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Service productivity gains through information and communication technology applications: a service marketing approach

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Abstract: Based on examples from ICT-based improvements in service productivity in the service organisations of three manufacturing firms, this article argues for a service-centred approach towards productivity. When improving the productivity of industrial services, one of the three profitability-generating strategies, cost efficiency, revenue effectiveness, and capacity utilisation – or a combination– can be used. Increased standardisation and automation is a consequence of technological development, making capacity less a constraint in services and even if ICT applications often primarily improve cost efficiency, the elements improved vary depending on the solution implemented. Thus, ICT can enhance existing service processes and enable new service offerings to increase overall profitability. A productivity model for ICT-based services is presented and it is suggested that central coordination is often required in order to develop ICT-based services.

Keywords: service productivity, information and communication technology, service offerings, cost efficiency, revenue effectiveness, capacity utilisation, front office, back office.

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relationships, and new technology. He graduated with an MSc in Industrial Engineering and Management from Linköping Institute of Technology and defended his licentiate thesis in June 2006. A Swedish licentiate degree is equivalent to two years of fulltime research.

1 Introduction

The service operations of manufacturing firms have long been highlighted as a high-profit, high-growth opportunity (e.g. Lele, 1986; Levitt, 1983) and they are often critical for long-term profitability. Since manufacturing firms have deep knowledge of their products and markets, they are often well positioned to perform service activities (Knecht et al., 1993; Mathieu, 2001; Wise and Baumgartner, 1999).

Industrial services are seen as processes which consist of a series of activities supporting customers' industrial production processes in a business-to-business context, so that value for customers is created in those processes (based on Grönroos, 2004 and Kowalkowski, 2006a). To these processes of exchange the generation, integration, and transformation of specialised competences (i.e. tacit and explicit knowledge) are fundamental (cf. Vargo and Lusch, 2004a). Examples of industrial services covered by this definition are repair, reconditioning, performance upgrade, inspection, maintenance, technical support and consulting, performance audit, spare parts provision, operation, and customer training.

The market for industrial services is often counter-cyclical and operating on it is likely to give higher margins and require fewer assets than do manufacturing activities (Oliva and Kallenberg, 2003). Albeit future growth and profit opportunities are identified for industrial services, profit margins are also exposed to increasing pressure from low-cost service providers (Henkel et al., 2004). It is therefore relevant to examine how manufacturing firms can increase their service productivity

It is assumed that information and communication technology (ICT) applications can increase service productivity in a variety of ways. The utilisation of ICT has enabled firms to improve their manufacturing processes, to increase output while concurrently reduce manufacturing costs, and to develop products that are more advanced. Similarly, ICT applications can be

used to improve manufacturing firms' existing service processes and develop new, more advanced services and solutions (Kindström, 2005; Koskela, 2002; Kowalkowski, 2006a; Normann, 2000), thereby increasing customer value and keeping competitors in check. ICT can also enhance the customer lock-in effects of an offering and in so doing create barriers to competitors' offerings and achieve higher switching costs (Hax and Wilde, 1999). In order to improve productivity, one can utilise various ICT applications which allow firms to store performance in electronic form, thereby setting capacity free (Gadrey, 2000; Hill, 1999; Lovelock and Gummesson, 2004).

Despite the fact that industrial services have evolved over the years, there is still a high potential for productivity improvement (Abrahamsson and Brege, 1995; Kalliokoski et al., 2004). One important reason for this is that fewer resources and investments in new technology have been allocated to service activities and another is that service strategies have been characterised by reactive rather than proactive behaviour (Kowalkowski, 2006a).

The objective of this paper is therefore to examine and discuss how ICT applications can increase industrial service productivity both through already existing and new services. In addition, the implications of new ICT applications for the service organisation are examined. Thus, the focus is not on technology and rapid technological diffusion as such, but instead, on what ICT applications may enable in terms of enhanced service offerings and better profitability. Thorough case studies have been conducted at the central service organisations of three international manufacturing firms in order to obtain a comprehensive picture of the impact of specific ICT applications.

The author argues that instead of making a distinction between goods and services based on dysfunctional and flawed taxonomies, offerings is a more appropriate, all-encompassing term to use (cf. Lovelock and Gummesson, 2004; Vargo and Lusch, 2004b; Wyckham et al., 1975) especially since customers "do not buy goods or services: they buy offerings which render

services which create value” (Gummesson, 1995, p. 250). Service should be the *raison d’être* for all organisational activities (Grönroos, 2000) as the dominant logic for marketing ought to be service-centred rather than goods-centred (Vargo and Lusch, 2004a). Thus goods-producing and services-producing firms must not be regarded as dichotomies (Bowen et al., 1989) and there is no inevitable contradiction between production orientation and market orientation (Kindström, 2003). Firms must however be aware that service logic differs from manufacturing logic and one has to recognise for example the heterogeneous standards of customers when creating their service offerings (Anderson and Narus, 1995; Vargo and Lusch, 2004b).

The outline of this paper is as follows. In Section 2, service productivity and ICT in service management will be discussed. Section 3 concerns methodological aspects of the data collection and analysis whereas the cases are discussed and analysed in Section 4. Finally, conclusions from the analysis, a productivity model for ICT-based services, and managerial implications are presented in Section 5.

2 A Service-centred approach towards productivity

Contrary to many established perspectives on production systems, the service production process is to a large extent an open system. Consequently, service productivity requires other premises and conditions than the manufacturing of goods (Larsson and Bowen, 1989). Variations in service quality occur not only because of heterogeneity (internal factors) but also due to the influence of customer participation (external factors) (Ojasalo, 1999). The customer is unequivocally a part of the social system of the firm, especially in the case of professional services, and this has important implications for the nature of the organisation (Parsons, 1956). Because value is co-created, customers themselves participate to some degree in the service production process and thus influence their own satisfaction and

perceived quality (Normann and Ramírez, 1993). For this reason, customers can be viewed as “partial employees” of the service providers (Mills and Morris, 1986). It is important not only to differentiate between differences in customer needs, but also to distinguish between active versus passive customer presence; i.e. the customer’s disposition to participate in the production process. Consequently, service production can take place either partly or fully in interaction between provider and customer (service encounter) and/or partly or fully in isolation from one another.

Customer perceived quality is recognised as something which is vital to take into consideration when discussing services, and quality cannot be separated from productivity in the case of services (Grönroos, 2000; Ojasalo, 1999; Vuorinen et al., 1998). However, generally speaking, to improve productivity and customer perceived quality in parallel is difficult in services (Anderson et al., 1997). If a firm intends to achieve increased service productivity through decisions concerning internal efficiency (i.e. cost reductions), the measures involved risk a deterioration in customer perceived quality and leading to a vicious cycle of dissatisfied customers and financial problems (Normann, 2000). This is not to say that improved profit orientation is not needed; internal efficiency should always be an objective, but the improvements have to be based on service characteristics, so that “the interrelationships between the internal and external effects are taken into account” (Grönroos, 2000, p. 186).

2.1 A service productivity framework

In order to study how both increased cost efficiency and service quality can be reciprocally achieved, a conceptual service productivity model proposed by Ojasalo (1999) and extended by Grönroos and Ojasalo (2004) is used. While productivity can be defined in terms of e.g. revenue per employee (Anderson et al., 1997), Ojasalo (1999) simply defines it as revenues from a given service divided by costs of providing it. The service productivity model in

Figure 1 is a function of three elements of which internal efficiency is the service provider's and the customer's input to the service process, i.e. the service production cost, and external efficiency is service output, both in terms of quantity and of how the service quality is perceived by the customer.

Insert Figure 1 here

The third element in the service productivity model is capacity efficiency (i.e. management of demand). This has to be taken into consideration as it is not possible to inventory the finished service (Donnelly, 1976; Rathmell, 1966; Regan, 1963). Hill (1977) argued that keeping services inventoried is not a physical impossibility, but that it is a logical impossibility as services imply some change in the condition of one goods item or person, and service stock is therefore an oxymoron. Accordingly, this has been a constraint when many services are compared with manufactured goods even if it is certainly not valid in all cases, e.g. monitoring a production process is a service and does not imply such a change in condition.

Furthermore, capacity can likewise constrain a firm's manufacturing operations (Wyckham et al., 1975), such as when it is difficult to get hold of skilled manufacturing personnel. Another example is when limited machinery output may impede a switch to an additional shift of goods production at times of peak demand. Besides, many services are associated with a temporary provision of capacity and a service such as rental means that the major characteristic of the service is to make the goods available to customers (Gadrey, 2000).

If demand exceeds what currently can be managed, it will have a negative effect on customer perceived quality, decreasing external efficiency and thereby reducing service productivity. Thus, both low demand and excess demand reduce productivity (Grönroos and Ojasalo, 2004). However, demand and supply imbalances can vary significantly between services as

peak demand for e.g. telecommunication and power supply is usually met without major delay despite extensive demand fluctuations over time (Lovelock, 1983).

Capacity utilisation is a main driver of profitability (Oliva and Kallenberg, 2003) and the shift in focus from a producer to a customer perspective, is a shift from the means to the utilisation (Gummesson, 1995). Although Grönroos and Ojasalo's (2004) productivity model includes the customer and signals the heterogeneity and intangibility aspects of services, it has limitations as it does not have the ability to show bottlenecks or to explain reasons for changes in productivity. Further, revenues do not always reflect perceived quality and it may be problematic to correctly assign costs to respective revenues and thereby measure service productivity as profitability only (Grönroos, 2000). Another issue that affects service productivity is the customer relationship continuity. On an individual level, the more frequently personnel interact with one another, the stronger their relationship is inclined to be (Granovetter, 1973). Similarly, long-term relationships with customers are considered important as productivity continuously increases as the relationship becomes stronger (Anderson et al., 1994; Hammarkvist et al., 1982; Ojasalo, 1999).

2.2 *ICT in service management*

In spite of the interrelationship between customer and provider, ICT applications can make it possible for manufacturing firms to both enhance service productivity and reduce costs for providing services (Anderson et al., 1997; Normann, 2000). Resources and activities can be dematerialised and unbundled in terms of place (where they take place), time (when they take place), actor (who performs them), and actor constellation (with whom they are performed) and then be rebundled into new offerings with a denser level of resource integration (Normann, 2001). This line of argument aligns very well with the service-dominant logic of marketing (Lusch and Vargo, 2006), and it can be further substantiated by Moran and Ghoshal's (1999) discussion of how firms interact with markets to create value. They note

that “it is not resources per se, but the ability to access, deploy, exchange, and combine them that lies at the heart of value creation” (p. 409).

Examples of factors influenced by the physical setting and the usage of ICT applications in service production are cost rationalisation, quality enhancements, beneficial customer linkages, behavioural implications, and technology adaptation. Although these factors tend to merge, it is important not to ignore them as separate factors in order to utilise their individual possibilities to derive advantage from new technology (Normann, 2000).

Firms can use ICT to capitalise the flexibility of service provision (Karmarkar, 2004; Vargo and Lusch, 2004b) but ICT can also be used to improve a firm’s internal efficiency through standardising (and possibly automating or eliminating) processes (Koskela, 2002; Pine et al., 1993; Sundbo, 1994). Investments in new technology and applications are expensive and often associated with risk taking. Nevertheless, reproduction costs for dematerialised resources have dropped considerably in spite of increased initial investment costs, and this implies that the ratio average cost/marginal cost has increased dramatically for immaterial resources compared with physical ones (Normann, 2001). Normann (2000) argues that a holistic view has to be adopted when implementing ICT and that ICT applications must enhance – and not disturb – the social processes that are associated with service provision.

Customer perceived quality is improved through better quality control and higher quality is possible by means of dematerialised information (Normann, 2000). It should be the firm’s driving factor and is totally compatible with productivity if there are customers willing to trade price for some level of standardisation and if cost saving ICT applications exist to provide services on a good enough level of customisation (Vargo and Lusch, 2004b). Hence, firms will have to balance customisation with standardisation with regard to quality (Anderson et al., 1997). Furthermore, customer perceived quality must be balanced with service productivity.

3 Methodology

A multiple case study approach was considered appropriate as the research strategy, since the aim of the research was to explore a contemporary phenomenon within its real-life context where the boundaries between the phenomenon and context were not clearly evident (cf. Yin, 1994). The three case firms BT Industries, Electrolux Laundry Systems, and ITT Flygt (henceforth BT, ELS, and Flygt) participated in a particular service project involving eight international manufacturing firms. The choice of firms was a deliberate research design parameter to increase external validity and ensure generalisation (cf. McDermott, 1999), i.e. that the findings are applicable to industrial service providers in other industries as well. Since the firms represented different industries and since their market conditions, intra-firm service organisation structure, service offerings and service offering development differed, their selection was associated with theoretical sampling as discussed by Eisenhardt (1989).

Most primary data was obtained through a number of semi-structured interviews with one or two managers from each case firm's central service organisation. Data was also collected in various discussion forums, project meetings, and workshops (see Figure 2). The discussion forums were similar to interviews in that they too were semi structured, but participants from more than one firm took part at the same time. The workshops dealt with specific topics related to the project and the agenda was set by the firm holding the specific workshop. One purpose, which proved to be a major advantage of the workshops and project meetings, was the opportunity to present empirical data previously collected, introduce preliminary results, discuss the findings, and continuously receive feedback.

Insert Figure 2 here

The interviews and discussion forums took between one and a half and three hours, whereas project meetings, discussion forums, and workshops took about five to six hours. Phone interviews, taking between 20 and 80 minutes, with representatives from each firm were also held in order to ask complementary questions and validate the cases. It is believed that high construct validity has been achieved, as the managers in question have been initiators and/or involved in the implementation phases of the ICT-related projects. A case study protocol was used to increase reliability. All interviews were taped and transcribed, notes were taken during all meetings, and all of this data is filed.

4 Improvements in service productivity

In all the case firms studied (see Figure 3), there is a trend towards increased service offerings. In line with the increasing industrialisation of services, this tendency requires firms to standardise their input to the service process to a much higher extent than before, and ICT applications can be a means to standardise operant resources and processes (Sundbo, 1994). Not only do the case firms have more service level agreements (SLAs) than before, but the numbers of international contracts are also increasing, which further emphasises standardisation in quality between local service organisations at different geographical markets. However, regardless of international contracts and increasingly global/central ICT systems, a strong local, customer-orientated service organisation is needed (Christopher, 1998). In the following part of this section, a number of ICT-based solutions which are either fully or partly implemented in the case firms, are discussed.

Insert Figure 3 here

4.1 *Service technician certification programme*

In connection with the professional laundry systems becoming increasingly complex, ELS has recognised a need to know not only what product knowledge the service partner has, but also the knowledge profile of each individual technician. A wrong action by a non-trained service technician in one country might not affect that specific business deal, but can lead to ELS missing business opportunities in other countries and possibly not becoming a preferred supplier to the customer. Therefore, an online certification programme has been launched to assure the homogenous quality of industrial services and that external service personnel too have the skills needed. It was developed by a local IT firm and the investment costs were considered moderate. The payback time can be considered almost non-existing, but there is nevertheless a minor running cost involved in managing the certification system and productivity losses in terms of technicians having to take the time to do the e-learning tests.

The e-learning certification programme is free-of-charge and the aim is to encompass 1,000 service providers. It is also a way for ELS to better find out who their service partners actually are. Husqvarna, a former Electrolux business unit that offers outdoor power products, has implemented a similar certification programme successfully. So far, it is too early to evaluate the success at ELS, but the reception among its service partners has been positive. Nevertheless, the propensity of individual technicians to use the system and the challenges to develop adequate software that actually will test relevant knowledge may cause delays in the implementation. None of ELS' competitors has a similar certification system, which is one of the reasons for ELS developing the system. The function of the system is to not only ensure that the service partner's individual technicians have the right competence, but also that the customer/user has the knowledge needed. Furthermore, online information, technical bulletins, and the spare parts catalogue can be linked to the system, and it can serve as a training package. The customer's operational personnel in the laundries can use the system so

that they not only receive information verbally. Thereby ELS can make sure that they know how to handle the equipment correctly. The customers pay for the training, which is either bought separately or bundled into a service package.

The online certification programme is an example of how ICT can be used to achieve a guaranteed minimum level of expertise among individual service technicians worldwide as more or less all service partners have internet access. The initiative is mainly a way to try to ensure that the service output will be of a certain homogeneous quality. Hence, a certification programme for service personnel is a knowledge-enhancing tool which can primarily be seen as a means to improve external efficiency through increased customer perceived quality of outcome. However, mapping the knowledge and skills that the personnel possess can also generate reduced costs when the technicians perform service operations and use the e-learning tool, but this effect can be considered to be secondary. Whether capacity utilisation will improve or not depends on whether it will take less time than previously to perform service operations and it is too early to claim such an effect.

4.2 *Installed base database*

Another initiative taken by ELS is the creation of an installed base database, which can provide the firm with information about machinery type, application, installation date, customer site, actions taken, etc. Better utilisation of the installed base database has also been proposed internally at Flygt but has so far been met with resistance. Improved mapping of the installed base gives the providers better customer insight and a better estimation of market potential, although the prerequisites for different industries can vary a lot. While ELS' and Flygt's products rather seldom are relocated and sold further, BT's products often change user and the many small businesses with one or only a few BT-made warehouse trucks are almost impossible to map. Besides internal resistance, Flygt is facing a problem with mapping as half

of the sales go via a third party (contractor) before reaching the customer and therefore are more difficult to trace.

Installed base knowledge is captured from interactions with the customer, formalised and made accessible through the database, and can thereby be used to improve customer perceived quality by providing services that are more accurate. It can help reduce the number of unnecessary journeys by service personnel to a customer site that can occur due to wrong equipment or personnel being sent because of incorrect information about the customer's machinery. As a result, not only external efficiency can be obtained but there is also the secondary impact of better cost efficiency and capacity utilisation of service technicians.

4.3 Mobile workshops

The growing number of SLAs enables advanced planning, so profitability can thereby be achieved through better capacity utilisation. As in the case of Flygt, SLAs enable the firm to plan repairs and improve the workshop occupation ratio. However, the service-centre workshop infrastructure did not match actual demand fluctuations and had a too limited reception area. It was assumed that workshops that are more mobile would enable more service on customer sites and thus make it possible to reduce the number of service centres. Furthermore, a more flexible service organisation means that capacity can be better balanced in accordance with customer demand, making e.g. SLAs and installed base information particularly useful as the resulting flexibility can enable larger productivity gains.

Therefore, structural changes have been initiated at some European markets, with the implication that the number of service centre workshops is halved. Instead, the 50% reduction in service centres is complemented with a mobile field force working in mobile workshops for site-based work and pump pick up and with service partners mostly in very remote areas. Eighty percent of Flygt's products are relatively small and can thereby be served with a mobile workshop, either a light service vehicle or a heavier mobile unit. The extended

reception area means that the technicians are able to serve more customers on site and thus increase revenues and improve external efficiency.

By utilising the personnel and equipment better, capacity efficiency in terms of the number of produced service hours and type of repairs can also increase, and as a secondary effect, it is estimated that total cost will decrease by approximately 10-15%. Since many competitors are small, local firms, Flygt could possibly reduce these firms' competitive advantage by having a flexible service organisation with faster response time. However, even if lead-times are improved, the actual service production takes a longer time. A repair that takes three hours in a service centre workshop may take half an hour longer time in the mobile workshop due to limited space. The mobile workshop is not a solution with an ICT core like the other productivity-enhancing solutions in this section, but ICT nevertheless facilitates the mobile workshop and can enhance productivity.

4.4 *Mobile business system*

When it comes to cost reduction, internal efficiency should be prioritised. Back-office activities in particular should be looked at, as they are invisible to customers (Grönroos, 2000). Many administrative activities are non-value-added and should therefore be eliminated (cf. Drucker, 1991).

EASY, the PDA (i.e. handheld terminal) solution developed in-house and implemented at BT is an example of such a measure that resulted above all in improved internal efficiency through reduced administrative costs. The development process took four years and a lot of time was spent on mapping existing processes and designing new ones. Most of the development took place in Sweden but other subsidiaries were also involved. It was not enough to have central support only and subsidiaries had to be "seized as hostages" by the central service organisation and involved to agree on common processes. In connection with the rollout in Sweden, Belgium and the UK, BT held a three-day education/training for all

service technicians. Intenia, the ERP system provider, was also involved early, which facilitated the rollout. In 2005, Movex was used in 15 of the 22 European subsidiaries.

In the EASY project, there were many individual desires that the project management did not take into consideration. In this case, the focus was improved cash flow and other eventual, positive effects were seen as additional. Moreover, the scope was limited to order handling. The project had two main objectives; reduced invoicing lead-time and reduced administrative cost. Lead-times were reduced dramatically, from 1-4 weeks to 1-3 days only, and in Sweden, the number of customer centres was reduced from six to two. In 2004, approximately 1,500 service technicians had PDAs connected to EASY and they performed a total of 5,000 service assignments daily, including both planned and emergency jobs. When implemented, the most critical cost for the mobile solution was the operator cost of synchronising the PDA with the ERP system through the GSM network, a cost that is continuously being reduced, thus decreasing the payback time.

The evaluation phase of the EASY project was a key aspect that was already integrated into the initial plan. After the pre-study and implementation in the three countries, the project was evaluated and related to the investment cost by calculating payback times, changes in return on capital employed, efficiency gains, and return on investment. Examples of indicators from these evaluations can be seen in Figure 4.

Insert Figure 4 here

While BT benefits from reduced cost for administration, increased cash flow, and improved quality and planning, customers have benefited from faster response to service calls and service technicians that have all the necessary customer information at hand through the PDA. Administration is also reduced for the customer, who signs the completed work order digitally

directly on the PDA's display and can choose to receive work reports by mail, fax or e-mail. Since all front-office personnel have access to relevant data about the customer fleet, the service assignments have been performed with fewer unnecessary journeys to the customer sites. This has led to higher perceived quality by the customer, something that has been measured in customer surveys on several occasions. Hence, the quality of service has incrementally increased and the service availability has become better too. On the other hand, personal communication between customer and provider has suffered from negative effects. Several synergies have been derived from the EASY implementation and the mobile business system has been marketed towards customers as a more time-efficient tool. Communicating to customers that ICT applications are used to enhance the service processes has made customers view BT as high-tech also with regard to services. One of the things most highly appreciated was the possibility for customers to receive work reports electronically, something BT offered free of charge. In 2005, this was something none of the competitors was able to offer and it was thus an advantage. Even if sending work reports by e-mail was only a side effect of the EASY project, it is nevertheless a success and makes it possible for BT to include attachments such as customer surveys in the e-mails. Possible technical extensions are to connect a web-based interface with customers and to change the work routines for the field technicians. A second phase of the EASY project was rolled out in 2005 and service technicians can now search for spare parts information. In addition, the goal is to reduce synchronisation time by half and to enable minor software updates on the field. PDAs otherwise have to be collected and updated on a BT site and the possibility of updating software during the technicians' regular work would save time and make the update process easier. Utilisation of real-time information on customers' truck fleets through PDAs is also something which is being discussed.

4.5 Remote monitoring and optimisation

Similar to BT's EASY solution, ELS' management information system for laundries (CMIS) makes the service organisation more technically advanced in the eyes of the customer and substitutes personnel for dematerialised information. However, the internal cost reduction is mainly related to front-end personnel. Furthermore, the system is more linked to revenue generation and customer perceived quality than is EASY, due to its impact in the service process output. In addition, it is present also when the customer produces the service in isolation from the service provider.

With the CMIS system, it is possible to change laundry times, batch sizes, and decrease centrifugation times slightly and still obtain more laundry per day, thereby obtaining better optimisation of laundry programmes and flows. By monitoring and governing the customer's process through CMIS, ELS can help to improve the software and laundry programmes. It is possible to have CMIS in up to 30 machines in one location. The selling point is that CMIS can help the customer to maximise equipment uptime in three ways:

- CMIS keeps a log of the maintenance work performed on the laundry machine. The customer has access to the logged maintenance statistics and can use this to see what has been done to the machine, when, and by whom.
- If minor errors and/or human errors occur, the system alerts the customer, who automatically receives suggestions on a PC on corrective measures. This feature is considered especially useful to determine whether the problem to be dealt with is a human error related to the customer's handling or an actual equipment error.
- The customer has access to alarm statistics, showing the five previous error codes.

CMIS can either be run as a local network only or there can be a gateway to ELS so the firm can monitor processes, error codes, and when the laundry system is out of operation. Not

many competitors have systems similar to CMIS, which has been offered for some years even if sales have not yet been extensive. The system is a standardised product irrespective of geographical market and ELS personnel install it at the customer site. The machines that support CMIS all have a CMIS port as standard and the new generation of products will all have a CMIS port. Nevertheless, the major impact of CMIS will not come until the majority of the customers have internet access. Although much new data can be extracted through CMIS, ELS has to have strategies and methods for how to use the information in order to enhance the firm's service offering.

One risk with laundry systems supporting CMIS is the Wash Program Manager, which is open software the customer can use to create new wash programmes from a PC. Thus, it is possible to construct wash programmes wearing more on the laundry, machines, and water usage than the original programme if the customer has poor knowledge. For that reason, the possibility of including e-learning or other means to ensure that the customer knows how to optimise the laundry process is discussed. The risk of poorly customer-designed wash programmes is however not only limited to this software; on many machines the customer can create programmes via the keypad on the machine.

5 Discussion and conclusions

When improving service productivity, one of three profitability-generating strategies, cost efficiency, revenue effectiveness, and capacity utilisation – or a combination of them – can be used if the service productivity model is applied. Long-term relationships with customers are valued by the case firms and their opinion is in line with the view of Ojasalo (1999), which is that that relationship continuity, as it is a learning experience, contributes positively to all three service-productivity elements. The interrelations between the three elements imply that although a new technical solution can make changes to one of the elements in particular, the

other two are also affected by the change and the elements improved vary depending on how ICT is made use of. Even though more parts of the service process can be handled as dematerialised information, it is not a totally new way of doing business; service marketing logic is still valid (Normann, 2001).

The solutions found by the case firms illustrate that different impacts on service productivity can derive from ICT despite a theoretically identical profitability increase in monetary terms. The different effects these solutions have on service productivity are presented in Figure 5.

Insert Figure 5 here

Although Figure 6 shows how service productivity is influenced, the magnitude of change is not discussed more than on a two-graded scale without any comparison to the other ICT-based solutions. A primary impact on productivity is an improvement that, according to the firms' service managers, has influenced productivity notably more than an element with a secondary impact.

In spite of the fact that all the ICT-based solutions discussed in this paper are successful (or presumed to be successful) cases, other solutions may have elements which have both a positive and a negative effect on service productivity. However, even if none of the cases analysed contain any overall negative impact, there can be a negative impact on one or more of the three productivity elements from specific service activities in the production process. For instance, service production in Flygt's mobile workshops takes longer than in service centre workshops although the total cost efficiency is improved, and the reduced personal, interfirm interactions which are a result of BT's mobile PDA solution may have some negative effect on service quality even though overall service quality has significantly improved. Furthermore, there are examples from other firms where technology-centric

customer relationship management (CRM) systems have neglected the human aspects of service production, which has in turn led to decreased customer perceived quality and thereby reduced long-term profitability (cf. Gummesson, 2001; Jayachandran et al., 2005; Kale, 2004; Rigby et al., 2002).

5.1 *Theoretical contribution*

ICT tends to expand a large firm's span of ownership and control as new technological possibilities reduce the transaction costs of internal information flows and in so doing, increase the gains for the firm's management (Barras, 1990). Although this will enable firms to expand through both vertical and horizontal integration, ICT paradoxically also allows a more flexible and decentralised organisational structure as business systems and other ICT applications enable firms to overcome some of the coordination problems that arise from firms operating on several geographical markets. Well-designed processes with implemented ICT applications, such as the certification programme, installed base database, mobile PDA solution, and remote monitoring and optimisation, may overcome the traditional problems involved in the management and utilisation of knowledge at geographically disparate organisational entities, as discussed by Hayek (1945) and Penrose (1955). In the cases presented in this paper, ICT applications have facilitated the externalisation and combination of knowledge which Nonaka (1994) refers to. An installed base database is a good example of how tacit knowledge from front-office personnel can be made explicit and available to other employees also.

Another ICT-related implication concerns the increased standardisation and automation of existing service processes, which means that some services previously produced in interaction between provider and customer, gradually become produced by one actor only in isolation from the other. Process monitoring does not have to be done by a technician on site as it can be automated and remotely managed by back-office operations as long as nothing unexpected

occurs, whereas some customer-training services and certification programmes can become self-service through e-learning software. On a day-to-day basis, the service encounter plays a less significant role than it previously did.

In line with Gadrey (2000), capacity is becoming less of a constraint in services due to ICT. Output quantity is still linked to demand but more output per input unit is possible. Better demand management is also possible as demand fluctuations are more manageable due to SLAs and preventive maintenance contracts. However, service personnel are still required – albeit not to the same extent as previously – and this puts a certain limit on the capacity of many services. Human resources play an important role for many industrial services, particularly as value co-creation requires dialogue between the customer and the provider (Ballantyne and Varey, 2006).

The automation and dematerialisation of activities and processes lead to both reduced and to increased costs of inputs to the service production process. The increases in costs can be assigned to investments in technology and systems, and to the maintenance of the latter. On the other hand, personnel costs have been reduced and ICT has led to faster service production time, such as faster service-response lead times in the cases of BT's PDA solution and Flygt's mobile workshops. The costs of obtaining information have also been reduced, as information becomes more easily accessible than it was before and can be parsed in better terms. More data available enables more accurate service provision and thereby better process and outcome quality. In addition, it makes new information- and knowledge-based services possible. However, even if much new data can be extracted and made available through ICT systems and applications, firms must have strategies and methods for how to use the information so it can enhance the service offerings. Besides, as other actors also participate in the service production process, these strategies and methods should not only involve the provider firm.

Many international firms, BT, ELS, and Flygt included, cooperate with local service partners and it is therefore necessary to include these firms in the productivity model for industrial services. The revised service productivity model (see Figure 6) considers this as well as the effects that ICT has on the production process. Service partners usually produce services (such as maintenance and repair) in interaction with customers but, although this is not common, it is also possible that services are produced in isolation. In those cases, as well as when the provider produces the service in isolation (such as remote monitoring), the customer gives the provider/service partner access to the installed base and the necessary equipment and information. Likewise, if the customer produces the service in isolation, indirect inputs from the provider in terms of information and systems are still required.

Insert Figure 6 here.

With regard to external efficiency, all actors involved in the service production contribute to output quantity and quality. Unlike Grönroos and Ojasalo (2004), the author argues that all three productivity modes contribute directly to output quantity. However, the process quality of services produced by the provider or service partner is not perceived by the customer. Thus, such production processes have less impact on total customer perceived quality. From the provider's point of view, the participation of customers and/or service partners in the service production introduces uncertainty, i.e. "incomplete information about varying foci" (Larsson and Bowen, 1989, p. 216). Therefore, quality control through certification programmes and other means may be required to ensure that the quality of the work performed by external personnel is satisfactory.

5.2 *Managerial implications*

Technology maturity internally and among customers and partners is required if the introduction of new technology is to be successful (Parasuraman, 2000). If there is resistance from the personnel, either the firm's own or its service partners', to learn and adapt new software and devices, it will result in reduced service quality and productivity. One example is the unwillingness of service technicians working at some of the service partners of ELS and unfamiliar with computers to use the computer-based certification programme. Likewise, if the customer is reluctant to use new technology, potential business opportunities will be lost. Hence, a firm like ELS faces the educational challenge of convincing some customers to take advantage of remote monitoring and the optimisation possibilities of the CMIS system.

As the development of service offerings can be a very complex process, its success requires a concerted effort and careful attention (Grönroos, 2000; Karmarkar, 2004; Normann, 2001). An inference drawn from the cases is that new technologies and applications need to be supported by central management commitment and not be left to individual subsidiaries to develop and implement. Firstly, the central service organisation is often able to better allocate time and resources for new projects, especially large-scale ones. For example, as new hardware was needed for the laundry equipment, ELS' development of the CMIS system required integration between the central service organisation and product development. It would not have been possible for any of the subsidiaries to develop this. Secondly, central coordination can eliminate duplication of work at subsidiaries working with similar solutions independent of one another and thus enable technical standardisation and more cost-efficient solutions. ELS' certification programme and CMIS system and BT's mobile business system are three examples of economies of scale achieved through central management. Goodwill trust between central and local entities is needed for this influence through unilateral formal

control in order not to increase the relational risk associated with intrafirm coordination and cooperation (Kowalkowski, 2006b).

Despite increased emphasis on central management commitment, one must not forget that local presence and customisation is critical too, and that to a high degree a successful service production process depends on the employees interacting with the customer. Furthermore, prominent subsidiaries can be sources of service innovation and pilot regions for implementation and evaluation of new offerings before these are launched on a wide front. Flygt's mobile workshops solution was initially implemented in a pilot region where the infrastructure and knowledge required was available, before gradually being spread to other subsidiaries. Likewise, BT's mobile business system was initially launched in three subsidiaries and evaluated. If a holistic approach to ICT is taken, firms have a better likelihood to increase their service productivity (i.e. profitability) when implementing new technology.

Because of the possibilities which come in the wake of ICT, the goal should not be to replace existing internal processes with more technically advanced ones automatically, but, in line with Normann (2001) to consider an extensive reconfiguration of processes and strategies to find revenues from existing as well as unfamiliar sources. However, service development does not necessarily always assume this far-reaching standpoint. In parallel to major changes, service development can be carried through in small, incremental steps; a minor advance leading to only moderate cost reductions is after all also an improvement resulting in a new, more profitable service offering.

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Figures

Figure 1. A service productivity model (adopted from Grönroos and Ojasalo, 2004, p. 418).

Figure 2. Data gathering.

	BT Industries	Electrolux Laundry Systems	ITT Flygt
# Interviews	2	1	1
# Phone interviews	1	1	1
# Participations in discussion forums	5	3	5
# Participations in workshops	4	1	5
# Participations in project meetings	1	3	8
# Total	13	9	20
# Meetings with respondent	(9) Product Manager (4) European Sales Manager	(7) Vice President Genuine Parts & Services (1) Senior Manager Customer Care (1) Manager Future Care Support Processes	(16) European Product Manager (4) Product Manager Spare Parts

Figure 3. The case firms.

	BT Industries	Electrolux Laundry Systems	ITT Flygt
Business	Warehouse solutions	Professional laundry	Fluid handling
Products	Warehouse trucks, counterbalanced trucks, manual trucks	Washer extractors, dryers, finishing equipment	Submersible drainage pumps, submersible sewage pumps and mixers, submersible propeller pumps
Service offerings	Single services, spare parts, SLAs, rental plans	Single services, spare parts, SLAs (not all markets)	Single services, spare parts, SLAs
Turnover (2004)	€1.4bn	€240m	€700m
No. of employees (2004)	4,800	1,500	4,100
Main customer segments	Retail trade	International hotel chains, national commercial laundries	Public utility, construction and mining, industry

Figure 4. Some evaluation indicators of the EASY project.

Indicators	Before	Current state
No of worksheets copy	>3	0-1
Feedback on worksheets	1-14 days	<1 day
Parts replenishment	3-14 days	1 day
Rolling planning	Monthly	Daily
Input of information	2 or more	1
Order spare parts direct	No	Yes
Auto directed allocation	No	Yes

Figure 5. Impact on service productivity elements by ICT-based solutions.

	Cost efficiency	Revenue effectiveness	Capacity utilisation
Certification programme	Secondary	Primary	
Installed base database	Secondary	Primary	Secondary
Mobile workshops	Secondary	Primary	Primary
Mobile PDA solution	Primary	Secondary	Secondary
Remote monitoring and optimisation	Primary	Primary	Secondary

Figure 6. A productivity model for ICT-based industrial services (based on Grönroos and Ojasalo, 2004, p. 418).