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### **Short-Term Gain, Long-Term Pain? The Long-Run Implications of Outsourcing for Organisational Innovation and Productivity**

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# **Short-Term Gain, Long-Term Pain? The Long-Run Implications of Outsourcing for Organisational Innovation and Productivity**

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## **ABSTRACT**

The paper examines the relationship between organisational innovation, the introduction of new internet-based ICTs, de-verticalisation, and the rapid growth in business service outsourcing over the last decade. In order to examine this issue, a model of organisational innovation is developed. In this model, the goal of managers is to identify an organisational design that more effectively integrates all the administrative activities of the firm. As part of the process of innovation, the managers can choose to carry out an administrative activity in-house or to outsource that activity. Key factors influencing this decision are the relative information costs of organising activities internally and the information costs associated with setting up and maintaining interfaces with external suppliers. The framework is examined within the context of a novel model of organisational innovation. Simulations conducted on this model enabled us to consider the short- and long-run impacts of outsourcing on administration overheads and on long-term productivity growth. An interesting finding is that managers of a firm can become locked into a low productivity growth trajectory, associated with the outsourcing of activities, if they are myopic and learn through their own actions. They perceive outsourcing to cut overhead costs in the short-run (as expected), and so engage in further outsourcing thereafter. This is to the detriment of long-run productivity gains (system economies) generated through organisational innovation. This occurs because the potential for organisational innovation is reduced when modular components are outsourced, placing them beyond the control of the firm's management. The findings accord with the empirical data, and provide a salutary warning to managers and policy-makers about the potential long-term implications of outsourcing.

Keywords: Outsourcing, organisational innovation, long-run productivity development

## **1. Introduction**

This paper examines the relationship between organizational innovation, the introduction of new internet-based ICTs, de-verticalisation, and the rapid growth in business service outsourcing over the last decade. Data are presented on a range of activities that are being outsourced. A set of potential advantages associated with outsourcing activities to knowledge-intensive service providers is discussed. The latest empirical studies are also examined; these highlight a set of potential disadvantages associated with outsourcing. The studies suggest that outsourcing may have advantages in the short run, but have negative long-run implications for competitive performance.

In order to examine this issue, a model of organisational innovation is developed. In this model, the goal of managers is to identify an organisational design that more effectively integrates all the administrative activities of the firm. As part of the process of innovation, the managers can choose to carry out an administrative activity in-house or to outsource that activity. Key factors influencing this decision are the relative information costs of organising activities internally and the information costs associated with setting up and maintaining interfaces with external suppliers. Herein lies the importance of new ICT. The introduction of new ICTs can alter the relative costs of internal and external administration. This captures a key stylised fact about knowledge-intensive business services (KIBS), such as business consultants, financial services, and ICT services: the rapid expansion of KIBS over the last decade is strongly connected the introduction and diffusion of internet-based networking ICTs.

The paper is organised as follows. Section 2 introduces the key concepts of organisational design and organisational innovation. It then outlines the core theoretical approach that is used to conceptualise organisational innovation. This is based on a modular theory of the firm, which is founded on the twin principles of increasing specialisation and the modularisation of complex organisational structures. Increasing the modularity of the

organisational structure not only leads to improvements in efficiency through specialisation, but enables a firm to realise systems economies, thereby pushing ahead the productivity frontier. At the core of the theoretical framework is a transmission mechanism between ICT adoption, organisational innovation and outsourcing. Using this theoretical framework, it is possible to discuss critically the long-run implications of outsourcing on productivity. Section 3 reviews recent empirical studies in order to identify a set of potential benefits and potential disadvantages associated with the outsourcing of activities to business services. It addresses, in particular, new empirical evidence that suggests that outsourcing can be detrimental to the innovative capacity of firms and, hence, have a negative impact on their long-run productivity growth. Section 4 describes the simulation model and the outputs it has generated. The model is used to investigate the manner in which the outsourcing of activities restricts the long-term opportunities for organisational innovation, leading to lower productivity growth. Section 5 pulls together the overall findings of the paper and points to interesting directions for further research.

## **2. Organisational Innovation**

The goal of organisational change is the identification of an organisational design that integrates more effectively all the administrative activities of the firm. An organisational design is a hierarchical structure that solves two key problems faced by managers. The first is the ‘fundamental co-ordination problem’; namely, how to organise the value-adding activities and information flows of the firm most effectively in order to maximise profit. In addition, managers need to resolve the ‘agency problem’: to realise and enforce co-ordination and control in production, both internally and across the boundary of the firm.

Organisational innovation involves the search for new organisational designs that alter the internal organisational structure of the firm, and change the boundary between the firm and markets (verticalisation/de-verticalisation). As just described, it is a search process that is

conducted within a complex search space containing many dimensions, and in which the dimensions are related to one another in highly non-linear ways. Dealing with this organisational complexity requires managers to engage in ongoing strategic experimentation and learning. It is this ongoing problem-solving activity that drives organisational change and innovation over time.

Our analysis is based on a modular theory of the firm, developed in recent work by Langlois and Robertson (1995), Baldwin and Clark (1997), Langlois (2002, 2003), and Marengo and Dosi (2005). The theory brings together Adam Smith's principles of specialisation and the division of labour (Smith, 1776), and Herbert Simon's discussion of complexity and the near-decomposability of complex problems (Simon, 1996, 2002), and provides a useful means of discussing organisational change and innovation. This theory is used to identify the set of conditions under which modularisation is associated with outsourcing to specialist KIBS, and to consider the impact of new ICTs on the decision to outsource.

Simon (1996, 2002) provides an important insight into problem-solving activity in general. He provides us with an idea of how problem-solving activity occurs in complex systems. Simon suggested that complex problems can be made more manageable by breaking them down into a set of constituent parts, or 'modular components'. In this way, the number of distinct elements in a system is reduced by grouping them into a smaller number of sub-systems. The great advantage of modularisation is that improvements can be made to one sub-component of the system without the need to change all the other parts of the system (as would be the case if there were no modularisation). There are costs, however. These are associated with the establishment and maintenance of organisational interfaces between sub-components. These interfaces enable a sub-component to function compatibly with all sub-components. This ensures the organisational structure as a whole functions in an integrated way, while maintaining a high degree of independence for each sub-component. Given these considerations, the task for management seeking a better division of labour becomes the identification of sub-systems, the

establishment of linkages between distinct sub-systems, and understanding, managing and codifying their interactions. First, they have to find out how to decompose its value-adding activities and, second, how to co-ordinate the sub-systems. Through successful modularisation, a complex system is then transformed into a nearly decomposable one.

To this theory, the concept of ‘system economies’, which was introduced by Nightingale *et al.* (2003), is added. The interpretation of system economies here is that these are mostly due to an improvement in the control of a given set of productive activities and, hence, they operate at the meta level. Managers of the firm seek to improve productivity by re-organising the way in which these value-adding activities interact. This productivity improvement is gained through the implementation of a more effective organisational design. Organisational innovation, the process through which new designs are devised, involves either splitting the administrative tasks into more organisational modules or the integration of organisational modules to increase control of the modular elements and their interaction. A superior organisational design improves the co-ordination and control of goods, traffic, materials, funds, services, and information that flows through the complex supply, production and distribution activities of the firm. In this way, better organisational designs (that is, more effective modularisation schemas) increase the utilisation of the firm’s installed productive capacity. Innovation begets further innovation. Through organisational innovation, managers gain a more specific view of the different activities of the firm, and see the potential creative opportunities that arise through breaking down ‘departmental silos’ and creating novel synergistic activities (that is, new organisational combinations). For example, the creation of stronger interactions between the sales and production departments can lead to new product opportunities being realised. These in turn may lead to economies of scope and, if it is possible to develop new markets, economies of scale. This builds upon an argument put forward by Baldwin and Clark (1997): the more modular the organisational design, the greater the likelihood of stimulating new inventions; that is,

innovation in products/services, distribution, and the other key value adding activities of the firm.

It is suggested here that the extent of organisational specialisation ultimately depends on a number of demand- and supply-side factors. On the demand side, it depends on the extent of the market (that is, increases in population and income), and the degree of competition (the elasticity of demand) (Young, 1928). On the supply side, it is affected by the availability of ICTs that enable activities to be subdivided and co-ordinated, and which enable managers to deal with the agency problem. To do this, managers must be able to generate information on the parts of the organisation for which they are directly responsible, and to exchange between them information on those different parts of the organisation. Together, the demand- and supply-side factors determine the extent to which activities can be effectively modularised and technical hierarchies established.

A number of issues can be discussed within this theoretical framework. To start with, the framework clarifies the relationship between new ICTs and more effective administrative control leading to system economies. The application of new, improved ICTs enable further modularisation of the organisation to occur by lowering the cost of managing and controlling information; this can lead to increased system economies (Brynjolfsson and Hitt, 2000). It was Chandler (1962, 1977) who first claimed that technology directly affects organisational structure. His observation goes to the heart of the present discussion. New ICTs alter the set of feasible technological opportunities in production and the division of labour (the fundamental co-ordination problem), and the opportunities for effective co-ordination and control within and across the boundary of the firm (the agency problem). These alter the relative efficacy of holding activities in-house and outsourcing. Depending on the particular vintage of ICTs, technological opportunities and cost reductions may stimulate verticalisation or de-verticalisation.

Internet-based ICTs enable the external co-ordination costs of the firm to be significantly reduced. This opens up new opportunities for outsourcing to occur within new, or experimental, organisational designs. Over the last decade, a new generation of ‘networking’ ICTs (built on open web and internet protocols) have provided the means by which firms can radically re-organise interactions with firms along the supply chain. It has opened up previously inconceivable levels of interaction between companies. This includes new opportunities for outsourcing to specialist KIBS providers. The networked corporation has emerged as a consequence of inter-firm networking activities along the supply chain. This has led to a flattening of the hierarchy of the firm, a tendency towards vertical disintegration, and for individual business units to become smaller in size.

It is important to note that the relationship between new ICTs and outsourcing is not simple. Certain types of new ICTs may decrease both the internal and external costs of communication. Internet technologies, for example, lower the cost of internal administration (through applications such as intranets) as well as reducing the administrative cost of external interaction. Others reduce internal costs only. As discussed by Reinstaller and Hölzl (2004), ICTs that were limited in their application to internal administrative activities (such as calculators, typewriters, Hollerith electric tabulating machines, and book-keeping machines) played an important role in the development of u-form and m-form hierarchies. Chandler (1977) and Yates (2000) have discussed the way in which these technologies were essential for the emergence of the modern hierarchical organisation in the period between the 1850s and the 1930s. Large corporations were the key purchasers of these new ICT technologies, and these technologies in turn further enhanced their ability to grow in size, with a tendency towards vertical integration and the greater centralisation of activities by bringing activities in-house, increasing the hierarchy within the firm.

A second issue that is of central importance in this paper is the long-run implications of outsourcing for firm performance. On the one hand, as discussed, internet-based technologies



reduce the cost of setting up organisational and information-based interactions with KIBS. This makes the outsourcing of activities that can be delivered more cheaply by the external supplier possible. At the same time, outsourcing reduces the internal administrative overhead of the firm. However, there are limits to the benefits of modularisation. To start with, while internal administration overheads are reduced, external administration overheads rise because an effective interface with the external provider needs to be set-up and maintained. The net benefit, in terms of administrative overheads, depends on whether the cost of the external interface is greater or lower than the cost of the internal interface. This is the non-separability effect discussed by Steinmueller (2003), and Miozzo and Grimshaw (2005). They suggest that the governance structures that oversee the interface interactions between client and supplier represent large, sunk investments. Consequently, suppliers are not easily substituted.

A more important potential disadvantage is the impact of outsourcing on the client's long-run potential for organisation innovation and, hence, on its long-run productivity growth. To understand this, the transmission mechanism just discussed can be applied. If new, internet-based ICTs significantly reduce external administration costs compared to internal ones, there is a stimulus for outsourcing. However, by outsourcing, the set of internal activities under the direct management of the firm is reduced. This reduces the set of modular elements with which managers can experiment and innovate to create new, more efficient organisational designs. In the long run, this can lead to lower productivity growth in the client firm. Prencipe (1997) and Brusoni *et al.* (2001) stress the need to retain control over R&D, not just for the activity itself, but because it is important to maintain control of the co-ordination of R&D, design and manufacturing activities.

### **3. Potential Advantages and Disadvantages of Outsourcing**

The 1990s saw a dramatic rise in the number of specialised business service firms. The sheer range of activities that are being outsourced is highlighted by McCarthy's (2002) study of

outsourcing by US firms. These activities not only include basic back-office activities such as payrolls, but they also include advanced, back-office activities such as legal services, and client-facing front-office activities in sales and marketing. The purchase of business services from external providers raised the performance of client firms in both services and manufacturing. While acknowledgement of the role played by business services in economic development is not new (see, for example, Greenfield, 1966), empirical studies of their impact are. For example, Windrum and Tomlinson (1999) tested the contribution to services and manufacturing of knowledge-intensive business services (KIBS) such as business consultants, financial services, and ICT services. Using input-output data from 1970 to 1990, they examined Germany, Japan, the Netherlands, and the UK. KIBS were found to have a positive impact on both service and manufacturing sectors in all four countries over the twenty-year period. Similar findings have been identified in studies by Drejer (2001), Peneder *et al.* (2003) and Tomlinson (2003). So, while the use of business services has grown rapidly, their use is not new.

A number of studies have sought to identify the key drivers for outsourcing. One of the best known is in the Morgan Chambers study of FTSE 100 firms (Morgan Chambers, 2001). In addition, there is The Outsourcing Institute's study of outsourcing in Japan (Outsourcing Institute, 2005). Taken together, these studies present a remarkably consistent picture. These are presented in Table 1 below. We see that the top three drivers are the same in each study. These are, in order, the reduction of operating costs, improving the focus of the business through a re-organisation of the activities that are conducted in-house and those that are externally sourced, and access to skills and technologies that are not held in-house. In both surveys, these three drivers together accounted for more than 60 per cent of all responses.

**Table 1. Drivers of Outsourcing in Rank Order**

Morgan Chambers Study	Outsourcing Institute Study
Cost saving	Reduce and control operating costs
Focus on core business	Improve company focus
Access to skills and technology	Gain access to world-class capabilities
Risk management	Free internal resources for other purposes
Quality service improvement	Resources are not available internally
Change enabler	Accelerate reengineering benefits
Business development	Function is difficult to manage/out of control
Other	Make capital funds available
	Share risks
	Cash infusion

These three key drivers have also been highlighted in the literature on KIBS. KIBS provide their clients with high-quality information on new business opportunities, new trends in the market place, and the business potential of new technologies, such as new ICTs. Through the outsourcing of specific inputs to KIBS, clients can improve productivity and competitive performance as existing in-house inputs are substituted for higher-quality, externally sourced inputs. Third, KIBS are exemplars of novel business models. They provide a concrete illustration of new business models and, through their ongoing relationship, introduce clients to these new ways of working and to new technologies. Antonelli (1998), for example, has highlighted the role of KIBS on the diffusion of new ICTs. KIBS are leading advocates of new, internet-based technologies because these technologies enable them to interface more effectively with clients and, as a consequence, to intermediate more effectively experience, information and knowledge between clients. In this way, KIBS have become key intermediaries, improving the efficiency and speed of learning within innovation networks.

As noted in section 2, a set of potential disadvantages associated with outsourcing exists. One potential disadvantage of outsourcing is its negative long-run implications for organisation innovation and, hence, long-run productivity growth. An empirical study based on a large-scale survey of large and medium-sized Swedish manufacturing and service firms has been conducted by Bengtsson and von Hartman (2005). They found that companies' evaluations of the direct

effects of outsourcing, for example, cost reduction through a diminution in the numbers of those directly employed, were fulfilled. However, management and administrative functions were not reduced. Indeed the firms report a strongly negative impact of outsourcing on logistics – for example, manufacturing lead times, delivery times and accuracy. They also report adverse effects on quality and the ability to adapt to customer demands. These key findings indicate that outsourcing is accompanied by more complex logistics, increasing the internal administrative overhead. Bengtsson and von Hartman report that these logistics problems were more common among amongst companies that outsource to low-cost countries.

These findings are supported by research conducted by other authors. First, it is observed that the contract needs to be monitored and measured carefully. This can prove expensive, and, indeed, increasingly so if skills in the client firm are lost over time (Domberger, 1998). Second, governance inseparability between client and supplier means considerable investment in interpersonal and administrative relations between the firms is necessary in order to support the new division of labour (Steinmueller, 2003; Miozzo and Grimshaw, 2005). Third, poorly delivered services will negatively affect the client's production or, where end-user services are delivered, the client's brand and reputation (Hinks and Hanson, 2001). Fourth, the security of sensitive information needs to be considered, with an increased risk of exposure of the clients' sensitive internal information (Mylott III, 1995). Fifth, there are well-documented cases of knowledge and information, acquired by the service provider, being shared with the clients' competitor firms. Clients believed that services and information would be proprietary, while the service providers saw the transactions as the basis for further business within the client's industry.

Of course, it is not just low-skilled activities that are being outsourced. Complex production and advanced R&D are also being outsourced. The inseparability of ICT from production means suppliers are not turn-key, that is, they cannot be easily substituted (Miozzo and Grimshaw, 2005). Prencipe (1997) highlights the dangers of outsourcing activities based on

simple notions of core and non-core competences. The outsourcing of what today appear to be non-core competences can seriously impair the development of new (core) technological competences in the future. Separation of development and production hampers innovation. Brusoni *et al.* (2001) emphasise the importance of retaining control over R&D, and the ability to co-ordinate the R&D, design and manufacturing activities of suppliers.

To summarise, a growing body of empirical research exists that suggests that the short-run gains of outsourcing may be more than offset in the longer term, leading to lower long-run productivity growth. This paper has formulated a theoretical framework for understanding these dangers; one that links organisational innovation with the adoption of new ICTs and with outsourcing opportunities. The framework enables us to identify a specific transmission mechanism between ICT adoption, organisational innovation and outsourcing. Further, the framework explains why outsourcing can have a negative impact upon organisational innovation and productivity in the long run. Specifically, the outsourcing of activities reduces the total set of modular elements that can be experimented with in the future. With fewer components under their control, managers are unable to experiment with all possible organisational combinations. The danger is that this precludes the ability to discover more efficient organisational designs. Hence, the firm can become locked in to a sub-optimal design space. If this is the case, then the outsourcing firm will suffer lower growth in productivity than if it had not outsourced (and the entire space of organisational designs could have been explored).

#### **4. The Modelling of Organisational Innovation, Outsourcing Strategies and the Impact of ICTs**

We have developed a model that captures the most important of the recent theoretical developments discussed in Section 2 of this paper. Here we use the model to study the effect of internet-based ICTs on outsourcing, organisational innovation and long-run productivity. New possibilities arise because internet-based ICTs reduce external co-ordination costs. We shall not,

in this paper, examine co-invention and co-production. Instead we focus on the outsourcing to KIBS of knowledge-intensive co-ordination and management activities, which have been highlighted in the empirical data discussed above. This includes, for example, the outsourcing of IT services to specialist KIBS providers. We examine the long-run implications of this type of outsourcing activity on organisational innovation and, consequently, productivity growth.

The model differs to standard economic models in three respects. First, it embodies the idea of a partially non-separable organisation and technology for the firm. Second, and in line with recent work on the theory of the firm and organisation, it views organisational change as a process of re-modularisation. Third, it assumes that firms are boundedly rational and learn adaptively from past experience. The first and third assumptions mean the model cannot be solved using closed-form analytical techniques, but must be investigated through simulation modelling.

At the heart of this model is the idea that management and business activities deliver services to production activities by fostering their productivity. Therefore, management has an incentive to improve the organisation and quality of managerial and administrative processes or ‘services’. It is assumed that management and administration are organised into teams. This implies there are inherent problems of control and co-ordination due to interdependencies and complementarities between the single activities or members in each team. As a consequence, the resulting organisation or technology is non-convex and cannot be optimised component-wise. Only if the organisation is modularised, that is, when teams are broken up and the specialisation of activities is fostered, is piecewise optimisation possible. To achieve this, the sources of interdependencies need to be identified, broken up and replaced by standardised interfaces, such that each modularised activity becomes interchangeable. This has been worked out in detail by Reinstaller and Hölzl (2004). We implement these ideas in a simple way by drawing on ideas developed by Altenberg (1995). It is assumed that the administration of a firm consists of a number of teams. Each team is represented by a vector in which each element is drawn from a

uniform distribution with values bounded between 0 and 1. The values reflect the performance of these activities, which may be interpreted as an index that captures how far each activity is from its (theoretical) productivity frontier for given skill levels and technical equipment.

The productivity of management and administrative activities is difficult to measure. It is assumed that it is reflected in their capability to reduce the labour cost of productive (or shop floor) activities. If one of the elements in the vector (one of the team members or one of the activities in a team) is changed by replacing it with a better performing element, non-separability means there are changes in all performance values in that vector (that is, for each element a new draw is made). The average performance of a team is given by the average value over all elements constituting it. This implies that it is more difficult to change performance for a larger team than for a smaller team.

In the present model, the management tries to solve the problems of co-ordination and control by introducing organisational innovations that allow it to control single activities in better ways. There are three possible innovation strategies:

1. The first strategy is 'split'. Here a large vector is split into smaller vectors and a neutralising interface connects the smaller teams within a new organisational process. This division of labour/specialisation process enables management to raise performance.
2. The second strategy is 'replace'. Here work performed by an existing team is improved by replacing its old working routines with the new, improved ones.
3. The third strategy is 'integrate'. This involves job enrichment strategies, combining activities and creating beneficial synergies, in order to improve productivity.

The probability of choosing any one of these strategies changes endogenously through reinforcement learning, as described by Arthur (1991). This means the weight of the probability of a strategy to be chosen by the management increases or decreases as it proves to be more or

less successful in improving the performance of managerial activities. Another aspect of organisational innovation discussed in Section 2 of this paper is that the literature on modularity assumes that innovativeness increases as a function of the degree of decomposition of organisations (see, for instance, Langlois 2002). It is, therefore, assumed that as the modularity of the organisation increases firms may invest in R&D to explore new innovation possibilities that increase the performance of all management activities. Following Silverberg and Verspagen (1994), these innovations are modelled as a Poisson process where the arrival parameter depends on the modularity of the activities.

In line with the discussion in Section 3 we study the comparative dynamic behaviour of the model with respect to two parameters. The first parameter is the outsourcing propensity of the management (denoted as ‘OSP’ in Figure 1). Altering the value of this parameter enables one to assess its impact on the dynamic behaviour. The outsourcing propensity captures the risk attitude of management, that is, its risk position towards the potential gains of outsourcing set against the loss of in-house managerial/administrative competences. Business service providers are assumed to have cost advantages over the firm in the production of certain services (see Box 9 in Figure 1). The process of outsourcing involves the service provider and the outsourcing firm negotiating a contract for the delivery of a specific service (for example, the management and delivery of specific IT services), at a specified price. If the outsourcing firm enters this contract, it shuts down its own activities and loses these competences. To simplify, it is assumed here that these are lost forever. This strong assumption is not necessarily unrealistic. Empirical evidence indicates it can be extremely difficult and expensive to re-acquire competences, especially in knowledge-intensive activities.

### *Administration*

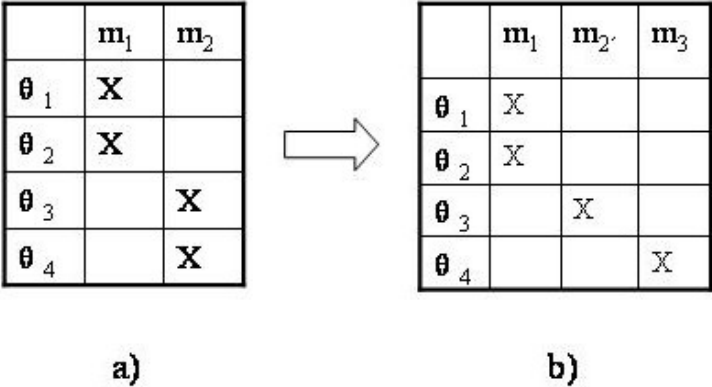
Figure 1 shows how an organisational design is conceptualised here. It is assumed that the administration of a firm delivers services to productive activities that eventually generate the



value added by the firm. The quality of these services,  $\theta_1$  to  $\theta_4$  in Figure 1, has an impact on the performance of productive activities. These services are produced by organisational activities  $m_1$  and  $m_2$  (see Figure 1a) which produce a subset of all services. More generally, the organisation of a firm consists of a set of  $n$  organisational modules or activities  $m_i$  grouped into an organisational design  $d = \langle m_1, m_2, \dots, m_n \rangle$  that delivers a vector  $\theta$  of  $k$  services to productive activities in the firm. The array  $d \in D$  corresponds to one organisational design, which is drawn from a finite space  $D$  of organisational designs. These are explored by management over time.

Each of the activities present in a design consists of  $\ell_i$  sub-activities or  $m_i = \langle x_k \rangle_{k=1}^{\ell_i}$ . The number of sub-activities  $\ell_i$  in each of these modules may vary, but it is assumed that each affects exactly one of the  $k$  output characteristics. Each larger activity in turn affects some subset of the services to the productive activities. Together these output characteristics meet well-defined customer needs in the market in which the firm operates. In the model here, the organisation of a firm is, therefore, defined through the characteristics of an organisational design  $d$  given by  $n$  organisational modules  $m_i$  and  $k$  service characteristics. The number of modules  $n$  is a measure of the degree of decomposition of organisational activities.

**Figure 1. Interdependence and modularity in organizational designs**



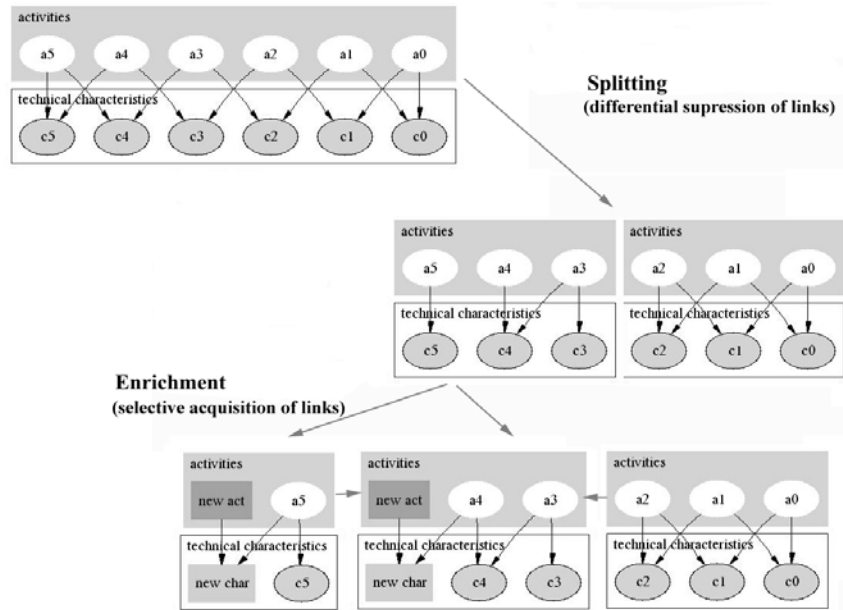
The sub-activities  $x$  in each module  $m_i$  are strongly related to one another, that is, the performance of each sub-activity  $\phi(x_k)_t$  at time step  $t$  affects the performance of all other sub-activities in the module and its performance is, in turn, influenced by all other sub-activities in the module. This implies that the total performance of a module  $\phi(m_i)_t$  changes if  $\phi(x_k)_t$  changes. The modules  $m_i$  themselves are linked through organisational and technical interfaces that neutralise the strong complementarities that persist between the sub-activities within each module. These interdependencies reflect a situation that is typical in team production, where the skills and activities of the members in a team are closely complementary and integrated. So, if one member performs under par, the work efficiency of all other members is affected. This is shown in Figure 1. If the management wants to improve service  $\theta_3$  produced in organisational module  $m_2$  then changing the work profile of the related activity  $x$  will actually imply the performance of the sub-activity producing service  $\theta_4$  is also affected. In the simulations we will determine  $\phi(m_i)_t$  by drawing  $\ell_i$  values from a uniform distribution with  $\phi(x_k)_t \rightarrow \text{Uniform}[0,1]$  and calculating the average over the  $\ell_i$  sub-activities. The impact of all  $n$  service producing administrative activities on firm performance is then given by,  $\Phi_t = \frac{1}{n} \sum_{i=1}^n \phi(m_i)_t$ . (This representation of organisational designs and their impact on the performance of productive activities corresponds to a generalised NK model (see Altenberg, 1995).)

In Figure 1b the problem of strong complementarity is resolved by splitting module  $m_2$  into two distinct sub-activities where each is focused on producing exactly one service. The co-ordination problem between the two sub-activities is solved by introducing a co-ordination mechanism between the two. Therefore the hierarchy increases and the co-ordination overhead increases. This captures Simon's (1996) idea of realising near-decomposable designs in order to control complex problems better. In this process, economies of system are realised.

### *Organisational Learning: Exploitation vs. Exploration*

The management of the firm is assumed to use a set of strategies  $S$  to explore the space of organisational designs  $D$ . The strategy space  $S = (s_1, s_2, s_3)$  consists of three strategies, each of which is used with probability  $\mu_j$  at each time step  $t$ . The firm pursues them to improve administrative services that have an impact on the performance of productive activities. The first strategy  $s_1$  corresponds to learning by doing. In this case all values for  $\phi(x_k)_{t+1}$  are redrawn, and if the average over the  $\ell_i$  sub-activities increases this will correspond to a performance improvement. The second and the third innovation strategies involve changing the organisational design of the firm. This is illustrated in Figure 2. The firm may engage in identifying and neutralising some of the complementarities that bind sub-activities into a module. This may enable it to split a more complex activity into a number of less complex activities and redesign its organisation accordingly. This decomposition strategy  $s_2$  is called ‘splitting’. It corresponds to the development of a near-decomposable design of administrative activities. Finally, it may pay the firm to redesign its production and organisation by organising smaller activities into larger and more complex modules. It is the reverse strategy of decomposition. It involves the selective acquisition of complementarity relationships between previously unrelated activities by, say, supporting the development of synergies. This integration strategy  $s_3$  we call ‘job-enrichment’. In both  $s_2$  and  $s_3$  the organisational design is changed, with poorly performing activities replaced by better performing ones. In this case all performance values  $\phi(x_k)_{t+1}$  for the elements in the new module(s) are redrawn and if their joint average increases this will again correspond to a performance improvement.

**Figure 2. Splitting and Enrichment as Strategies in Organizational Re-Design**



These strategies are assumed to affect the performance  $\Phi_t$  of productive activities through economies of system, that is, by allowing for better control of productive activities and, therefore, pushing productivity for a given technology towards its limit.

As discussed earlier, the literature on modularity advances the argument that an increase of the modularity of a system leads also to an improvement in the innovation rate. The basic idea behind this is that modularity allows a better understanding of the workings of a system and, therefore, increases the chance that better ways of doing things are discovered. Here it is assumed that, depending on the degree of decomposition of the administration of the firm given by the number of activities  $n$ , the likelihood that better ways of organising the production process are discovered increases if the firm invests into this process of exploration. This will push ahead the performance  $\Phi_t$  of productive activities by a factor  $(1 + \varepsilon_t)$ , where  $\varepsilon_{t+1} = \varepsilon_t(1 + \tau)$ . In the simulation, parameter  $\tau$  has a small positive value as does  $\varepsilon_t$  at  $t=0$ . The probability of the firm making an innovation  $\varepsilon_t$  is determined by a Poisson process with an arrival rate  $\alpha$ . Following Silverberg and Verspagen (1994), it is assumed that the firm's

investments have first increasing and then decreasing returns, which are reflected in a logistic representation of the arrival rate given by

$$\alpha_{t+1} = \frac{\alpha_{\min} \alpha_{\max}}{\alpha_{\min} + (\alpha_{\max} - \alpha_{\min})^{-(r^* n_t)}} .$$

Here  $\alpha_{\min}$  represents a small autonomous probability of making a fortuitous innovation without investing in this type of innovation, and  $\alpha_{\max}$  corresponds to an asymptotic saturation level of the arrival rate. As can be seen, this process depends on the propensity to invest ( $r$ ) and on the degree of decomposition, which essentially captures the innovation potential.

The behaviour of the firm is given by the probability distribution over its three actions. The innovation policy mix  $s_t = [\mu_{1,t} s_1 \quad \mu_{2,t} s_2 \quad \mu_{3,t} s_3]$ , with  $\mu_{1,t} + \mu_{2,t} + \mu_{3,t} = 1$ , that maximises profits  $\Pi_d(s_t)$ , evolves through reinforcement learning given some initial probabilities  $\mu_{j,t=0}$ . This should not be interpreted as conscious randomisation, rather it indicates (from the perspective of the outside observer) how likely it is that the decision maker will choose each of these three actions. The reinforcement learning dynamics applied here is identical to the one explored by Arthur (1993), where each of the strategies is allocated a strength according to its past contribution to the performance of the firm

$$\mu_{j,t+1} = \mu_{j,t} + \frac{\Delta\Pi(s_j)_t - \mu_{j,t} \sum_j \Delta\Pi(s_j)_t}{\sum_j \sum_t \Delta\Pi(s_j)_t}, \quad (1)$$

where  $\Delta\Pi(s_j)_t = \Pi(s_j)_t - \Pi(s_j)_{t-1}$  indicates the change in the performance improvement between two time steps  $t$  and  $t-1$  where strategy  $s_j$  was used. Equation (1) reinforces the strategies that performed best in the past, that is, those which previously maximised profits.

### *Costs of Production for a given Organisational Design*

It is assumed that white-collar activities are not productive in themselves, but that they improve the utilisation and the development of the firm's productive resources. More precisely, It is assumed that the services produced by an administrative activity  $m_i$  have an impact on the performance of productive activities,  $\phi(m_i)_i$ . As mentioned previously, the impact on the unit costs of productive activities by all  $n$  modules is given by  $\Phi_i$ . The unit costs of productive activities are then given by:

$$vc_{d,t} = w_p l_p e^{-(1+\varepsilon_i)\Phi_i},$$

where  $w_p$  is the average wage bill per unit of output paid for productive activities, and  $l_p$  is the unit labour requirement.

In the administration of a firm there are two types of activities. The first set of activities produces services for productive activities. The second set of activities co-ordinate the interaction between these services. Only service-producing administrative activities are outsourced as co-ordination activities typically reflect critical management skills. We also assume that the number of services a module produces is proportional to its skill intensity, that is, the more services an activity produces, the higher the skills levels are that are required to carry them out. This in turn implies that the average wage paid to these activities is higher than to activities where only a few services are produced. For simplicity, it is assumed that the unit wage cost of producing one service to productive activities and that of carrying out one co-ordination task are the same.

Information technologies affect co-ordination costs. Here a distinction is made between the cost of internal co-ordination and the cost of external co-ordination. Total administrative overhead costs are then defined by:

$$oc_{d,t} = (zl_a w \bar{\ell} + (1-z) \sum_h p_h) + l_c w (v_{int} e^{-\theta_{int}} + v_{ext} e^{-\theta_{ext}}),$$

where  $l_a$  and  $l_c$  are the unit labour requirements for service and co-ordination activities,  $w$  is the going wage rate paid per “skill unit”,  $\bar{\ell}$  is the average number of services produced in each administrative activity,  $p_h$  are the prices paid for outsourced activities,  $v_{int}$  and  $v_{ext}$  are the number of internal and external co-ordination activities, and  $\theta_{int}$  and  $\theta_{ext}$  reflect the impact of the use of ICTs on internal and external co-ordination costs respectively. Variable  $z$ ,  $0 \leq z \leq 1$ , weights the unit costs of production of administrative services produced in-house and those produced elsewhere by their respective share in the total number of services produced.

It is assumed that a subcontractor typically has a cost advantage in producing a particular service. If a specific service producing administrative module  $m_i$  is outsourced the unit cost of production of its services by the service firm is then given by:

$$cs_h = l_{a,h} w \ell_i \gamma_h + l_{c,h} w (v_{int,h} e^{-\theta_{int}} + v_{ext,h} e^{-\theta_{ext}}),$$

where  $\gamma$  now reflects the comparative cost advantage service firm  $h$  has in producing the services of administrative activity  $m_i$ . In the simulations we will assume that  $\gamma \rightarrow N(1, \sigma^2)$ , that is, the cost advantage is normally distributed around a mean of 1 (meaning that, *a priori*, there might be no cost advantage) with some variance  $\sigma^2$ . Variables  $l_{a,s}$  and  $l_{c,h}$  reflect the relative unit labour requirements for service producing and co-ordination activities and  $v_{int,h}$  and  $v_{ext,h}$  indicate the number of internal and external co-ordination activities the service supplier has to manage. Assuming now that the supplier has some market power such that the company is able to charge a positive mark-up  $\xi$  over costs then the unit price for the services of supplier  $h$  to the outsourcing firm is given by:

$$p_h = (1 + \xi) c s_h.$$

Finally, it is assumed that the firm has a certain propensity  $r$  to invest part of its revenues into the exploration of innovation potentials due to the modularity of the administration. These costs are then given by:

$$r c_t = r p_t q_t,$$

where  $p_t$  and  $q_t$  are the prices charged and the quantities sold at a time step  $t$ .

### *Profits*

If the firm acts in an environment in which monopolistic competition prevails, it will face a downward sloping (inverse) demand given by:

$$p_t = \frac{I s}{q_t^{1/\eta}},$$

where  $p_t$  is the price the firm is able to charge at time  $t$ ,  $I s$  is the amount of income customers spend on the firm's product,  $q_t$  is the firm's output and  $\eta$ ,  $\eta > 1$ , is the price elasticity of demand. Following standard theory, the optimum output and price for a given organisational design  $d$  are given by:

$$q_{t,d}^* = \left[ \frac{I s (1 - 1/\eta)}{v c_{d,t} + o c_{d,t}} \right]^\eta,$$

$$p_{t,d}^* = \frac{\eta (v c_{d,t} + o c_{d,t})}{\eta - 1}$$

Therefore, for each organisational design  $d$  the firm tries to maximise profits

$$\Pi_d(s_t) = (p_t^* - v c_{d,t} - o c_{d,t}) q_t^* - r c_t - c_t,$$



by reducing the unit costs of production. In the model presented here, the firm does this by pursuing different strategies  $s_t$  of organisational innovation that enable improvements in the performance of the firm's productive activities to be made. The term  $c_t$  reflects the fixed capital cost. It is assumed that the firm needs to keep its capital-output ratio constant and, therefore, invests or disinvests as output changes.

### *The Adoption and Outsourcing Decision*

The decision to adopt an organisational innovation and the decision to outsource will depend on the economic profitability of doing so. Therefore, the management of the firm will calculate the expected profits  $E[\Pi_{d'}(s_t)]$  that a new organisational design  $d'$  is likely to generate and compare them with the profits that the current design yields. Therefore, the decision rule to adopt a new organisational design  $d'$  is given by the following inequalities:

$$\begin{cases} \Pi_d(s_t) \geq E[\Pi_{d'}(s_t)] & \text{reject innovation} \\ \Pi_d(s_t) < E[\Pi_{d'}(s_t)] & \text{accept innovation,} \end{cases}$$

Depending on the management strategy, a firm may have a certain propensity to pursue outsourcing as a strategy, such that, given strategy parameter  $os$ ,  $0 \leq os \leq 1$ , it will calculate the expected profits of outsourcing these services to other firms leading to an organisational design  $d''$  with probability  $pr_{os}$

$$\text{if } pr_{os} > os \quad \begin{cases} E[\Pi_{d''}(s_t)] \leq E[\Pi_{d'}(s_t)] & \text{inhouse} \\ E[\Pi_{d''}(s_t)] > E[\Pi_{d'}(s_t)] & \text{outsource} \end{cases}.$$

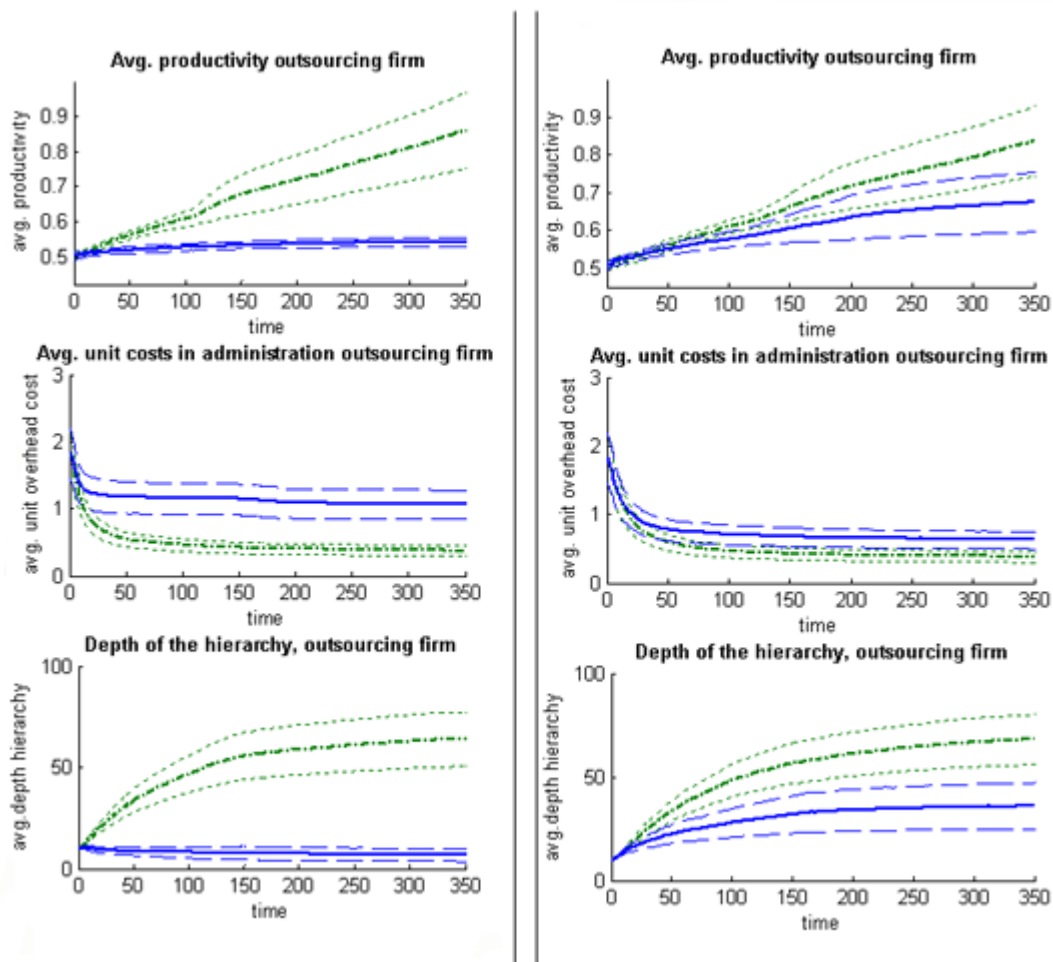
These are the decision rules the firm follows in order to maximise its profits at each moment in time.

## **5. Results**

Using the model, four different scenarios have been examined. The parameters used to calibrate the model are given in the appendix. The results of the simulation runs are presented in Figure 3. The plots in the top quadrant of Figure 3 show the development of productivity in the firm. The bold line always represents the mean over 50 runs for each parameter setting, while the thin dashed lines represent the 95 per cent confidence interval of the results of the runs. The plots in the middle of Figure 3 show the development of overhead costs over time and, finally, the plots in the bottom quadrants show the depth of hierarchy of the firm's administration structure.

The first two scenarios, presented in the left part of Figure 3, juxtapose the impact of ICTs on performance, and the costs of the firm for a given *high* propensity of managers to choose outsourcing as a strategy. The results for low internal, but high external, co-ordination costs are represented by dash-dot-dash lines, while those for equally efficient internal and external communication costs are represented by unbroken lines.

**Figure 3. Simulation Runs**



Notes: The left-hand graphs represent a scenario with high outsourcing propensity by management; those in the right, a scenario with low outsourcing propensity by management. Dash-dot-dash lines represent runs with low internal communication costs only for a given outsourcing propensity. Unbroken lines represent runs with low internal and low external communication costs for a given outsourcing propensity. The bold lines represent means over 50 runs, the thin dashed lines 95 per cent confidence intervals around these means.

The findings suggest that a high outsourcing propensity, supported by low external co-ordination costs, lead to a paradoxical development. The firm performs worse in the long run if external co-ordination costs fall. The explanation for this apparent paradox is as follows. Managers of the firm are myopically learning over time. They do not have information on the payoffs of all possible choices, and are unable to observe the pay-offs of firms that choose a different strategy. Hence, they are only able to observe the payoffs associated with their own past choices. In other words, managers of the firm are engaged in pure learning-by-doing. In practice, this is a reasonable approximation of the reality for managers in the vast majority of

firms. Unlike physical products and services, which can be obtained and reverse engineered, managers do not have ready access to information on other firms' organisational structures, administrative services, and the performance of those organisational structures.

Under these circumstances, the managers of the firm perceive there to be cost-cutting potentials if ICTs lead to a fall in external co-ordination costs, and proceed to outsource a high number of service activities. As a consequence, the depth of the hierarchy is reduced and in the beginning overhead costs drop as well. Productivity also grows initially. It grows at a much slower rate than if the firm had not outsourced but, of course, the firm does not actually 'see' this in practice because it has chosen to pursue the alternative trajectory of outsourcing. Unfortunately, as the firm continues along this path, productivity growth continues to fall and can even stagnate. The upshot is that managers focused on the short-run cost-cutting effect will succeed in reducing costs, but will, unwittingly, reduce the long-run innovation potential of the firm as well.

New ICTs lower internal co-ordination costs. This supports the development of increased modularity in the administration of the firm. As the activities become more specialised, it is easier to improve the quality of their service to the productive activities. At the same time, the long-run potential for radical organisational innovations is exploited successfully. The long-run productivity of the firm under this scenario outperforms alternative scenarios where external co-ordination costs are lowered by new ICTs and firms engage in outsourcing. These results lend support to the thesis that the 'quick-fix' strategy, to outsource in order to reduce costs, endangers the long-run performance and survival of firms.

On the right hand side of Figure 2, the results for the third and fourth scenarios are presented. In these scenarios, the outsourcing propensities of management are low. Again, we consider what happens if ICT reduces external co-ordination costs and what happens if ICTs reduce internal external co-ordination costs. Once again, the finding is that ICTs which stimulate internal organizational innovation outperform the scenario where ICTs stimulate outsourcing.

As before, the reason is that the long-run productivity potential of the firm depends on the degree of decomposition of administrative activities. Therefore, firms always fare better in the long run if they keep the service activities in-house and reap all the benefits of the process of organizational innovation. Once activities are outsourced, suppliers in our model charge a constant price and no longer improve the quality of the services they deliver. As a consequence, producing services in-house is the dominant strategy in this simulation.

The results seem to mirror the observations of the empirical studies discussed in section 3. However, it is important to observe that long-run productivity of the scenarios with low external co-ordination cost comes close to the long-run productivity levels where external co-ordination costs are high in the upper end of the confidence interval. This outcome depends on the propensity of the firm to invest in radical organisational innovation. It suggests that, if a firm chooses to (moderately) outsource and is inclined to do so by low external co-ordination costs, it should scale up its investment in radical organisational innovations, which will exploit the potential for innovation better.

## **6. Conclusions and Suggestions for Future Research**

The paper has investigated the thesis that outsourcing activities to business services (KIBS) can cut certain types of administrative costs, but that they may reduce productivity growth in the long run. This is the striking thesis that is emerging from the latest empirical research on the long-term impacts of outsourcing on the innovative capabilities and productivity growth of client firms. The paper summarised the short- and long-term costs and benefits of outsourcing, and proceeded to place them a more analytical footing through the development of a framework of organisational innovation that integrates decisions to outsource with the introduction of cost saving new ICTs. The framework specified a transmission mechanism that explains the links between the adoption of new ICTs, alternative strategies for organisational restructuring, system economies and the decision to outsource.

The framework has been implemented in a novel model of organisational innovation. Simulations conducted on this model enabled us to consider the short- and long-run impacts of outsourcing on administration overheads and on long-term productivity growth. The interesting finding is that managers of a firm can become locked into a low productivity growth trajectory, associated with the outsourcing of activities, if they are myopic and learn through their own actions. They perceive outsourcing to cut overhead costs in the short run (as expected), and so engage in further outsourcing thereafter. This is to the detriment of long-run productivity gains (system economies) generated through organisational innovation. This occurs because the potential for organisational innovation is reduced when modular components are outsourced, placing them beyond the control of the firms' management. The findings accord well with the empirical data, and provide a salutary warning for managers and policy-makers about the potential long-term implications of outsourcing.

Looking forward, there are a number of interesting extensions that can be made to the current model. Future research will also explore the relaxation of certain assumptions of the current model. For instance, outsourcing is purely concerned with access and cost of externally produced services. This accords with empirical findings regarding the main drivers of outsourcing. However, other considerations have been highlighted by the theoretical literature on KIBS, such as co-production and the co-innovation of products and services. These will be explored in future research.

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