12 Towards a Contingency View of Infrastructure and Knowledge: an exploratory study

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INTRODUCTION

IT infrastructures coupled with BPR initiatives have the potential of supporting and enabling new organisational forms and help firms face the challenges of globalisation. The management literature gives prescriptions of how to set up, implement and use infrastructures to reach a new IT capability, diminish transaction costs and obtain competitive advantage. However, the scant empirical basis of such literature goes hand in hand with the lack of a theory linking the deployment of infrastructure to the nature of the business and the industry. This study of the deployment and use of infrastructures in six large multinationals prepares the ground for a contingency approach to the whole issue. The different implementation processes and applications reported by the case studies suggest that there is much more variety than a 'one best way' recommended by the literature. The theory of the firm as a repository of knowledge processes is a good candidate to explain qualitatively the empirical evidence, and provides a contingency framework that can be further tested.

Corporate infrastructure as a concept emerged in the 1980s in relation to the planning of large corporate information systems. It emphasises the standardisation of systems and data throughout the corporation as a way to reconcile the centralised IS department and resources on the one hand, and the distribution of systems and applications on the other. Today, managing an infrastructure to deliver effective IT capability means dealing with problems such as: aligning strategy with IT architecture and key business processes information requirements; (Henderson *et al.*, 1996) universal use and access of IT resources; standardisation; interoperability of systems and applica-

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tions through protocols and gateways; flexibility, resilience and security (Hanseth, 1996). Ideally, infrastructure reconciles local variety and proliferation of applications and usages of IT with centralised planning and control over IT resources and business processes. (Hanseth, 1996; Broadbent and Weill, 1997).

However, the more one looks at how large corporations are setting up and deploying complex IT infrastructures, often in connection with BPR projects (Broadbent *et al.*, 1995), the more the picture emerging is fuzzy: strategic alignment does not fully explain the dynamics of implementation (Ciborra, 1997; Sauer and Burn, 1997), and power games prevail over efficiency considerations (Knights *et al.*, 1997). At the limit, infrastructures seem to 'drift' (Ciborra, 1996), or being created by planning as well as by improvisation (Orlikowski, 1996).

In order to appreciate the key factors determining the dynamics of corporate infrastructures, an exploratory empirical study has been carried out in six multinationals: IBM, Hoffmann La Roche, Astra, SKF, Statoil and Norsk Hydro. The deployment and use of infrastructure has been followed up in a variety of corporate functions: Marketing; Production; R&D, etc. focusing on the relationships between headquarters and affiliates. A number of technologies and relevant business processes have been analysed, ranging from Lotus Notes platforms to office automation suites, SAP, Internet and Intranet, to dedicated systems, standards and protocol.

The data collected confirmed the initial awareness: infrastructures 'in action' differ significantly from the neat pictures provided by the management literature. For example, they cannot be classified in just three types (utility; dependence; enabling), (Weill *et al.*, 1996) since they drift from one use mode to another with no apparent logic; the implementation process is far from being straightforward, but is punctuated by opportunistic moves and power games (Murray and Willmott, 1997). A theory able to predict success or failure of an infrastructure project is still missing. So far, only recipes or maxims have been put forward: but what happens if a firm does not follow them? Unfortunately, reliance on previous empirical research and its conclusions has been of little help in explaining the cases at hand (Broadbent *et al.*, 1996). Namely, while IT infrastructure capabilities do vary according to industry, emerging applications such as Lotus Notes or SAP are being adopted across all industries. This tends to confound the evidence of a difference. While infrastructure varies with the intensity of business unit synergy, there can be very different ways of achieving such a synergy (e.g. by interlocking processes through BPR, or providing a common business template through access to Web sites). Since the planning process is so punctuated by surprises, chance and opportunistic adjustments, in none of the cases could a correlation be established between emphasis on strategic intent, management backing and infrastructure deployment. In one important case, Roche (see below), just the opposite has occurred: only by 'releasing' management tracking and control a (different) infrastructure could emerge.

This chapter attempts at linking the empirical study of infrastructure *in situ* with economic theory. Two streams of economic thinking are utilised: the economics of infrastructures, in particular standards (Grindley, 1995), and the theory of the firm emphasising the knowledge processing properties embedded in the firm's routines (Nelson and Winter, 1982). These theories are harnessed to understand what happens to corporate infrastructures in practice: how are they developed; where are they applied; what are their impacts and degree of success. The cases provide a rich, though initial and exploratory evidence to set out a new framework on which to build, and subsequently test, a contingency view of infrastructure. The key contingency factor is the nature of the knowledge processes in the business and the implementation process. The framework allows classifying otherwise confusing cases and generating further hypotheses to be tested.

THE ECONOMIC PERSPECTIVES

Two relevant aspects of the life of an infrastructure, i.e. its deployment and the type of business process to which it is applied, can be analysed by tapping economic theories stemming from industrial organisation and institutional economics.

The implementation process

Schematically, a typical management agenda concerning corporate infrastructure would entail the following:

- analysis of the firm's strategic context to elicit the key business drivers;
- a joint consideration for the need to improve or transform existing business processes and infrastructure;

- formulation and implementation of relevant BPR and technical change plans;
- envisioning changes in roles, responsibilities, incentives, skills, organisational structures required by BPR and infrastructure reforms. (Broadbent and Weill, 1997)

One should be wary of this 'one best way' kind of agenda since it hides a number of dilemmas. For example, one may ask: are there decreasing returns to infrastructure? (Cordella and Simon, 1997) Does more infrastructure investment in a changing business mean more sophisticated infrastructure or just facing maintenance and adaptation costs of an existing, rigid technology and organisation? Relatedly, is it better to build a flexible infrastructure that enables a wide range of unplanned business redesign options, or a highly consistent (i.e. aligned) infrastructure with the current strategic intent? Is there a trade-off between alignment and flexibility? Extensive studies of top managers' opinions do not lead to any clear-cut conclusion (Duncan, 1995).

The models of strategic alignment and the agendas that spell out what to do in order to extract the maximum IT capability from corporate infrastructure suggest (Luftman, 1996; Broadbent and Weill, 1997):

- Aligning business and technology strategies is an ongoing executive responsibility: 'strategic alignment is a journey, not an event';
- Managers must be ready to learn and adapt, no matter what is the alignment pattern selected at one point in time;
- There are barriers that due to political, cultural or economic factors impede the smooth implementation of any strategic plan concerning infrastructure.

While the management agendas tend to be precise in guiding the *formulation* of an infrastructure plan, they do not give any special advice on *implementation* and adaptation. They only provide words of caution, but these do not suffice to translate a sound plan into its production (Argyris and Schoen, 1996).

Economics of standards and network infrastructures, (Hanseth, 1996; Hanseth *et al.*, 1996) can overcome the sometimes narrow 'information engineering mindset' that lures in the managerial discourses about infrastructure. Consider the issue of pricing, as an example of how economics can broaden the implementation agenda. Pricing a collective good has several facets: how to let people use more pay more; how to avoid free riding; what is the trade off between universal service type of delivery vs. a customised service; how to reach a *critical mass* of infrastructure users? Who should benefit or pay for the positive and/or negative *externalities* generated by infrastructure use?

A balanced answer to such questions is a key factor for the take off and long-term development of any infrastructure. The pricing issue points to another important topic: the scope for control over an infrastructure is limited, and management have to live with a resource that they can govern only in part (pending the issue of transaction costs (Coase, 1962)). Also, the governance of infrastructure is a problem, not a given, since there can be multiple stakeholders with conflicting interests. The net result can be an infrastructure that expands and grows in directions and to an extent largely outside the control of any individual stakeholder. Building large infrastructures takes time. All elements are connected. New requirements appear which the infrastructure has to adapt to. A whole infrastructure cannot be changed instantly – the new has to be connected to the old. Hence, the old – the installed base – influences how the new is designed. Infrastructures develop through extending and improving the *installed base* (Hanseth, 1996).

A large information infrastructure is not just hard to change. It might also be a powerful actor influencing its own future life – its extension and size as well as its form. Consider the issue of 'standards' as a part of a more general phenomenon labelled 'self-reinforcing mechanisms' (Arthur, 1996) and 'network externalities' (Katz and Shapiro, 1986). A standard which builds up an installed base ahead of its competitors becomes cumulatively more attractive, making the choice of standards 'path dependent', and highly influenced by a small advantage gained in the early stages (Grindley, 1995).

Other key effects of self-reinforcing mechanisms are (Arthur, 1996):

- *Lock-in*: i.e. when a technology has been adopted it will be impossible to develop competing technologies.
- *Possible inefficiency*: i.e. the best solution may not necessarily win (David, 1987).

Information infrastructures are paradigmatic examples of phenomena where 'network externalities' and positive feedback (increasing return on adoption) are crucial, and accordingly technologies easily being 'locked-in' and turning irreversible. Designing and governing an infrastructure differ from designing an MIS, due to the far reaching influence of the installed base and the self-reinforcing mechanisms. The very scope of the management agenda changes. Infrastructure is not just a complex, shared tool that management are free to align according to their strategy. The economic perspective highlights a more limited and opportunistic agenda involving trade-offs and dilemmas, and a number of tactics. David (1987) points out three dilemmas in developing networking technologies:

- *Narrow policy window.* There may be only brief and uncertain 'windows in time', during which effective interventions can be made at moderate costs.
- *Blind giants.* Decision-makers are likely to have greatest power to influence the future trajectories of network technologies, just when suitable knowledge on which to make system-wide choices is most lacking;

An important remedy to help overcome the effects of positive feedback and network externalities, i.e. lock-in and inefficiency, is the construction of gateways and adapters (Katz and Shapiro, 1986; David and Bunn, 1988).

In sum, while from an engineering and managerial perspective the task is to design, build, align and control an infrastructure, the thrust of the economic understanding of the dynamics of infrastructures points out that 'cultivating' (Dahlbom and Janlert, 1996) an installed base is a more realistic option. The concept of cultivation focuses on the limits of rational, human control (Simon, 1976). Also, one should expect to find a variety of implementation processes when dealing with infrastructures: the actions of multiple stakeholders, and their limited scope; externalities and transaction costs, combined with the influence of non-linear development processes make the outcome of any implementation less predictable than the management and engineering literature would like us to believe.

THE THEORY OF THE FIRM

Why is an infrastructure useful? The management literature replies in rather generic terms: it is useful to run interlinked applications to process and communicate information seamlessly. Or, it supports streamlined processes. At the limit, it enhances coordination and decreases transaction costs. Unfortunately, the information engineering frameworks have so far paid little attention to the economics of the firm. As a consequence, theoretical developments about the role of core capabilities (Prahalad and Hamel, 1990); the resource-based view of strategy (Barney, 1991); the model of the knowledge creating company (Nonaka and Takeuchi, 1996) tend to be largely ignored, or just objects of superficial attention. This is a pity, since the common denominator of these theories is the study of the firm as a collection of people 'who know what to do'. 'Productivity derives in part from transaction and monitoring cost considerations, but it also depends on . . . the conditions that underlie the acquisition and use of knowledge' (Demsetz, 1993). Knowledge is embedded in the members' skills and the organisational routines (Nelson and Winter, 1982). Both tacit and articulated, it represents the key asset to obtain a sustainable competitive advantage. Firms can be looked at as 'treasuries of process knowledge' and of the specialised inputs and resources required to put knowledge to work (Boyton and Victor, 1991). Infrastructure is one of such key resources, since the very business processes it supports are the embodiment of the know how of the firm. If 'economic organization, including the firm, must reflect the fact that knowledge is costly to produce, maintain and use' (Demsetz, 1991), one can look at infrastructure as a device dedicated to lower such costs, by allowing its efficient processing, communication and accumulation.

The knowledge embedded in products, services and processes vary across firms and industries. In high-tech. firms workers are highly skilled, production processes are complex and products knowledge-rich. Other industries, e.g. the production of metal may rely on processes that are stable, based on routine knowledge. A firm, or an industry, can migrate from a knowledge-poor to a knowledge-rich business. Thus, Benetton operates in an industry traditionally considered mature and knowledge poor. However, it has succeeded in re-inventing the mature business by adding knowledge to its distribution chain, production process, marketing, etc. Moreover, Benetton's IT use suggests that the higher the knowledge content (in process and product), the higher the investment in infrastructure. In sum, the type of infrastructure does not vary arbitrarily; rather, it adapts in range and scope to the type of knowledge 'embedded' in the firm and the industry.

This exploratory study has focused on 'globalisation', a process making knowledge (creation, diffusion, utilisation) increasingly more important to deliver competitive products and services (Reich, 1991). Creating and getting access to knowledge requires closer collaboration inside an organisation, but even more so with outside partners – customers (Norman and Ramirez, 1994) as well as subcontractors. This collaboration of course needs to be supported by infrastructures.

THE COMPANY CASES

The company cases can now be reviewed in short, by presenting 'vignettes' with some impressionistic details about infrastructures, their application domains and implementation processes. The cases concern companies which are well known, and need only scant information about their industry, size, turnover, etc.

IBM

Since the second half of the 1990s IBM has been formulating and deploying an extensive fabric of new processes and tools in order to be able to operate efficiently on a world-wide basis as a global company. One of the most important is Customer Relationship Management (CRM).

CRM consists of an array of processes that streamline all the activities between IBM and its customers across markets, product lines and geographies. It affects more than 120 000 employees world-wide and it is based on a variety of existing and new systems and applications. CRM is supposed to be the backbone for the completion of any business transaction: from the early opportunity identification to the order fulfilment and customer satisfaction evaluation. The main components of CRM, processes, roles and IT tools, represent the infrastructure of the new, global IBM. Indeed, internally CRM is nicknamed the 'plumbing' of IBM.

Various management units and practices are dedicated to the strategic management and operational deployment of CRM. Backed by full top management support its implementation has been going on for four years. However, from the initial top-down approach, management has shifted to a more opportunistic attitude, trying to fix gradually the sources of resistance emerged during the long deployment phase. The IT platform has not delivered the expected support so far, because of the huge installed base of pre- existing applications. While the development from scratch of a totally new IT infrastructure is out of question, new hope comes from commercial applications such as Lotus Notes and SAP.

SKF

SKF is a Swedish multinational that produces bearings. It is operating in more than 130 countries, with production at more than 80 different sites. Its employees are 43 000. SKF has grown from its initial 15 employees in 1907 rather slowly, by successfully developing its organisation and information technology in a gradual way. For example, already in the 1970s it began securing its own global communications infrastructure (based on the SNA protocol). In the 1980s it standardised its information systems into an integrated ‘common systems’ set. In the 1990s it introduced process orientation in production and distribution. The infrastructure built over the last decades allows SKF to run global forecasting and supply systems through a variety of corporate applications, message transfer systems and satellite links. For example, the International Customer Service System, installed in 1981, provides a key global interface between the sales and manufacturing units. Other systems are dedicated to master production scheduling; manufacturing; and finance. What is striking is that SKF seems to have always focused on production, and has developed its infrastructure as a Management Information System for global production control. Sometimes, ambitious applications, expected to provide rich information on production processes and products, have been abandoned in favour of more basic versions.

Thanks to its hefty market share throughout the decades SKF has been able to grow gradually and build its infrastructure accordingly. On the other hand, its information systems do not strike the observer as sophisticated or state of the art. Recently, however, SKF has increased its focus on customer service, having implications for its infrastructure. Ford, for instance, wants SKF to access their stock control systems twice a day to figure out their needs for bearings. Unitor, distributing bearings (among other products) to ships requires SKF to deliver any bearing at any harbour within 24 hours and easy access to SKF’s technical expertise (which means using modern telecommunications).

Norsk Hydro

Norsk Hydro (NH) is a diversified Norwegian company, founded in 1905. Since 1972 its income has grown from kr1billion to kr85billion.

Besides its original fertilisers business, it produces light metals, oil and gas. The business divisions have enjoyed a high level of autonomy. Independent IT strategies and solutions have been the common practice, although a corporate IT department has been there for quite some time. Since the late 1980s the main goals of corporate IT have been:

- unified solutions to avoid duplication of efforts among the divisions;
- infrastructure standards;
- sharing competence in systems development.

To achieve these goals institutions important for building consensus were created. Consensus was reached about the need for a common protocol (TCP/IP), and a corporate standard concerning office automation applications. Since some of the new divisions were 'allergic to mainframes', the common standard (called Bridge) referred to desktop and communication applications only. Building the Bridge platform was a slow and difficult process because of the highly decentralised way in which PCs had been purchased and applied by the divisions. Today, there are about Bridge 20 000 users. Over the years, however, with the proliferation of systems and applications (Windows, new Operating Systems, Networks, etc.), the Bridge has become an umbrella infrastructure, losing its initial focus on desktop applications. Several functions are duplicated (Lotus and Microsoft desktop products, Notes mail and cc:mail, Notes data bases and Web, etc.).

Throughout the 1990s collaboration and knowledge sharing between divisions as well as outside organisations (like engineering companies in the oil sector) has been increasingly focused. Lotus Notes and the rest of Bridge are seen as important tools supporting this. Notes use has been supported by the development of an infrastructure of more than one hundred servers. Beyond that diffusion has been based on local user initiatives. After a slow start, Notes use gained momentum. Currently about 1500 applications are in operation.

Variety does not occur among the divisions only. Even within each division solutions may differ. For example, Hydro Agri Europe, the largest division, has grown in the 1970s and 1980s through the acquisition of fertiliser companies all over Europe. In line with traditional NH management policy, the new companies were run 'hands off'. But lowering margins urged management to integrate and streamline operations across Europe through an ambitious re-engineering effort. To support this IT management initiated the development of a new infrastructure for the whole division, in which SAP played a key role. Lately, the BPR project has been discontinued and subsumed into the SAP project. The latter is proceeding slowly due the complexity involved in unifying existing work practices, the installed base of technology that still has to be in operation, and the new SAP solution.

To get the best possible services for SAP processing, it was decided to outsource IT operations. This, however, caused incredible trouble for the operations of the Bridge infrastructure.

Statoil

Statoil is the State of Norway's oil firm founded in 1972; it has 17000 employees and operates in 25 countries. The post gulf war period and the ensuing recession in the oil industry triggered major re-organisations in most of the large oil companies. Statoil was no exception embarking in cross-functional projects to cut operational costs. Cost savings affected also IT, at the time seen as an expense item. Thus Lotus office automation software was chosen mainly for price reasons. The early adoption of Lotus Notes was due to mere chance. The upturn of the economy and a major oil field discovery gave a new self-confidence to the young company. The newly centralised IT unit (Statoil Data) benefited of the new atmosphere. The initial small-scale phenomenon of LN grew to the point of making Statoil one of the largest user of LN world-wide. The process of LN diffusion was punctuated by various episodes of mobilisation and alignment of different actors: the advanced technology group, corporate IT and functional management. Notes has been spread based on a combination of centralised push and grass root activities. Today, after several waves of consolidation, there are more than 1200 applications of LN throughout the company. Some support key processes like project management, exploration and production (including applications for knowledge transfer among functions and projects).

Astra Haessle

Astra Haessle is a relatively small (about 1500 employees) research company belonging to the Swedish multinational Astra. It is a newcomer in the pharmaceutical industry, but extremely successful thanks to its leading drug against ulcers. The company has been undergoing major BPR initiatives aimed at speeding up of the product development process. IT has been seen as a key component of such redesign. For example, a major project was launched aimed at squeezing time during the clinical trial process. A new IT infrastructure comprising hand held terminals and sophisticated networks supported remote data capture in 500 centres in 12 different countries. Though conceived and planned centrally, the project suffered from the fact that the initial analysis model was not effective in representing all the facets of the remote data capture operations. In particular the large size and the role of the installed base of computing equipment at these sites were ignored. Formally, all the projects are still on going and successful: still, very little is being deployed on a full scale.

ROCHE (1 and 2)

In Hoffmann La Roche (Roche) objects of study have been two different infrastructures in Strategic Marketing (here named Roche 1 and 2).

Roche 1

In the 1980s Strategic Marketing championed the establishment of the first corporate network. The purpose of the network and its applications, that went under the name of MedNet, was to support the new, global Marketing function.

The infrastructure was developed independently from corporate IT. This led to duplication of efforts and competence shortages at the time when standard commercial solutions were not yet available. The network was developed before Windows. This slowed down the overall development and lead to huge project costs. This caused the uneven level of adoption in the affiliates, since an affiliate had to invest significant resources to be able to use the network. After eight years of development the acceptance of the main applications (consulting medical literature; accessing clinical trials data; office automation) was low (with the exception of e-mail), and generated frustration ('we would never do it again, had we to start it today'). Some affiliates were even developing systems of their own, on distinct platforms.

MedNet was a breakthrough, but not for its expected results. Rather, it heralded a cultural revolution within Roche: IT used for networking, not just data processing. After almost 10 years from its launch MedNet was discontinued. Its negative aspects, especially costs, dictated its end. However, it survived as a network infrastructure. What was phased out was the application portfolio.

Roche 2

Today, the new infrastructure emerging in Strategic Marketing is composed of Intranet/Internet sites, conceived and developed by the 'Therapies'. A Therapy is a semi-autonomous team of highly skilled managers who craft the marketing policies world-wide, and provide product know how to the national affiliates.

With minimal coordination and direction, each Therapy has developed or is developing Web sites for internal and external communication. Style, approach and contents may vary sharply for each team. One striking features of the Web sites is their interaction with constituencies outside Roche. Namely, for some diseases external constituencies such as associations, lobbies, doctors, up to individual patients exert their voice and have a relatively high degree of horizontal communication on the Net. In response to the outside initiatives, some Therapies have created Internet Web sites directed to the public as part of a new marketing mix. When MedNet was still in existence, Internet had been kept at bay because of confidentiality concerns, in a company known for its secrecy. But, the Internet infrastructure gained ground and ultimately won because its use was backed by a global scientific community which crosses company and institutional boundaries when they need to exchange knowledge.

A NEW FRAMEWORK

The snapshots above give only a first impression of the variety of applications and business contexts. In some cases implementation is taking a number of years and the applications of the infrastructure are still incongruous in the daily work flow (IBM and Astra). Full backing from top management is no guarantee of immediate or long-term success (IBM and Roche 1, respectively), or fast implementation (IBM and Astra). A totally decentralised development process can actually lead to a self-feeding diffusion (Roche 2). While in the latter case infrastructure is an enabling one, for SKF it is simultaneously utility, dependence creating and enabling. *De facto* opportunistic implementation led to partially decentralised support of business processes in Norsk Hydro and Statoil.

One way to find a logic in such disparate results is to rely on what has emerged from the economic theories. Specifically, consider:

- the implementation process, i.e. the way the firm learns how to develop the infrastructure;
- the knowledge processes being supported or enabled by the infrastructure.

The implementation process can unfold from the 'top down', as prescribed by the management literature; be 'fragmented', when top-down initiatives get diluted by the organisational context and pursued in more adaptive, *ad hoc* ways; or, 'grass roots' where no plan or pretension of central control exists.

Knowledge processes can be of three main kinds: 'routine' knowledge characterising business processes whose execution does not need each time the processing of new knowledge; 'recombination', i.e. sharing and re-using 'standardised' knowledge packages; and 'emergent', where new knowledge has to be created continuously to cope with the requirements of knowledge-intensive processes and products.

Relying on these two dimensions a 'knowledge matrix' can be built. On this matrix the company cases can be placed, as shown in Table 12.1.

The reasons justifying in detail the qualitative classification of the cases on the knowledge matrix cannot be reported here. However, empirical evidence suggests the following relationships. The firms positioned on the diagonal seem to enjoy a good match between the way the infrastructure is developed and the nature of the business to which it is applied. In this way it is possible to reconcile apparently opposite styles of implementation (think of SKF and Roche 2),

Table 12.1 The cases classified on the knowledge matrix

Knowledge type/ Implementation process	*'Routine'*	*'Rec ombination'*	*'Emergent'*
'Top-down'	SKF	Roche 1, IBM	
'Fragmented'		Norsk Hydro, Statoil	Astra
'Grass root'			Roche 2

and their successful outcomes. The firms lying outside the diagonal seem to suffer from some form of 'mismatch'. Roche 1 has been a failure because a top down implementation was coupled with a structured way of packaging knowledge, in a business that is knowledge intensive. This can also explain why the IBM infrastructure does not fly as fast as expected, even with strong top management support.

The empirical material also illustrates a trend where the companies are moving towards the lower right corner of Table 12.1 as a part of their strategy for being more competitive globally. This corresponds to the theoretical arguments presented above. We can not conclude, however, that 'grass root' activities and absence of top management will guarantee success in infrastructure development. Although centralised management control often works poorly, coordination of infrastructure development is indeed important. What seems to work as an efficient coordinator is a powerful installed base of infrastructure gaining momentum (Hughes, 1987), serving as fertile soil for cultivating new ones. This is what happens in the rapid growth in use of Internet in Roche and Notes in Statoil and Norsk Hydro. This phenomenon is exactly the mechanism at work in the rapid development of the Internet as a universally shared infrastructure.

CONCLUSION

The study of six multinationals using large infrastructures to achieve globalisation and streamline processes confirms the scepticism towards the too coarse information engineering and managerial models found in the current literature. The reality of infrastructure projects in large corporations is more intertwined and intriguing. One way to make sense of the evidence gained from the present empirical study is to rely on a more robust theory of the firm and infrastructure building. The economic theories selected have confirmed that one is bound to find a variety of styles of implementing and using infrastructures as a resource to manage knowledge in organisations. Theorising has led to a knowledge matrix that classifies empirical cases and predicts the problems an infrastructure may encounter in different businesses. The stage is then set for further empirical research, both quantitative and qualitative, to enlarge the body of working hypotheses and confirm/disconfirm the results gained so far.

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