IT AND DYNAMIC CAPABILITIES

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Abstract. Organisations are involved in a continuous process of change in order to renew capabilities and achieve a competitive advantage in a hyper-competitive setting. This paper proposes a model for the creation of dynamic capabilities and studies the complementary role of Information Technology Capabilities in supporting this creation process: 1) Identifying the firm's repertory of capabilities (over time and space); 2) maintaining a capabilities catalogue; and, 3) assisting the transformation of existing capabilities and internal transfer of new synthesised capabilities throughout the organisation.

1. Introduction

A resource-based view of the firm understands that the heterogeneous resources and capabilities possessed by companies will explain both the existence of the firm and any difference in its results. The company is understood to be a specific set of resources. Amit and Schoemaker [1] define resources as a stock of factors which are possessed or controlled by the company.

Capabilities are the skills of resource co-ordination and mobilisation. Capabilities (flow) are resources (stock) which work together [2] by means of well established routines [3].

Resources and capabilities are core when they are fundamental to the performance of a company and its strategy [2, 4]. Growth, the opportunity to provide new products and enter new markets, does not depend so much upon demand as upon the resources and capabilities possessed by a company [5]. Core Resources and capabilities can be sources of sustainable competitive advantages for the firm if they allow it to develop strategies that generate value, if they are scarce, inimitable and difficult to substitute, and if they are appropriately integrated in the organization [6, 7]. The combination, development, exploitation and protection of the company's specific resources provide the basis for these competitive advantages.

Resources and capabilities are complementary when they lever the performance of other resources and capabilities [8]. Core resources and capabilities tend to require the presence of complementary resources and capabilities in order to create or add value.

However, the core resources and capabilities that form the basis of sustainable competitive advantage for the firm are static. Thus, they may stop being valuable if environmental conditions change. In this respect, it is necessary to consider capabilities in a more dynamic sense. Dynamic capabilities are the ability of a company to integrate, build and reshape internal and external capabilities in order to provide a rapid response to any change in its environment [9]. The dynamic capabilities of an organisation reflect its ability to achieve innovative ways in which to compete in any given circumstances. The aforementioned dynamism relates to the capacity to change routines and even the resources which go to make up those routines. Creating dynamic capabilities in order to achieve new competitive advantages requires a knowledge of how to change core capabilities.

To develop the resource-based theory of the firm it is necessary to specify concepts [10] in the creation of dynamic capabilities [9]. This approach allows other capabilities to be taken into consideration when, although they may not yet be core capabilities, they may become so in the future. These dynamic capabilities will allow the company to anticipate or adapt to changing environments.

It must be pointed out that in highly complex circumstances company boundaries are blurred and environment and organisation may be confused. In situations such as these greater emphasis should be placed on human assets, information systems, and knowledge management. Information technology (IT), supporting an information system, plays a decisive role in this context [11, 12].

The resource-based view of the firm is useful for studying IT [13]. On the one hand, previous literature defines IT as an Infrastructure (ITI) of hardware, software and communications media, whereas this view considers IT as a resource. On the other hand, contributions about organisation routines [3] explaining ITI connectivity and its informative content (intangible assets) do not abound. The management of these routines and intangible assets turns ITI from a commodity into a valuable asset.

Mata, Fuerst and Barney [13] state that ITI provides no advantage in itself, although skills in the management of ITI could produce advantages if they enabled the firm to perceive and exploit other capabilities that could prove to be sources of competitive advantage [6]. In this paper, these ITI management skills, or IT Capabilities (ITC), refer to the aforementioned management of routines and intangible assets. Assets that could support the creation of core capabilities.

ITC may support the creation of new capabilities by providing a means of co-ordinating personnel, enhancing communication, storing, processing, and transferring information to wherever it may be required. These ITC functions play a key role as catalysts in the creation of dynamic capabilities.

Literature relating IT to the resource-based view of the firm does not abound. This paper proposes a dynamic capability creation process supported by ITC which addresses this gap.

The development of dynamic capabilities is relevant in complex contexts where ITC may play a key role. These complex contexts, originating from the internal complexity of the organisation and the external complexity of the environment, make it necessary to assess the validity of current theories and, additionally, to discover new concepts leading to new theories. By studying the creation of dynamic capabilities, this paper aims to proceed along the latter road, the one on which single, strategic and organisational theories may give way to equally valid eclectic solutions [11].

The added value of this paper lies in its proposal of a dynamic capabilities creation model, and its study of the complementary role of ITC in this creation process. We offer an integrative model for the management of dynamic capabilities, which considers all possible sources of dynamic capabilities (whereas the existing literature offers only partial descriptions of these sources and of the process of capabilities generation) [14, 15, 16, 17], and we find that the role ITC may play in this process is significant. The contribution of ITC in developing dynamic capabilities proves critical in the case of large, geographically-dispersed organizations. Furthermore, we provide various practical implications for management if they wish to manage their capabilities successfully with the support of ITC, and of the complementary human resources and business capabilities.

This article is structured as follows: After this introduction, Section 2 proposes a model of the generation of dynamic capabilities from the transformation of other capabilities already possessed by the firm, as well as the development or acquisition of capabilities not previously held. We shall particularly stress the contribution of dormant and peripheral capabilities in the process of the development of dynamic capabilities. At the end of Section 2 we shall offer an integrative model that will allow us to consider jointly the various sources and stages of the process of generating dynamic capabilities.

In Section 3 we shall analyze how ITC contribute to the development of dynamic capabilities by supporting the management of dormant and peripheral capabilities. Section 4 points out that the support ITC provide will not be sufficient unless certain complementary human resources and business capabilities are also present. In Section 5 we outline the practical implications that our model has for management. In Section 6, we assess the viability of alternative means of acquiring new capabilities not developed by the model. In this section we also point out some limitations to the model we have developed. Finally, in Section 7 we draw some conclusions of our work.

2. A dynamic capabilities creation model

Dynamic capabilities are seen to possess two principal forms of generation [14, 15, 18, 19, 16]. Dynamic capabilities come from either (1) dormant or latent capabilities, which are accumulated through collective experiences and reside in ‘organisational memory’, so they are not in use; or (2) from peripheral capabilities, which are in use but are not considered core capabilities of the company. Although, neither of the aforementioned capabilities forms part of current core capabilities, they may provide a source for future capabilities.

The search for new capabilities may be approached from two different angles. The first refers to the development or acquisition of new capabilities from external sources. This capacity has been identified by Garud and Nayyar [16] as absorptive capacity. The

second way to develop new capabilities is by taking advantage of capabilities that already exist in the company, dormant from the past (dormant capabilities), those that are separate from core capabilities (peripheral capabilities), or current core capabilities. The capacity to transform existing capabilities into new ones is called transformative capacity [16]. Figure 1 outlines the aforementioned sources of dynamic capabilities. The creation process will be explained in greater detail below, with special emphasis on the role played by ITC in transformative capacity.

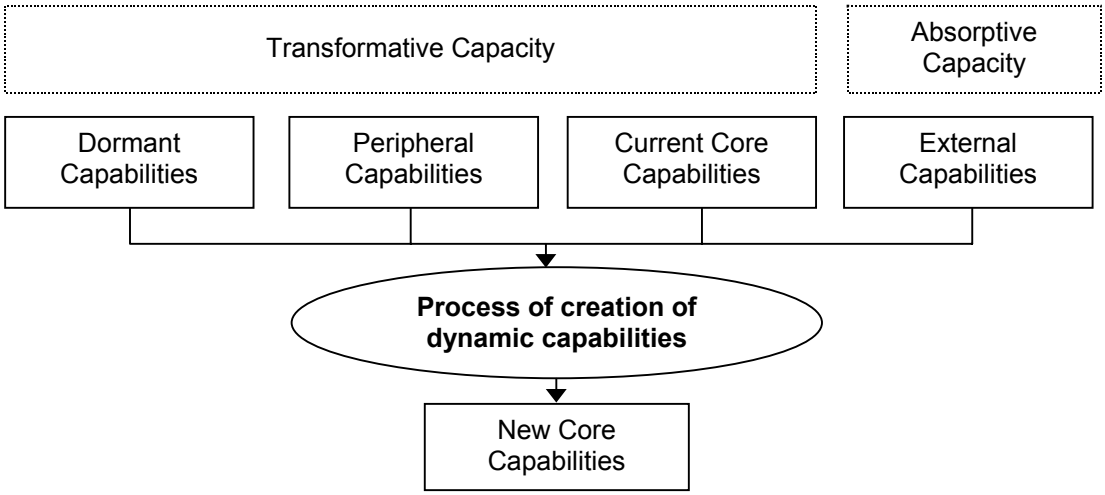

Fig. 1. Sources of dynamic capabilities

The concept of transformative capacity contrasts with that of absorptive capacity, whereby a firm perceives and makes use of external capabilities. Absorptive capacity is insufficient if an accumulation of capabilities dependent upon paths followed in the past is required, if the moment when the capability is acquired is critical,[1] and if, in a changing environment, the company has no desire to react to external changes but rather intends to create some such changes itself.

Absorptive capacity, by definition, allows for imitable capabilities that are unlikely to provide any source of competitive advantage. To be a source of sustainable competitive advantage, a resource must be valuable, scarce and difficult to imitate or acquire [6]. As this is unlikely with external capabilities, absorptive capacity only provides a sustainable competitive advantage if combined with complementary capabilities belonging to the company, and these are valuable (either in their own right or jointly with complementary capabilities), scarce and difficult to imitate or acquire.

Transformative capacity may generate company specific and difficult to imitate capabilities of great strategic value for the company because internal capabilities are more likely to be company specific, path dependent, socially complex, and causally ambiguous.

ITC have three different roles to play in the creation of dynamic capabilities: (1) to support the identification of the organisation's historic (dormant) and peripheral capabilities; (2) to keep a catalogue of capabilities or a map of people who possess them [12, 16]; and (3) to act as transmitters, spreading them throughout the company,

[1] For instance, previous developments of a capability may make it easier to absorb, but this is not the case when the capability becomes specific for a company.

generating dynamic capabilities which originate from those capabilities that already exist within the firm [20, 17].

Dynamic capabilities from dormant capabilities

Dormant capabilities may be transmitted over a period of time by means of (1) a selection process that determines what should be kept alive within the organisation; (2) the development of skills aimed at keeping them dormant (creating a catalogue describing such capabilities, or when it is difficult to include these in the catalogue because of their tacit nature, keeping a map of the knowledgeable people, allowing employees to contact the people with useful knowledge); (3) their reactivation, when necessary, and synthesis; (4) and their transfer. These tasks of selection, maintenance, reactivation, synthesis of capabilities, and transfer [20, 17], are part of the aforementioned transformative capacity (see Figure 2).

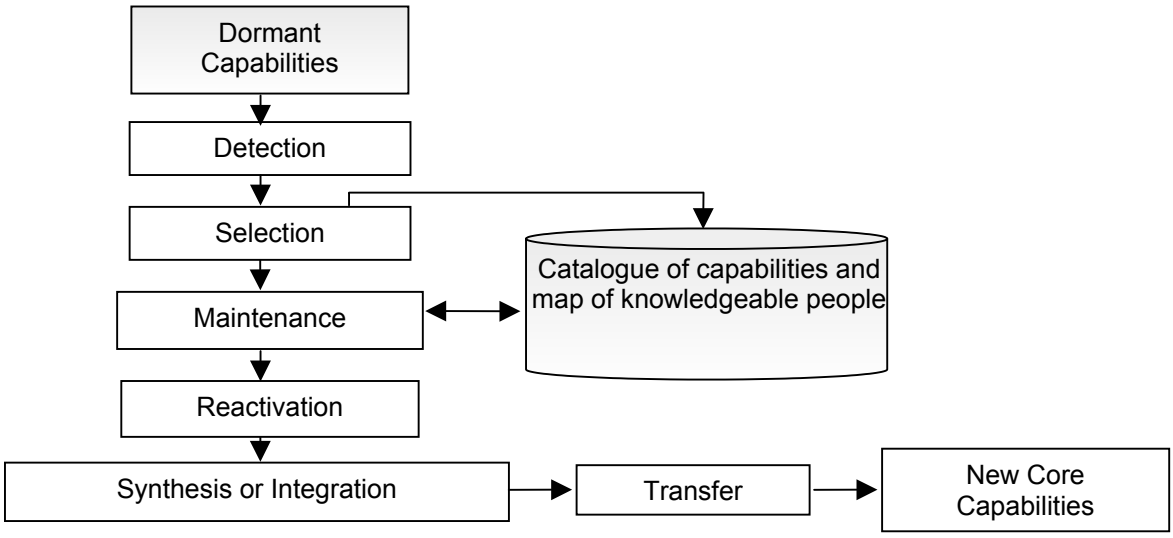

Fig. 2. Dynamic capabilities creation process from dormant capabilities

But why should a capability remain dormant? It may seem to do little more than produce apparently unnecessary costs. The answer lies in the fact that delays exist in technological development, from the supply side, and in the development of the market, from the demand side. Demand for a product or service may arise in the future as a result of institutional changes, changes in customer requirements or, from the supplier's point of view, a convergence of asynchronous technological vectors (where some vectors were temporary bottlenecks for others) that make new services or products possible.

Lost dormant capabilities could prove difficult or even impossible to rebuild or acquire when they are required by new conditions of supply and demand. [16]. It may also be observed that the different types of restructuring undergone by a firm may lead to a loss of key capabilities (dormant and peripheral, possessed by outsourced personnel), that might support future competitive advantages [21].

Dynamic capabilities from peripheral capabilities

Capabilities are rarely found to be widespread throughout an organisation; they are more likely to be found where they were produced, in individuals or small groups who possess the relevant know-how and in those who undergo the learning process. Sometimes they even spread to an organisational sub-unit or to a specific function. These are known as peripheral capabilities. If they are spread out and shared amongst different sub-units, functions or processes, the likelihood of discovering new opportunities increases. In addition, newly emerging opportunities may mean combining a number of capabilities cultivated in different parts of the organisation [17].

Initially it is necessary to find out what peripheral capabilities the firm possesses. Usually these capabilities will require no search at all, since they are quite familiar to members of the organisation. Detected capabilities enlarge the catalogue (or the map of knowledgeable people, if tacit capabilities), and they require no maintenance, since they are living capabilities. When necessary, catalogued capabilities, or even capabilities that are not yet catalogued, may be aggregated to other capabilities, thus forming dynamic capabilities. The transfer process has the advantage that there is no need to search the organisational memory of individuals, since it is possible to rely on those who currently exercise these capabilities.

The process of creation of dynamic capabilities from peripheral capabilities is summarised in Figure 3.

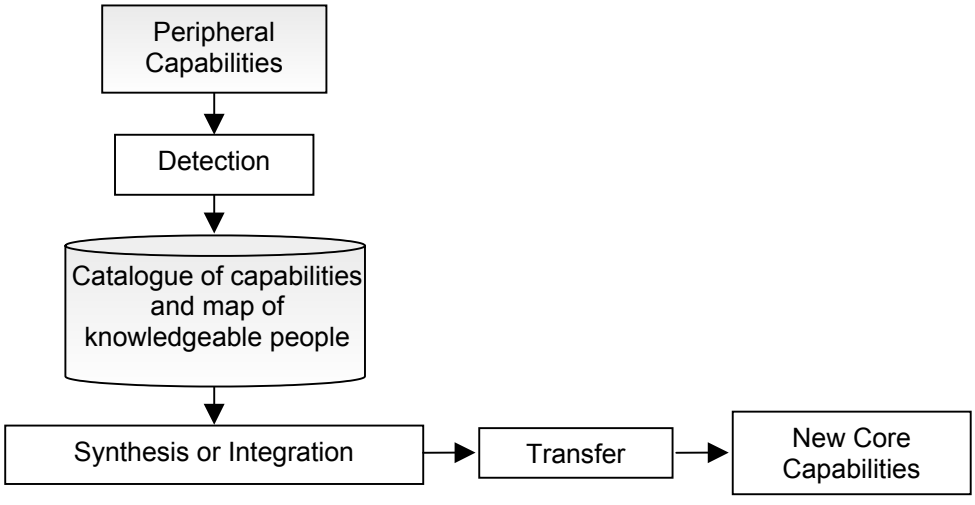

Fig. 3. Dynamic capabilities creation process from peripheral capabilities

The final model

The dynamic capabilities creation process explained above reflects a programmatic perspective as opposed to one based on the emergent production of new capabilities. In the emergent path, the company naturally and regularly develops certain capabilities.

Nevertheless, in complex contexts, companies feel obliged to programme the development of their capabilities with the aim of speeding them up, instead of simply relying on emergent processes [16].

Furthermore, formalisation of the new capabilities creation process may encourage a more ambitious strategic proposal [22] and increase both the skills of those involved and their desire to share and transfer capabilities.

The final dynamic capabilities creation model considers both the programmatic and the emergent path, and all possible sources of dynamic capabilities, both internal and external (see Figure 4). Transformative and absorptive processes do not take place independently. On the contrary, the synthesis stage integrates dormant, peripheral, current core and external capabilities.

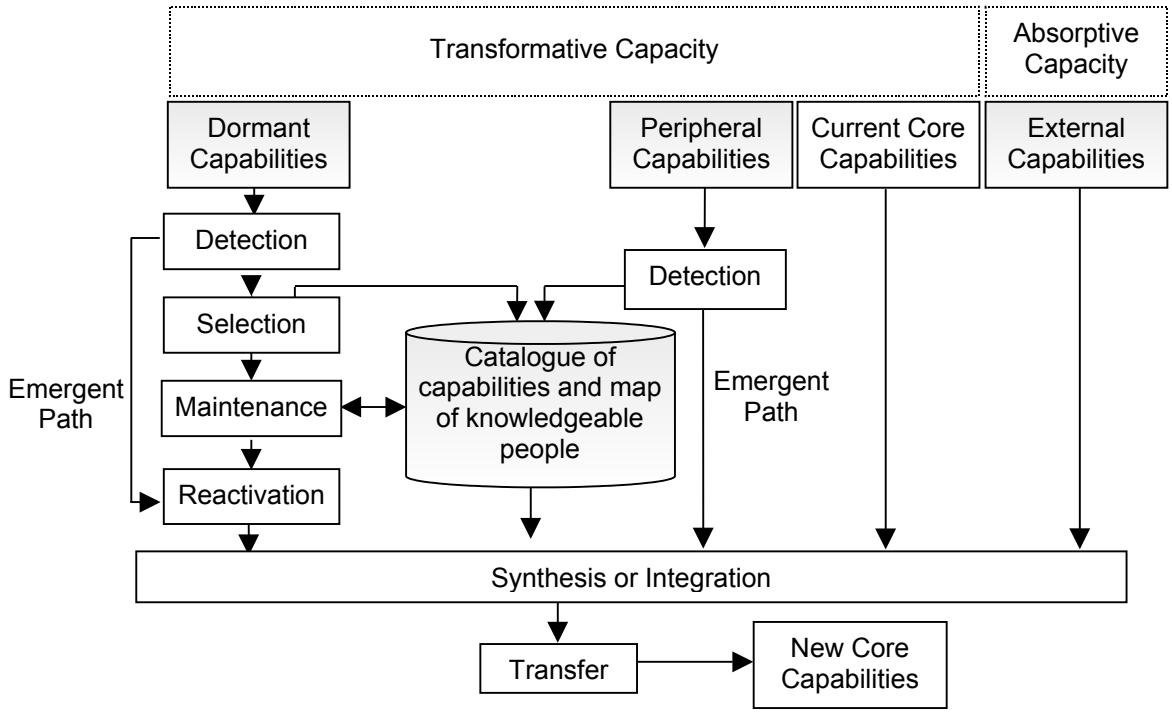

Fig. 4. Process of creation of dynamic capability

3. ITC and dynamic capabilities

The role played by ITC in the creation of dynamic capabilities derived from dormant capabilities is to help with the transmission of the latter through time. It does this because ITC may (1) satisfy the demand for information required for the selection of capabilities which are to remain dormant (instead of their being forgotten); (2) help to maintain them through the proper integration of ITC, complementary human resources and business capabilities [23]; (3) collaborate when necessary in their reactivation and synthesis [16] by integrating [17] simple skills in complex capabilities, both valuable and difficult to imitate; and (4) promote their transfer throughout the firm (also counting on the support of the previously mentioned complementary resources and capabilities).

ITC have three different roles to play in the process of selection, maintenance, reactivation, synthesis, and transfer of dormant capabilities: (1) to support decision

making; (2) to facilitate communication; and (3) to act as a catalogue or map of capabilities. Firstly, ITC support the decision making that may take place, by supplying the necessary information, providing prospective and simulation tools, statistics, etc. In this way, they will help at the selection stage to collect information of an internal or external character that allows for a decision to be made as to whether the assessed capability may be regarded as an option (in financial terms) for future competitive advantages. ITC also help to carry out simulations which reflect the impact that the decision to maintain will have on other units. During the maintenance stage, they allow for an ordered view of the catalogue of capabilities or the map of people who possess tacit capabilities (see Figure 4), facilitating inspection of their content and, if necessary, their update. In the process of reactivation, ITC facilitate the inspection of catalogued dormant and peripheral capabilities, collaborate in the standardization of the capabilities (if possible) to facilitate integration, and monitor market and technological variables which may trigger reactivation and synthesis. Finally, the information supplied by ITC will improve the transfer process of the synthesised capability, by supporting its articulation (making tacit capabilities explicit, wherever possible) and the internalisation of capabilities (transforming explicit capabilities into know-how by performing the job) [17].

The second role of ITC is that of facilitating communication processes through the means that they provide for personnel to communicate with each other, by-passing functional, hierarchical, geographical, and temporal boundaries. In this way the mechanisms of lateral co-ordination (liaison work, work groups and permanent committees, integrating managers and matrix structure, etc.) become enriched, thereby increasing the capacity of the organisation for processing information. By playing this role in the selection process, ITC provide mechanisms for running and co-ordinating work groups, helping them to identify the capabilities to be catalogued or knowledgeable people to be mapped. At the maintenance stage, ITC help to develop means whereby researchers, technicians and engineers may share the information to be maintained and easily reach knowledgeable people, if necessary, using the aforementioned map. ITC facilitate reactivation and synthesis by encouraging researchers and workers to make their advances more widely available, providing a means for sharing information and transferring it in such a way that the convergence of capability vectors is rapidly detected. Both formal and informal communication, as well as improved lateral links, stimulate the process of transferring synthesised capabilities, making those that are explicit more widespread, and supporting learning by doing [17] from knowledgeable people, which is necessary in the case of capabilities that are difficult to structure.

Thirdly, in collaboration with human resources, ITC act as a repository for descriptions of capabilities and constitute the catalogue and the map [12] alluded to earlier in connection with the maintenance task. This catalogue contains an inventory of capabilities and, wherever possible, standardises and codes the information to make it more accessible to those who participate in the work of maintenance and reactivation at any given time, wherever they may be. Standardisation aims to minimise the amount of information required for reactivation to be registered (in rapidly changing environments the amount will be greater), and to facilitate discovery of convergence between different capacities. Where standardisation is not possible (when dealing with tacit capabilities), then the support of the human resources that retain these dormant capabilities becomes fundamental. In this sense, the catalogue must include a map of the worksites where these tacit capabilities are possessed, and details of how to contact those who possess

them. As the firm looks ahead to further future synthesis, the standardisation of catalogued capabilities should be extended to include the standardisation of recently synthesised developments.

When ITC are used for locating and managing peripheral capabilities, the concepts of detection, storage, synthesis and transfer, previously explained for dormant capabilities, will also prove useful (unlike selection and maintenance, since peripheral capabilities are in use). The support function provided by ITC in decision making, fostering the communication and storage of information are also applicable to the detection, inventory, synthesis and transfer of peripheral capabilities, all of which are useful in the creation of dynamic capabilities. The facilities provided by ITC in improving communication within the company, encouraging both formal and informal lateral links, would be one way of detecting concealed peripheral capabilities. Improvement of lateral links and communication with the organisation as a whole makes it possible to cross the functional, hierarchical, temporary, geographic or external boundaries of the business unit such as suppliers or clients. It is these boundaries that keep peripheral capabilities in their place of origin.

The role of ITC will not simply be to supply information and transfer it through the formal capability creation processes (programmatic path). It will also be to intervene in informal processes (emergent path), by improving communications between members of the firm.

4. ITC and complementary resources and capabilities

In addition, the stages involved in the development process of dynamic capabilities require complementary resources and capabilities [24, 25] that support ITC. Complementary resources and capabilities arise when a resource, or capability, produces greater results in the presence of other resources or capabilities than it does on its own [26, 27, 1, 28, 8]. This would occur, for example, with the introduction of an EDI[2] system combined with pre-existing confidence in the supplier. This relationship with the supplier is a complementary business capability that would be essential for the EDI system to be successful.

If ITC are not integrated with complementary resources and capabilities, then they are not in themselves efficient, either in creating and maintaining competitive advantages, or in supporting the creation process of new capabilities. When complementary resources and capabilities and ITC are working together, they are difficult to imitate, thus sustainable competitive advantages become more feasible.

Powell and Dent-Micallef [23] ask why it is that some companies encounter difficulties while others prosper when using the same ITI, and why ITI-based advantages dissipate so quickly. The answer they suggest is that ITI, complementary human resources and business capabilities must be integrated. Nevertheless, according to Mata, Fuerst and Barney [13], ITI are an improbable source of competitive advantage, unlike ITC. Thus the integrated management of ITC and complementary resources and capabilities could

[2] Electronic Data Interchange: allows the transference, via public telecoms networks, of structured and standardized documents. Acts as electronic messenger service of transactional documents between applications on different computers. It thereby carries out and registers business transactions (for example, orders, manufacturing orders, delivery orders, etc.).

improve the creation of dynamic capabilities and become a source of sustainable competitive advantages.

In this sense, the role of ITC in the creation of dynamic capabilities requires complementary human resources, such as open organisation and communication, consensus, top management commitment, flexibility, and experience in strategic-ITI integration. On the other hand, with regard to complementary business capabilities, the ITC role in the creation of dynamic capabilities requires a close relationship and IT connections with suppliers, suitable IT training and planning, redesigning processes, orientation towards teamwork, and benchmarking capabilities.

Not only do ITC require the aforementioned complementary resources and capabilities, they also produce synergic effects, which is why such complementary resources and capabilities are fostered by ITC. Such was the case of BP Exploration, a subsidiary of British Petroleum, where the difficulty of storing tacit knowledge in computerised catalogues was recognised and led to the encouragement, thanks to ITC, of remote virtual team work [12]. This led, on the one hand, to the creation of dynamic capabilities, capturing dormant capabilities in an emergent path (it was the programmed path which relied on the catalogue) and, on the other, to locating peripheral capabilities in a simpler and more efficient manner.

5. Practical implications for management

Management should be aware that core capabilities that today support the competitive advantage of their company may not do so tomorrow if environmental conditions change. In this respect, the firm should learn to manage its dynamic capabilities in order to make the appropriate adjustments. This requires the firm to take care of its dormant and peripheral capabilities and for it to be able to transform them into new core capabilities according to the process shown in Figure 4. Nevertheless, as is shown in Figure 5, many questions need to be specified more clearly and in a more operative way.

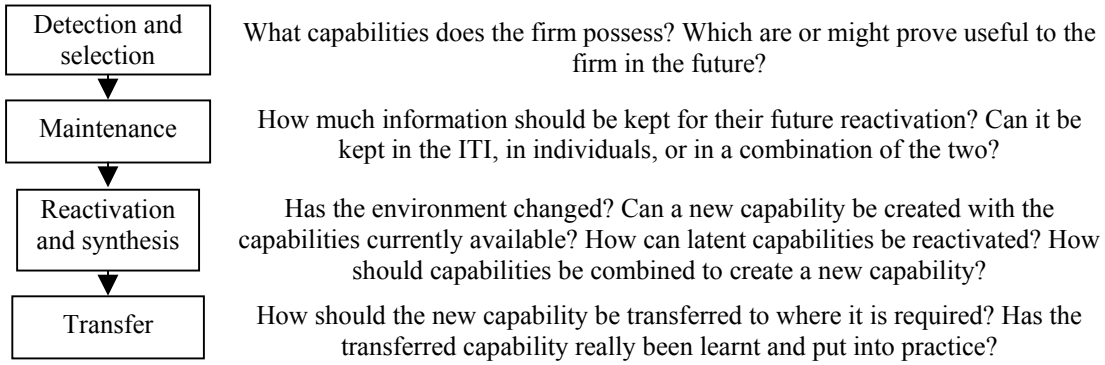

Fig. 5. Some practical questions in the development of dynamic capabilities

We shall now outline some practical considerations that affect every stage of the process of transforming capabilities into dynamic capabilities. In this process, ITC and

their integration with complementary human resources and business capabilities will prove critical [23]. Also of use will be some of the recommendations offered by Garud and Nayyar [16], and Doz [17].

Detection and selection

In the detection stage it is necessary to collect information relating to the dormant and peripheral capabilities held by the firm. This will require the different departments and business units to be coordinated, since the capabilities that may prove most useful tend to be socially complex (being a combination of the skills of many people) and causally ambiguous (it being difficult to identify all the elements that make them valuable). The complementary role of human resources in which many of these capabilities reside is crucial here, since an open communication and a commitment to this stage and to the process in general will be required.

Management should be able to manage and train work groups responsible for creating a first inventory of what the firm knows how to do, even if this is not at present a source of competitive advantage (peripheral capability), or what the firm knew how to do (dormant capabilities). It is important to assign to different teams the identification of different types of capabilities (production, R&D, engineering etc.). Also, all the members of the organization should work together in the work of these groups. This participation will only be gained if the staff are informed about what the intention of the process is, what exactly the teams are looking for and how important it could be for the future of the firm.

In this stage of detection the organization should possess the ITC that allow it to put the ITI at the disposal of the teams and of the staff contributing in the search for capabilities. The use of electronic communications media (e.g. the firm's intranet) by team members to communicate among themselves and with other staff in the firm, may help in the detection process in large and geographically-dispersed firms. Developing web pages, accessible from the firm's intranet, that list and define the capabilities found, especially noting the individuals in which the capabilities are found, will mean that these individuals feel valued by their firm, and will motivate other employees to contribute.

In the selection stage it is necessary for the firm to estimate which of the capabilities found might help it to implement strategies of value, at the present moment as well as for the case when the environmental conditions change. In this last case, the firm would have to clearly define the alternative scenario that would add value to these capabilities (for example, technological advances in production, change in consumer tastes, opening to international trade, etc.).

In the case of peripheral capabilities, selection is not required, because these are capabilities that the firm uses at the present time, and hence they are available when required. However, it is necessary to assess their potential in order to protect them in the case of organizational restructuring (outsourcing, downsizing, delayering, etc.).

In choosing the dormant capabilities to maintain, as well as their potential value, the firm should also consider the difficulty in reconstructing them from zero should it

require them, as well as the impact the decision to maintain them alive will have on other business units and other capabilities.

The responsibility for selecting which capabilities to maintain should be given to one team only integrated by members from the teams charged earlier with their detection. The global view of the capabilities available on the intranet will make this task easier. The selection will require such a global perspective, since members should consider from this stage the potential for synthesis or integration that each capability has, either among themselves, with the core capabilities of the firm, or with newly acquired capabilities.

The more or less tacit nature of the capabilities will decide whether in the selection the support of ITC or people will be more or less. In this respect, more complex measures will need to be taken (such as mechanisms of formal planning, face-to-face meetings, work teams, brainstorming, etc.) when the choice affects tacit capabilities. In the case of more explicit and tangible capabilities, it would be advisable to establish as objectively as possible criteria for assessing their potential future. In this respect, the tools for budgeting, simulation and modeling that ITC provide will be of use in assessing the economic and future viability of developing projects based on these capabilities, as well as for measuring the impact that they will have on other business units in the firm.

Maintenance

The maintenance stage only applies to dormant capabilities. It is not necessary to maintain peripheral capabilities found in use at present in the organization. Only in the case where a peripheral capability selected as valuable is externalized or abandoned might it be logical to consider its maintenance. In fact, in this case the peripheral capability would become dormant.

One of the questions to consider when maintaining dormant capabilities is how much information should be kept. To be efficient, the firm should keep the minimum quantity of information necessary for a future reactivation of the maintained capability.

The quantity of information required for selecting, maintaining, reactivating and transferring capabilities, and their location in human resources or in ITI, is influenced by the characteristics of the dormant capability to be transferred through time. These characteristics are whether it is (1) tacit or explicit, that is, whether or not it can be described as a whole or coded; (2) simple or complex, the former requiring little information in its description and the latter requiring a great deal; and (3) systemic or independent, the former needing to be described in relation to other capabilities and the latter to be described in its own right.

Capabilities that are tacit, complex or systemic are more difficult to transmit over a period of time (dormant capabilities) [16] or through space (peripheral capabilities). If this were not the case (and they were explicit, simple, and independent), they would be more homogeneously spread throughout companies, easy to obtain from scratch, and thus of less strategic value. It is not worth maintaining easily transmitted dormant capabilities (explicit, simple and independent) unless the firm possesses the ability to prevent others from gaining access to them, or they gain value only when combined with complementary capabilities belonging exclusively to the firm and without which

they are worthless. Moreover, it is also necessary to consider that in rapidly-changing environments more information should be kept.

From the practical point of view, ITC can help to maintain a computerized catalogue of capabilities. Once again the firm's intranet will make this catalogue visible, allow it to be reviewed periodically to assess the need to continue to maintain certain capabilities or to reactivate others and to convert them into core capabilities. The catalogue of capabilities should be fed by following a defined protocol for standardizing the information that must be included for each capability (area to which the capability is limited, description of the capability, key people in which the capability resides, competitive importance, technological or market factors that would make the capability important for the firm, etc.). This allows for a homogeneous view of the entire catalogue, and permits the detection of convergences promoting the reactivation and synthesis of capabilities. Moreover, the catalogue should be, as well as structured, flexible to be able to include tacit capabilities (at least those that can be structured in some form), and for it to be able to withstand continual variations in the capabilities catalogued.

The tacit character of the capabilities might, however, make them difficult to structure, and thereby difficult to include in such a catalogue. In this case it would be useful to set up a directory on the intranet, as up-to-date as possible, which reflects who is who, what their knowledge is, their position in the organization, and how to contact them (email, telephone, office). A themed ordering of the projects undertaken, innovations made, and new technologies and management systems used, should also be available on the intranet. This applies not only for those that were successful (which may form part of the peripheral and core capabilities of the firm), but also for those that failed (dormant capabilities), mentioning explicitly who was responsible for the project and who participated in it.

The most efficient way of forming these databases and making sure they are up-to-date is to motivate (via compensation, public recognition, etc) the staff possessing the capabilities, as well as those responsible for the projects, so that they update them. A climate must be formed in which employees feel more valued by the firm in function of the capabilities that they possess.

Moreover, electronic communication via the computing networks of the firm will allow those people who possess capabilities to share the information that is to be maintained. In this respect, it would be useful to create themed discussion groups (for example, on a particular productive technology the firm once used but no longer does). These forums might have various objectives: to maintain the dormant capabilities, look for applications that justify their reactivation – considering the possibility that they are integrated with other capabilities to form new capabilities (synthesis stage) – and to facilitate their quick reactivation when necessary.

In this maintenance stage it is especially important to consider the complementary role of human resources. The larger the tacit component of the capability to be maintained, the more the firm should rely on people; it is similarly necessary to retain the key people who possess the tacit capability, or whole teams when the capability is systemic.

The management should, however, control the capabilities that are stored, assessing which capabilities are included, which eliminated, the possibility of reactivation when required (time required for a capability's reactivation, whether the individual or team

that would allow such a reactivation remain in the firm, etc.), the maintenance costs of a dormant capability, the costs of the information system cataloguing the capabilities and allowing a fluent communication between interested parties, etc.

Reactivation and synthesis

The reactivation of a latent capability and the synthesis or integration of the differing sources of dynamic capabilities (dormant, peripheral or core capabilities) will arise when there are technological and market convergences which change the situation and make the development of new capabilities appropriate.

Prior to any process of reactivation and synthesis, a firm must find the need and opportunity to renew the existing core capabilities and develop new ones. The appropriate ITC will be required in order to monitor these changes. The wide range of ITI that support decision-making and their appropriate use (ITC) will favour these stages. In this respect Management Information Systems[3] (MIS) will be of use, including: systems which detect changes in the market (marketing MIS[4]), in productive efficiency (Production MIS[5]) or in the progress of the firm's financial data variables (Financial MIS[6]).

For their part, Decision Support Systems[7] (DSS) help to plan and simulate in models the impact that decisions regarding the integration and reactivation of new capabilities will have on the internal units of the firm and on the market. New projects may force the firm to commit financial, technical and human resources that might be required in other parts of the organization.

Executive Information Systems[8] (EIS), which focus more on the exterior of the firm, on its competitive environment and strategic planning, can detect factors that trigger changes that will affect the firm. Some specialized computing tools detect changes which are more difficult to observe, using specific techniques. Thus, Data Warehouses,[9] which are constructed for commercial purposes, are analyzed by Data Mining[10] tools.

Once a firm decides it needs to reactivate and synthesize a capability it must go to where it resides or is maintained. First, it should consult the computer catalogue of standardized capabilities, as well as the directory detailing the people and teams holding

[3] Integrated systems that collect information concerning the planning, control and coordination of operations at the tactical level. They support repetitive and structured management activity and decision-making.
[4] Collect data on sales, prospective data on clients and information about competitors.
[5] Provide information on the cost and status of production, suppliers, and the physical component (plant localization, layout of production lines, and sequences of the production process) and informational (timing of production processes and inventory) of the production.
[6] These collect firm accounting and financial data, as well as financial data from the environment (government monetary policies, credit conditions of the financial system, etc).
[7] Support structured and semi-structured decision-making, especially at the tactical level. Deal with similar data to that of MIS systems, but because they can also construct models, they permit managers to explore alternative scenarios and look for hidden correlations in the data.
[8] Provide directors with non-structured information on the general activity of the company, and about its environment (for example, on its industrial sector, its competitors, or technological innovations), which is useful for strategic decision-making.
[9] Collection of business data, thematically aggregated, and organized to support strategic long-term decision-making.
[10] These use different types of statistical tools (to discover relations between data), neuronal networks (to discover functional models), discriminant analysis, decision trees, and other techniques, in order to extract information from the data warehouse to illustrate behaviour patterns among consumers.

the most tacit capabilities. Synthesis is made easier by the fact that the capabilities are standardized in the catalogue. The standardization should help a firm to quickly detect if the conditions predicted as necessary for reactivation are present (monitoring the technological and market variables which trigger the need for reactivation), and to improve the convergence between differing capabilities to facilitate their synthesis.

Firms should bring together researchers, technicians and engineers who create new capabilities and those individuals who use and maintain them, or need them. Discussion groups using the firm's intranet and email can help in this, as well as periodic face-to-face meetings.

Firms should incentivize individuals who consult the catalogue of capabilities in order to solve problems they have or to take advantage of emerging opportunities. In order for this to happen it should promote experimentation and not punish those errors that arise from it (within the limits defined by the firm). All staff should be aware of the content of the catalogue so that they do not waste time "reinventing the wheel". Moreover, the firm should incentivize those people who hold tacit capabilities to share them in the synthesis, without making them feel they will become dispensable to the firm because of this.

The firm should deploy all the means at its disposal (electronic or otherwise) to encourage information sharing: firm-internal publications, seminars and work sessions among those creating capabilities and those who use them, promote the lateral mechanisms of the information processes [29], etc.

It should also commit the organizational and financial resources required. In this respect, it should form teams with responsibility for the reactivation and synthesis of specific capabilities, allow sufficient time for this to succeed (to avoid possible resistance to change [30]), and facilitate access to other complementary resources and capabilities.

Transfer

Once the new capability has been synthesized it is necessary to transfer it to those workers who must incorporate it into their routines and tasks. ITC can accelerate the transmission of capabilities. On the one hand they allow people to develop formal and informal communication processes, facilitating the task of coordinating lateral links, as well as providing access to people possessing the capability in question. In this way it is possible to interchange information about how to do things, supported by video-conference, email, discussion groups, etc.

On the other hand, in the case that the capabilities can be structured, the firm needs to articulate them in order to allow the transfer of documents. In this respect, it can describe in great detail, for instance graphically, those structured tasks whose complexity requires it. For example, some aeronautical firms (such as Airbus) are developing graphical simulations of aircraft component assembly. These simulations allow workers to learn at the workplace how to assemble pieces and which tools to use (which encourages learning-by-doing and learning-by-using).

As in earlier stages, the role of the managers in the management of human resources will be fundamental for the transfer stage to develop appropriately. Managers should

counteract any perception of failure caused by initial falls in productivity when using the new capabilities. They must motivate transfer creating a climate of tolerance of ambiguity and the tacit, so that employees are receptive to the transference of capabilities which are less easily articulated. They must also motivate those transferring the capability, so that they obtain recognition, and that they do not feel dispensable once they have transferred their knowledge. It is also important to encourage informal learning via interaction within work groups.

6. Discussion

The maintenance of dormant capabilities, the search for peripheral capabilities, the identification of current core capabilities and the possession of the necessary complementary resources and capabilities, when all of these (separately or jointly) are difficult to acquire and imitate, may constitute an internal source of dynamic capabilities. However, other solutions do exist, such as the capacity to absorb external capabilities (see Figure 1), mergers with other organisations, the acquisition of a whole company which possesses the desired capabilities, or the establishment of some kind of temporary alliance or agreement with other companies. Nevertheless, absorption of external capabilities is not free of drawbacks (as mentioned earlier), and acquisition may entail a financial problem. Moreover, acquisitions and mergers involve the acquisition of other undesired resources and capabilities, the difficulty of integrating different business cultures, and the enormous investment in time needed to make the firms work as a single company.

Alliance or agreement would appear to be a more feasible option. This is illustrated by Baden-Fuller and Volberda [15], for whom the limits of a company do not end with its legal standing, but with the limits of its knowledge of the creation and exploitation of processes. In any event, alliances will lend resources and capabilities to the cause, but will not transfer them to a company deficient in such resources and capabilities if they are inimitable. Difficulties in their imitation arise when they are obtained at a specific point of time [6], are developed over a long period [31], happen to be causally ambiguous [32, 6] or socially complex [6], or are specific to the company of origin.

The model developed in this paper presents some limitations. In the first place, the existence of dormant capabilities is not possible in newly-created companies. These companies do, however, have the advantage of greater flexibility for change because they have less inertia or rigidity [30] originating from the past. On the other hand, peripheral capabilities are more often found in large, complex and diversified companies than in smaller companies.

Furthermore, although the role played by ITC in the management of dynamic capabilities has been highlighted in this paper, the role of human resources must not be ignored. Capabilities reside in people, who are able to create dynamic capabilities. ITC have only a complementary role, although they are essential when firms are geographically dispersed. But it must be mentioned that existing ITC could produce elements of inertia or rigidity, deriving from routines that are out-dated, undesirable, and difficult to eradicate, and would resist necessary change.

A third limitation is the absence of a methodology that indicates which dormant and peripheral capabilities are to be inventoried, thus constituting a promise of future

dynamic capability. Although previous literature offers certain clues, it seems to have been left to the judgement of management. The options of whether or not to maintain dormant capabilities, and whether or not to inventory any detected peripheral capabilities, are usually studied *a posteriori*, after they have been successful in the creation of dynamic capabilities.

It is important to consider the negative impact that restructuring might have on the development of dynamic capabilities [16, 21]. The loss of key personnel in whom organisational memory resides no doubt affects the existence of dormant capabilities. On the other hand, the outsourcing of activities and processes limits the possibilities of obtaining dynamic capabilities originating from the peripheral capabilities of the outsourced process [33].

Finally, the proposed model may appear similar to knowledge management models. Nevertheless, this model underlines the role of ITC and goes beyond knowledge management, as it may include other intangible assets in addition to knowledge. Examples of these would be reputation, patents, trademark, contact networks, strategic databases [34, 35], organisational routines, etc.

7. Conclusion

The theory of resources and capabilities must consider not only core capabilities but also a whole range of capabilities, core and non-core. In addition, it must explain how core capabilities are created. The perspective of dynamic capabilities [9] takes other capabilities into account, thus possibly providing options for obtaining future core capabilities. These dynamic capabilities will allow the company to anticipate or adjust to changing environments. This paper proposes a programmatic dynamic capabilities creation model possessing two main non-exclusive generating paths. The first leading from latent or dormant capabilities [14, 15, 18, 19, 16], and the second from peripheral capabilities [36, 37].

The added value of this paper lies in its proposal of a dynamic capabilities creation model, and its study of the complementary role of ITC in this creation process. We thereby offer an integrative model for the management of dynamic capabilities, completing partial approaches described in the literature [14, 15, 16]. The function of dormant and peripheral capabilities is particularly significant, as is the role that ITC may play in this process. Finally, we outline some practical implications to help managers successfully manage the firm's capabilities.

Mata, Fuerst and Barney [13] state that ITI offers no advantage in itself, but skills in the management of ITI (ITC) may produce advantages if they enable the company to perceive, manage and exploit other capabilities that may in turn provide future sources of competitive advantage [6]. Consequently, this paper proposes a framework that shows in detail how ITC facilitate the creation of dynamic capabilities, by supporting the tasks of detection, selection, cataloguing, maintenance, reactivation, synthesis, and transfer of dormant capabilities on the one hand, and the detection, cataloguing, synthesis and transfer of peripheral capabilities on the other.

Nevertheless, the development of dynamic capabilities requires certain complementary resources and capabilities. In fact, if ITC do not integrate with complementary resources

and capabilities, it is not efficient on its own in supporting the creation process of new capabilities. Appropriate integration must occur between ITC, complementary human resources and business capabilities.

References

1. R. Amit, P. Schoemaker, Strategic assets and organizational rent, Strategic Management Journal 14, 1993, pp. 33-46.

2. R.M. Grant, The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation, California Management Review (Spring), 1991, pp. 114-135.

3. R.R. Nelson, S. Winter, An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, 1982.

4. C.K. Prahalad, G. Hamel, The core competence of the corporation, Harvard Business Review 68 (3), 1990, pp. 79-91.

5. E.T. Penrose, The Theory of the growth of the firm, Oxford University Press, New York. First edition 1958, London, 1995.

6. J.B. Barney, Firm resources and sustained competitive advantage, Journal of Management 17 (1), 1991, pp. 99-120.

7. J.B. Barney, R.W. Griffin, The Management of Organization: Strategy, Structure, Behavior, Houghton Miffin Company, Boston, 1992.

8. P. Milgrom, J. Roberts, Complementarities and Fit: Strategy, Structure and Organizational Change in Manufacturing, Journal of Accounting and Economics 19 (2/3), 1995, pp. 179-208.

9. D.J. Teece, G. Pisano, A. Shuen, Dynamic Capabilities and Strategic Management, Strategic Management Journal 18 (7), 1997, pp. 509-533.

10. B. Wernerfelt, The resource-based view of the firm: ten years after, Strategic Management Journal 16, 1995, pp. 171-174.

11. B. Lowendahl, O. Revang, Challenges to Existing Strategy Theory in a Postindustrial Society, Strategic Management Journal 19, 1998, pp. 755-773.

12. T.H. Davenport, D.W. De Long, M.C. Beers, Successful knowledge management projects, Sloan Management Review 39 (2), 1998, pp. 43-58.

13. F.J. Mata, W.L. Fuerst, J.B. Barney, Information Technology and Sustained Competitive advantage: A Resource-Based Analysis, MIS Quarterly 19 (4), 1995, pp. 487-506.

14. C. Baden-Fuller, H. Volberda, Strategic Renewal in Large Complex Organisations: A Competence Based View, Working Paper, 16th Strategic Management Society Annual Conference, November, Phoenix, Arizona, 1996.

15. C. Baden-Fuller, H. Volberda, Dormant capabilities, complex organizations and renewal, Working Paper, American Academy of Management, Boston, August, 1997.

16. R. Garud, P.R. Nayyar, Transformative Capacity: Continual Structuring by Intertemporal Technology Transfer, Strategic Management Journal 15, 1994, pp. 365-385.

17. Y. Doz, Managing Core Competency for Corporate Renewal: Towards a Managerial Theory of Core Competencies, Working Papers, INSEAD, 1994.

18. C. Baden-Fuller, J. Stopford, Rejuvenating the mature business, Routledge, London, 2nd Edition, 1994.

19. R.A. Burgelman, Fading Memories: A Process Theory of Strategic Business Exit in Dynamic Environments, Administrative Science Quarterly 39, 1994, pp. 24-56.

20. D. Ulrich, M.A. Von Glinow, T. Jick, High-impact learning: Building and diffusing learning capability, Organizational Dynamics 22 (2), 1993, pp. 52-66.

21. G. Hamel, C.K. Prahalad, Competing for the Future, Harvard Business Review 72 (4), 1994, pp. 122-128.

22. G. Hamel, C.K. Prahalad, Strategic Intent, Harvard Business Review (May-June), 1989, pp. 63-77.

23. T.C. Powell, A. Dent-Micallef, Information technology as competitive advantage: the role of human, business, and technology resources, Strategic Management Journal 18 (5), 1997, pp. 375-405.

24. D.J. Teece, The competitive challenge. Strategies for industrial innovation and renewal, Harper & Row, Publishers, New York, 1987.

25. D.J. Teece, R.P. Rumelt, G. Dosi, S. Winter, Understanding corporate coherence: Theory and evidence, Journal of Economic Behavior and Organization 23, 1994, pp. 1-30.

26. B. Wernerfelt, A resource-based view of the firm, Strategic Management Journal 5, 1984, pp. 171-180.

27. D.J. Teece, Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy, Research Policy 15, 1986, pp. 285-305.

28. J.A. Black, K.B. Boal, Strategic resources: Traits, configuration and paths to sustainable competitive advantage, Strategic Management Journal 15, 1994, pp. 131-148.

29. J. Galbraith, Designing Complex Organizations, Addison-Wesley, Reading, MA, 1973.

30. R.P. Rumelt, Inertia and transformation, In: Montgomery, C.A. Resource-Based and Evolutionary Theories of the Firm: Towards a Synthesis. Kluwer Academic Publishers, 1995, pp. 101-132.

31. I. Dierickx, K. Cool, Assets stock accumulation and sustainability of competitive advantage, Management Science 35 (12), 1989, pp. 1504-1511.

32. S.A. Lippman, R.P. Rumelt, Uncertain imitability: An analysis of internal differences in efficiency under competition, The Bell Journal of Economics 13, 1982, pp. 418-438.

33. M.A. Hitt, B.W. Keats, S.M. Demarie, Navigating in the New Competitive Landscape: Building Strategic Flexibility and Competitive Advantage in the 21st Century, The Academy of Management Executive 12 (4), 1998, pp. 22-42.

34. R. Hall, The strategic analysis of intangible resources, Strategic Management Journal 13, 1992, pp. 135-144.

35. R. Hall, A framework linking intangible resources and capabilities to sustainable competitive advantage, Strategic Management Journal 14, 1993, pp. 607-618.

36. J.D. Lorenzo-Gomez, J. Ruiz-Navarro, Reinventing core competencies in mature industries: strategic renewal in large complex organizations, Working Paper, 17th Strategic Management Society Annual Conference, Barcelona, October, 1997.

37. J. Ruiz-Navarro, Turnaround and renewal in a Spanish shipyard, Long Range Planning 31, 1998, pp. 51-59.