensures fit with the environment. Examples of environmental conditions driving local adaptation are consumer preferences (Cui and Liu, 2001), labor practices (Rosenzweig and Nohria, 1994), or cultural differences (Lemak and Arunthanes, 1997).

With regard to the systematic reuse and transfer of knowledge across temporal and/or spatial settings, adaptation refers to alterations applied to knowledge assets in order to match the characteristics of the recipient setting (e.g., Szulanski and Jensen, 2006; Williams, 2007). Similarly to other formulations of the same concept in strategic management (e.g., Levinthal, 1997), this definition hints at a positive relationship between adaptive efforts and chances of successful outcomes. For example, the interorganizational transfer of practices has been found more likely to succeed if significant adaptations to cognitive and normative rules of the host environment increase the local acceptance of the knowledge being transferred (Griffith et al., 2000; Kirkman, Gibson, and Shapiro, 2001; Luo, 2000; Morosini et al., 1998). Theoretical contributions posit that some form of adaptation of reused knowledge be practically inevitable in any instance of transfer (Baden-Fuller and Winter, 2007), and empirical studies have found that, even when intended for exact replication, the transfer and reuse of knowledge is almost invariably accompanied by alterations of the underlying assets (Jensen and Szulanski, 2004).

Scholars tend to agree that the reason for the inevitability of adaptation in processes of knowledge transfer must be sought in another fundamental characteristic of knowledge: its context dependence (Argote and Ingram, 2000; Kostova and Roth, 2002; Prahalad and Doz, 1987). As Williams (2007) notes, context-dependent knowledge arises from the rich connections between organizations and their environment. In particular, the fact that organization-environment relationships determine the structure and composition of the resources within which organizational knowledge resides and accrues – for example, people,

routines, practices – has three important consequences. First, part of the organizational knowledge that connects and integrates assets and resources into interdependent systems tends to be tacit (Amit and Schoemaker, 1993; Nelson and Winter 1982; Polanyi 1964) and embedded in a peculiar context of use. Second, context-dependent knowledge that cannot be transferred directly has to be recreated at the recipient setting (Kogut and Zander, 1992) in a way that reflects, in turn, the specificities of a new, different context. Third, when the transferred knowledge starts being employed in the new context, new needs for adaptation are generated by problems and contingencies that were impossible to predict before the transfer (Dutton and Thomas, 1985; Rosenberg, 1982).

### **Replication and Adaptation in fast-paced industries**

Although replication and adaptation can be seen as organizational responses to distinct attributes of knowledge, they seldom appear separately in real instances of knowledge transfer. Almost always, instead, transferred knowledge interacts with knowledge available at the recipient setting; within such interactions, obstacles to perfect replication – i.e., needs for adaptation – arise from local specificities (Winter, 1995). Williams (2007) stresses that replication and adaptation are not separate phenomena because any “knowledge transfer will usually involve knowledge that requires replication and knowledge that requires adaptation”; and consequently, “we need to change our understanding of replication [...] as the absence of adaptation” (p. 867).

The need to reconcile and combine replicative and adaptive efforts within the same instances of knowledge reutilization seems particularly urgent in today’s fast-changing world. As Farjoun (2007) highlights, “across all industry contexts, firms need to balance the partially inconsistent requirements of static efficiency and commitment with those of dynamic efficiency and adaptability” (p. 207). If replication tends to be the first vocational approach

when firms attempt to exploit existing knowledge, at the same time, needs for adaptation are increasingly pressing in fast-paced settings such as the computer (Eisenhardt and Tabrizi, 1995; Brown and Eisenhardt, 1997), microcomputer (Bourgeois and Eisenhardt, 1988; Eisenhardt and Bourgeois, 1988; Eisenhardt, 1989a), information technology (Bogner and Barr, 2000), semiconductor (Nadkarni and Barr, 2008), biotechnology (Judge and Miller, 1991), biomedical (Smith et al., 1994), and health care (Stepanovich and Uhrig, 1999) industries. Relatively to the transfer and reutilization of organizational knowledge, we define as *fast-paced* those industries in which the clash between drivers of replication and needs for adaptation is rendered particularly harsh by the simultaneous occurrence of:

- Rapid and continuous changes in the firm's *environment*, i.e., transformations of the social, economic, technological, political, and regulatory factors that affect the entire industry (e.g., Dill, 1958; Duncan, 1972; Thompson, 1967), and;
- Frequent variations of the *context* into which organizational knowledge is transferred and reused, i.e., the situational opportunities and constraints that affect the transfer of knowledge, as well as the functional relationships between the factors involved (adapted from Johns, 2006)<sup>1</sup>.

Recognizing that changes in the organization's environment and variations of the recipient context impede pure replication prompts for questioning the generalizability of empirical studies that advocate for the "copy exactly" recipe, with little or no attention paid to the adaptive part of the transfer endeavor. In fast-paced industries, firms have to reuse existing knowledge extensively, but at the same time they must develop vital competences of fast adaptation (Eisenhardt, 1989a; Stalk and Hout, 1990). Fast and continuous environmental change, in fact, entails that information becomes rapidly inaccurate and obsolete (Bourgeois and Eisenhardt, 1988), so that relying solely on the employment of templates is impossible.

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<sup>1</sup> Johns defined the general concept of context as those "situational opportunities and constraints that affect the occurrence and meaning of organizational behavior as well as functional relationships between variables" (2006: 386).

For organizations in fast-paced industries, then, the strategic problem around knowledge exploitation is not to ascertain whether successful growth can be attained by replication or by adaptation, but instead to understand and learn how the two approaches can be pursued simultaneously.

This investigation found inspiration and guidance in recommendations for further research provided by previous studies. In particular, it took up the calls for studying empirical settings other than chain organizations (e.g., Szulanski and Jensen, 2008), and for analyzing the reutilization of organizational knowledge at the fine-grained level of the underlying assets and resources involved in the transfer and their mutual interrelationships (Williams, 2007).

The research was exploratory, in that it started from key constructs (such as knowledge transfer, knowledge assets, replication and adaptation of organizational knowledge, etc.) and sought to identify specific variables and to unveil relevant relationships among them. Such exploratory process proceeded inductively according to the logic of grounded theory building, which allows generating novel theoretical insights from field data (Glaser and Strauss, 1967). Since it was necessary to collect and analyze in depth different kinds of data from various sources of evidence, case studies appeared the most suitable research strategy (Yin, 2003). The next section provides details of the research method.

## **METHOD**

### **Setting**

The general setting of the research is the information and communication technology (ICT) industry. This industry is particularly interesting to study issues of knowledge transfer and reuse for its knowledge-intensiveness and because it hosts a structural conflict between drivers of replication and needs for adaptation of knowledge assets. Relentless technological

innovation connotes it as a highly dynamic industry (e.g., Bourgeois and Eisenhardt, 1988; Eisenhardt and Tabrizi, 1995; Ilinitich, D'Aveni, and Lewin, 1996), so that ICT firms' survival depends on the ability to change and adapt their products (Brown and Eisenhardt, 1997; D'Aveni, 1994; Eisenhardt, 1989a; Galunic and Eisenhardt, 1996). Innovation-based competition implies that high sunk costs associated with learning, researching, and developing innovative products and services generate high incentives to leverage and reuse existing knowledge (technological as well as organizational), in order to fuel a constant quest for efficiency, profitability, and growth (Winter, 1995).

Alpha and Beta, two ICT multinational corporations, have provided the specific setting for the study. Both organizations have been dealing for decades with replication and adaptation at the product as well as the organizational level. As a result of rapid technological change, they underwent frequent and dramatic transformations throughout their history. Moreover, both firms operate in conditions of high context variation, for they serve business customers belonging to a broad range of different industries – to name but a few, aerospace, defense, banking, chemicals, petroleum, construction, consumer products, financial markets, healthcare, insurance, media and entertainment, etc.. Finally, the choice of the two firms was also driven by the logic of comparison and aimed at maximizing cross-case differences. Consistently with the idea that firms in fast changing-environments tend to experiment with different organizational forms and arrangements (e.g., Ilinitich, D'Aveni, and Lewin, 1996), Alpha and Beta showed signs of being deeply different organizations, in that they had different corporate histories, presented different structures and strategies, and played different roles within the industry. Furthermore, as many other multinational corporations, they comprised several divisions and a number of units within each division, which led to a great organizational variety. Given cross-case differences and within-case variety it seemed reasonable to expect that also the organizational processes and mechanisms associated with

the replication-adaptation exercise within the two firms would take different forms, so that the phenomenon of study would be better observed and understood by comparing its diverse, firm-specific manifestations.

### **Research design**

The research process hinged on theoretical sampling and constant comparison of qualitative data and proceeded by multiple reiterations of joint collection, coding, and analysis through which theoretical insights emerged from empirical evidence (Glaser and Strauss, 1967). Although the investigation developed as a continuum and involved moving back and forth across multiple levels of analysis (firm, unit, product, and project), for a clearer illustration it is useful to distinguish among three logical and – with some approximation – chronological phases.

The first phase of the investigation (January 2008-March 2009) was carried out at the firm level. At the outset, we aimed to confirm, revise, update, and refine the company profiles and the firm-related information in general, with special emphasis on their articulate organizational structures. Subsequently, we sought to gain a notion of the types of knowledge assets typically observable at both firms and to identify examples of knowledge transfer that could provide relevant insights about the research problem. In particular, we wanted to spot real instances of knowledge transfer in which the phenomena of replication and adaptation were likely to be observed, and to identify parts of the organization in which the occurrence of both phenomena was clearly evident – for example, divisions and subdivisions, rather than business areas, or functions such as procurement, sales, design, production, delivery, and so forth. At this point, we focused our attention on the interfirm transfer of knowledge taking place within the provision of ICT solutions to business customers. ICT solutions are systems of hardware and software products and related services delivered comprehensively and

seamlessly to address a client's business and/or operational needs (Davies, 2004). The transfer towards customers appeared particularly interesting and relevant to study for the likely simultaneous presence of drivers of replication and drivers of adaptation bearing on the same act of transfer. Efficiency gains deriving from reusing assets and knowledge across clients represented powerful incentives to replicate. At the same time, however, interfirm transfers (as opposed to intrafirm ones) are subject, by nature, to a higher variance of the recipient contexts (the different customer organizations), which leads to more numerous, diverse, and pressing needs for adaptation. As emerged in previous research, product changes and innovations are a primary form of adaptation (e.g., Eisenhardt and Tabrizi, 1995), and many firms adapt or even transform themselves by introducing new products or improving existing ones (Brown and Eisenhardt, 1995; Burgelman, 1991; Chakravarthy, 1997; Dougherty, 1992; Womack, Jones, and Roos, 1990). In virtue of these considerations, we closed this phase of the research by identifying two units, one in each firm, to be investigated further in the next phases. Both units seemed especially interesting and relevant to study for a number of reasons. First, they were considered in their respective organizations champions in the provision of ICT solutions to business customers, and had showed a special ability to implement successful transfer of knowledge assets consistently, across different customer industries. Second, they put in place an eminent example of interfirm transfer and reuse of organizational knowledge, since the ICT solutions they sold to clients had been originally designed, created, and developed internally to address operational needs of the two firms. Third, as the two units began to exploit extensively these knowledge assets by reusing and selling them across clients in different industries, they had to produce simultaneous efforts of replication and adaptation in a recurrent and consistent fashion. Finally, and consistently with the findings of other studies (Williams, 2007), such instances of joint replication and

adaptation led to very successful knowledge transfer, as the implementation of the underlying ICT solutions had a very positive impact on the performance of the recipient organizations.

The second phase of the investigation (April 2009-October 2009) was carried out at the unit and the product levels. The aim was to seize the reasons of the success of the two units in coping with the tension between drivers of replication and needs of adaptation and, despite such tension, delivering successful knowledge transfer systematically and consistently across time, and geographic locations. We first collected data on the units' organizational background and structure, as well as their relationships and exchanges with the rest of the organization. Later on, we focused on the ICT solutions provided by the two units. We collected data about: a) the kind of knowledge assets they were made of; b) how those assets had been created or acquired; c) how they worked together; d) the practical problems they solved; e) how they were transferred to clients, and; f) whether their adoption and reuse by the recipient organization was successful or not.

The third and final phase of the study (November 2009-November 2010) was carried out at the product and the project levels, and consisted of a closer scrutiny of concrete instances of transfer, treated and referred to by managers of both units as distinct customer projects. Given the systemic interrelationships that tied together the different types of transferred assets, we chose to follow the approach of that part of the literature (Rivkin, 2001; Williams, 2007) that examines the whole transfer endeavor – or transfer relationship between the unit and its customers. While many scholars have analyzed the transfer of a single asset (e.g., Kostova and Roth, 2002; Szulanski, 1996), transfer relationships tend to involve multiple types of assets that embed organizational knowledge (Argote, 1999). Referring to each project and to the transferred ICT solutions in their entirety, we investigated: a) how the conflicting objectives of replication and adaptation were pursued and realized by the unit; b) what concrete actions or interventions were put in place in order to replicate or adapt; c) how

such actions and interventions contributed to a successful transfer, and; d) whether and how the unit laid the basis for taking advantage from such actions and interventions in future projects.

### **Data collection**

We collected and analyzed qualitative data in the form of interviews, as main source of data, documents, and field notes. We carried out a purposeful selection of informants (Lincoln and Guba, 1985), and first interviewed those who could help us obtain background information on the firm and identify those parts of the organization that appeared most likely to offer evidence of the phenomena of study. From this point onwards, we followed a snowball approach and selected informants by asking each interviewee who could provide useful and relevant data about the research problem. A total of 92 interviews were conducted with 65 informants, either face-to-face during visits to the firms or by telephone. Interviewees were informed beforehand, via telephone and/or email, about the topic, purpose, and format of the interview. Interviews averaged an hour and ranged from 20 minutes to three hours. Of all interviews, 74 were audio-recorded and transcribed within 15 days of interview; for the 18 non-recorded interviews detailed notes were taken during the interview and then ordered and complemented by additional notes within the following 36 hours. Most interviews were conducted by one member of the research group, 25 interviews by two members.

In the first phase of the investigation, we interviewed executives and top managers as key informants (Kumar, Stern, and Anderson 1993), ranging from senior vice president to head of subdivision and global industry experts. After an introductory part addressing the companies' overall profiles and corporate structures, questions probed into the different types of

knowledge assets typically detained, created, or acquired by the two firms, and elicited the illustration of several examples of transfer and reutilization of such assets.

In the second phase, we interviewed informants who either belonged to the two selected units or collaborated with them in the design, development, and transfer to customers of ICT solutions. Informants included unit directors, commercial directors, project managers, product managers, and commercial managers. We conducted semistructured interviews to gather information about the unit, its ICT solutions, and the transfer of such solutions to customers. Introductory questions regarded the interviewees' background, the details of their personal competence and experience, their current position and tasks, and the history and organizational background of the units. Subsequent questions concerned the characteristics of the ICT solutions provided by the unit and of their transfer and reutilization across customers. In particular, the attention was on the different types of knowledge assets involved in the transfer, their interrelationships and interdependences, and the practical problems they aimed to solve for the recipient organization. As the interview went further, the focus shifted onto the specific activities carried out by the unit for the creation, acquisition, management, transfer and reutilization of those knowledge assets. In particular, questions sought to identify drivers of replication and needs of adaptation typically bearing on the transfer endeavor, and to understand how such drivers and needs were addressed.

In the third phase, we interviewed project managers, and managers in charge of the design, development, implementation, delivery, and support of the transferred ICT solutions. For each of the ten projects, we started interviewing the project manager and went on meeting other managers involved in the project as long as new informants could provide new and relevant data. Interviews regarded the project background, the resources and assets reused and deployed for the project, the customer requirements for alterations of those assets, the

challenges associated with the implementation of such alterations, the learning about altered and newly developed assets, and their reusability in future projects.

We resorted to current documents and archival data to integrate and complement the data collected through interviews. Documents collected and analyzed in the first phase included organizational charts, annual reports, division and subdivision presentations, corporate brochures and booklets, press releases, and printouts of non-public company webpages. Documents gathered in the second and third phases included product brochures and specifications, examples of contracts with customers, project documentation, internal presentations, and reports. Besides providing a secondary source of data, these documents helped us to identify crucial elements of discussion to be addressed and deepened during the interviews.

### **Data analysis**

As the study unfolded, we ran many iterative and comprehensive examinations of collected data, relevant literature, and emerging conceptual insights. Following this approach, we established what incidents among the data had theoretical relevance, and consequently draw indications for the sampling and collection of new data.

As interviews transcripts, documents, archival data, and field notes were produced, we analyzed them inductively according to the prescriptions of constant comparison methods (Glaser and Strauss, 1967; Miles and Huberman, 1994). During multiple close readings of the data, we identified as many relevant incidents and concepts as possible, and labeled them either with brief descriptive phrases or using terms present in the data, generally referred to as in-vivo (Strauss and Corbin, 1990) or first order (Van Maanen, 1979) codes. We grouped similar codes together into homogenous categories, distinguished codes that differed, and reviewed incidents and codes across categories several times until no new concepts emerged.

Next, we reordered and regrouped categories in a systematic search for relationships among and patterns across them. As we refined categories in greater depth and specified their properties in detail, some categories stood out as core concepts of the emergent framework, whereas others were reconceptualized and absorbed by the former, more abstract concepts. Finally, we reviewed the data again with a few key categories in mind in order to determine whether they could be illustrated through specific incidents. The refinement, selection, and illustration of the core categories through raw data went on recursively until we were able to define and explain the theoretical relationships that linked them.

## FINDINGS

Our analysis shows that Alpha and Beta have elaborated a complex response to the concurring drivers of replication and of adaptation. As a result, these organizations can treat replication and adaptation as mutually reinforcing and complementary approaches, rather than opposing and contradictory ones. We introduce the concept of *adaptive replication* to designate the process by which the studied firms combine replicative and adaptive efforts together to resolve a continuous tension between stability and change (as in Figure 1).

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The process of adaptive replication involves four activities: 1) Template creation; 2) Template employment; 3) Principle extraction, and; 4) Principle enforcement. In order to understand how these activities contribute to the adaptive replication process, it is useful to examine briefly the drivers that have been found to condition the transfer of knowledge.

As AlphaCore and BetaSuite are marketed globally towards many large corporations, the interfirm transfer of the underlying knowledge assets keeps presenting the challenge of a

continuous tension between drivers of replication and drivers of adaptation. Data show that, at both organizations, conflicting forces regularly impact on the same instances of knowledge transfer and reuse. Moreover, replication and adaptation cannot be represented by a neat contraposition between internal incentives (to replicate) and external pressures (to adapt), but each of the two phenomena is driven by endogenous and exogenous factors alike. On the one hand, the advantages of replication (i.e., greater efficiency and profitability, improved competitiveness, faster dimensional growth, diminished uncertainty and risk, and enhanced operational consistency) are pursued and enjoyed by both the transferring and the recipient organization. On the other hand, the alteration and adaptation of the transferred assets are driven not just by external constraints – the recipient’s needs to differentiate from competitors, and to comply with established routines – but also by factors that are specific to the transferring organization, such as behavioral attitudes towards fit, and the interest to broaden the scope of asset exploitation. Such an articulate picture clarifies why Alpha and Beta simply cannot treat replication and adaptation as distinct and alternative approaches. Both organizations needed to put in place a set of differentiated responses to diverse categories of needs and constraints. As we will see, some of these responses are intuitive, others are not.

### **Template definition**

The adaptive replication process starts with the definition of templates with reference to concrete cases, or scenarios, of utilization. Templates crystalize organizational knowledge at two levels: at the level of the overall solution – i.e., the system of interdependent knowledge assets – they specify which components participate in the system of knowledge assets, and how they relate to each other; at the level of the single component, they provide a working example for each specific knowledge asset.

The definition of templates is carried out along a similar pattern across the two firms, and involves: a) the componentization and modularization of the whole system, so as to build portfolios of interdependent and interchangeable hardware, software, and service components, or modules, and; b) the progressive *productization* of knowledge, so that service-related knowledge is codified into formalized routines and procedures, whereas business, process, and technological knowledge is embedded into software applications, and/or embodied into hardware products. In the typical expressions of managers at the two firms, this process sounds like:

*“The first thing we would try to do was, can you create a standard set of design rules and guidelines? Can you define a number of essential scenarios that you’re going to encounter – a limited number, maybe – and then specify maybe three or four designs that would actually meet 80% of those requirements?”* (Beta)

*“So there’s this kind of incremental process of detail the step, standardize the step, detail the deliverable, standardize the deliverable, look across the steps in deliverables, see if we can map these onto some kind of common kind of item, and then aggregate that up. [...] If you can just write down the steps in enough detail, then the tacit knowledge won’t matter.”* (Alpha)

*“I think the other thing that’s very noticeable about [our] approach is that, increasingly, we’re embedding our methods into software tools.”* (Alpha)

## **Template deployment**

After a template has been defined, its deployment in multiple instances of transfer gives it concrete structure. Template deployment allows extensive replication of knowledge assets at both the system and the component levels. A manager at Beta summarizes how using templates sustains fast dimensional growth.

*“Once we proved this worked, we found a number of the bigger contracts [who] wanted to use it. [...] If you pick banking, for example, we were in the big four, whereas this kind of approach took us into all the other banks.” (Beta)*

However, template deployment is not just about replication. It can also – and it generally does – involve adaptation to the requirements and specificities of the recipient organization. As an Alpha manager points out: “There are always good reasons why you need a local variant, and inevitably these things get customized locally”. We indicate with the term *fine-tuning* alterations, changes, or adjustments at the level of the single knowledge asset, which do not affect the system template. Fine-tuning is often necessary to improve the fit of a system’s components with the recipient context: “What we do is, every single deployment to the customer, we change it slightly.” As components get used and reused over time, however, fine-tuning tends to become less frequent.

*“Every sale is slightly different. But over time, as we’ve sold it to different customers, we’ve actually added that bit in. So you’ve got a position where, first time, we nearly had to decide to write the simple application from scratch, second time it’s about 60% of what a customer wants, and now we’re in a position where 90% of that are ready.” (Beta)*

### **Principle extraction**

Extracting principles from working templates means identifying the essential logic behind the functioning of a given system of knowledge assets. Principles clarify the causal relationship between a given template design and its performance. They can be used to generate new designs that embody the same logic, as it happens, for example, when new problems need to be addressed by creating new templates. Managers of the two firms refer to events like this with expressions like:

*“We’re actually looking at a couple of other sectors right now, to look at the deployment of the same concept, there.” (Alpha)*

*“[After] probably about a year of doing the WAN, that went down quite well, customers liked that. But then, we started to get requests for doing other things in the same way, the same model.” (Beta)*

A crucial aspect of principle extraction is that it can only be accomplished through the integration of different domains of knowledge (i.e., business, operational, technological, architectural, etc.). Knowledge integration is required to deconstruct a system of diverse knowledge assets in terms of functioning principle(s), and to construct new systems that embody the same principle(s) in non-obvious way.

### **Principle enforcement**

Extracted principles are then enforced into the creation of new families of templates, in order to start new waves of replication. Evidence at Alpha and Beta suggests that principles are not formalized, that is, the knowledge they capture is not codified. For this reason, as a principle

is extracted, it needs to be embodied straight away into a template, which gives it structure and representation. Principle extraction and enforcement, then, cannot be separate activities, but have to be carried out in tight sequence by the same team.

The enforcement of principles happens at the system level, and results either in novel variants of the original template obtained by rearranging part of its components, (reconfiguration), or in the creation of new templates. Especially when combined with fine-tuning, reconfigurations play an important role in delivering “unique” solutions and providing original responses to local constraints, such as the need for differentiation. Managers at both firms rely heavily and consistently on this concept.

*“Customers want something that is unique to them. And they want to see that unique value much earlier in the sell cycle. And the challenge is, how you get that uniqueness upfront, but build that using the platform that you have.” (Alpha)*

*“In addition to the components that I’ve talked about – the best hardware, the best software, the skills and capabilities – is our ability to orchestrate and co-ordinate these in a meaningful way for clients.” (Alpha)*

*“It’s a sort of matrix concept. And you can apply the general principle to a number of technologies. Each of the boxes has a specific definition, a specific price, [...] and a written description of what the service will be, if you decide to buy it. And the customer can then pick, broadly, whatever mix he wants.” (Beta)*

*“So in the end, you add all of those products in some shape or form, and for each customer, actually, the combination that they want might be slightly different.”*

(Beta)

The organization’s ability to enforce principle through reconfiguration increases over time.

*“When we first started deploying solutions, the challenge was to take what were basic components of a solution and then create something very specific to a customer, and that typically takes a fair amount of customization.[...] I think, over time, that we’re starting to change our model a little so that we are trying to provide standard solutions that are configured: a subtle difference from developing bespoke solutions. [...] Ideally, all we do is configuring it to meet the client’s needs. And we strongly recommend with the engagement of the client that we don’t proceed into bespoke solution build. [...] And therefore there’s a shorter route to a solution for the customer, because then they can see the gains relatively quickly.”*

(Beta)

The extraction and enforcement of principle is not a means of replication. Much of the opposite, they lead to adaptation, in that they allow reorienting overall systems of knowledge assets to new sets of requirements, or even new context of utilization. A manager at Beta exemplifies such shift:

*“There’s now a product been developed, which, obviously, is almost the same thing, but for sales, let’s say for white-collar workers. It’s aimed at sales force automation because, like a blue-collar worker, a salesman might start at home. So,*

*there's now a sales force automation product just about to be launched. [...] And they've tried to replicate, although it's obviously not exactly the same, [...] they're using the same principle.” (Beta)*

## **HINTS OF DISCUSSION**

We started this study with the purpose of understanding how firms in fast-paced industries cope with the tension between needs of replication and drivers of adaptation that condition the transfer of their knowledge. We found that both the studied organizations have put in place a complex process through which replicative and adaptive efforts are combined together, and applied selectively to systems of interdependent knowledge assets, in order to provide differentiated responses to different drivers. A few aspects of these findings are particularly meaningful for their potential contribution to research.

First, our analysis seems to suggest that the exploitation of organizational knowledge in fast-changing environmental and context conditions should rely on mixed approaches, which combine the creation and exploitation of stable assets with the ability to manage and reuse those assets with some degree of flexibility. In other terms, strategies of replication and strategies of adaptation should not be conceived of and implemented as independent and mutually exclusive. There is instead a tight interplay between the two approaches that makes them not just interdependent, but even mutually reinforcing. On the one hand, in fact, pure replication by deployment of templates seems unfeasible without the fine-tuning of at least some of the knowledge assets that form the template. On the other hand, the innovation and learning achieved through fine-tuning sustains the extraction of principles, and the creation of new templates through the enforcement of such principles.

Second, the experience of Alpha and Beta leads us to question the possibility of “replication by principle” (Baden-Fuller and Winter, 2007). Indeed, templates appear as the only media of

replication emerging from this research. While extracting and enforcing principles is essential to capture the internal functioning of a template, and to create new sets of templates suitable for new and different contexts of use, there is no evidence that principles are themselves either tools or objects of replication. Principles are exceptionally elusive entities, on which the entire process of adaptive replication hinges to generate innovation and change. From a knowledge management perspective, however, the tight logical and temporal connection between the extraction and enforcement of principles appears as the only way possible that the organization has to tackle the complexity typical of large technical systems.

Finally, the results of this work stress the importance of architectural knowledge and advocate for the adoption of a system view in the study of problems of knowledge management. Engaging in adaptive replication, in fact, entails understanding how not just a single asset but instead systems of knowledge assets work together and relate to each other. Formalizing such systems as sets of interdependent components and seizing their internal interrelationships is essential for implementing each of the four subprocesses of template creation, template deployment, principle extraction, and principle enforcement. From a methodological point of view, this consideration casts doubts on the exhaustiveness and significance of those studies of knowledge transfer that focus just on one single asset at a time.

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Figure 1. *The Adaptive Replication Model*

