Benefits of ICT Service Outsourcing

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Key Words: *ITC-services, outsourcing, process changes, productivity.*

Abstract. *The research by Maliranta and Rouvinen based on the Finnish industrial statistics confirms that the productivity improvements from ICT services in firms correlate with organizational and process changes. These results implied a further question: Which types of process changes create the most beneficial productivity improvements in different environments. The research on process improvements has been done in ETLA, in the University of Jyväskylä and in the University of Oulu, where the Three Viewpoint Method (3VPM) [1, 12] was developed for the productivity analysis of process changes. In this paper we apply the 3VPM approach to analyze the outsourcing and multisourcing of ICT services from a group of SMEs to one ICT service company or to separate IT and network service companies. The question is can outsourcing improve the total productivity of these SME firms as service customers. Outsourcing is considered often as a synonym for offshoring, where the service tasks are performed abroad in a country where people are paid less. In our study we study outsourcing benefits without this type of salary reduction.*

1. Introduction

The productivity increases from ICT (Information and Communication Technologies) in industry and society are of rather recent origin show Mika Maliranta and Petri Rouvinen from ETLA [10,11]. According to their research it seems that the excess productivity effect of ICT-equipped labor typically ranges from eight to eighteen per cent. The effect tends to be larger in services than in manufacturing. The effect is often manifold in younger and can even be negative in older firms. Since organizational changes are easier to implement in younger firms and recently established firms have by definition a new structure, this can be interpreted as evidence of the need for complementary organizational changes. Manufacturing firms seem to benefit from ICT-induced efficiency in internal communications, whereas service firms benefit form efficiency in external communications.

The literature has contributed to IT benefit measurement and management in four major areas: Performance improvements, the issue of information systems reach, tangible and intangible benefits and benefit evolution [15]. The benefits from process changes when workflow systems have been introduced are measured in [17]. Our work continues this research by developing a formal process modelling and analysis framework, the Three Viewpoint Method (3VPM) [1, 12], for the calculation of benefits created by the process changes enabled by the new ICT services.

In the literature there is little knowledge so far of what are best practices in organizing ICT-assisted work. It is nevertheless obvious that in the future when the ICT benefits are optimally applied in new process forms, the job descriptions will ultimately differ considerably from the current ones. The productivity improvements created by ICT services are a result of customer process changes enabled by the service processes. Depending on customer process types different improvements are possible. The benefits from customer process changes should be larger than the cost of the service in order the service to be feasible.

2. Business Process Modelling

Business process was defined by Davenport [4] as a specific ordering of work activities across time and place, with a beginning and end, and with clearly defined inputs and outputs. The initial approaches to business process development were published in the early 1990's [2, 7]. The term business process re-engineering (BPR) was also introduced at that time [7]. The management and improvement of business processes has generated since a large amount of literature, including topics such as Re-engineering the Corporation [8], Process Innovation [3], Improving Performance [16], Business Process Management [18] and Business Process Change [9]. All approaches have the same notion of improving the performance of the organization by developing business processes.

The first task in business process development is the process modelling, where the necessary features of the process are documented. There are several modelling approaches for this purpose based on Business Process Diagrams such as Business Process Modelling Notation (BPMN) by Object Management Group (OMG) [13], Ericsson Penker extension of Unified Modelling Language (UML) [5] and Workflow Nets [19,14]. Here we apply the UML Activity Diagram notation [5].

When a service is provided for a customer business process or a personal process interaction with the service process changes the customer process in a way that creates productivity improvements. Usually the utility of the productivity improvements should be larger than the cost of the service. However, in public services the utility is not only the performance improvement in the customer's process but also the utilities created through externalities in the society (*figure1*).

In addition to the process diagrams, both performance and cost modelling of the process are needed when productivity improvements are analyzed. We call the modelling approach that uses these three viewpoints: 1) diagrams, 2) performance and 3) cost, as *Three Viewpoint Modelling (3VPM)* [12]. For performance we use queuing network models to calculate the throughput and waiting times of events or tasks in the process

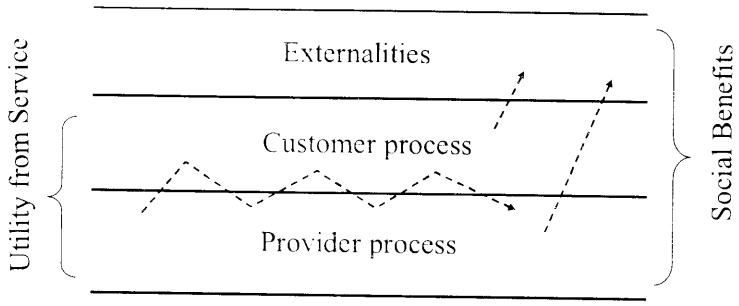

Figure 1. The benefits created by a service process

and the utilizations of the resources related to the activities of the process [6]. In cost analysis the fixed costs in the process are related to the costs per time unit of the fixed resources involved, as well as to the fixed quality costs and fixed risk costs. The variable costs of the process are related to the product of the utilization and the cost per time unit of the variable resources involved, as well as to the waiting costs, quality costs and risk costs that depend on the load of the system.

3. Business Process Analysis

The micro-level analysis of a system of processes is based on the following four steps: Drawing the logical process diagrams of the original and transformed processes, calculating the process performance analysis of the obtained models, calculating the activity-based costs of the models and comparing the results of the original and transformed models.

3.1. Create the Logical Process Diagrams

The first task, with the employees, is to create a cognitive description (a swim line model) of the work process. There are several descriptive models and corresponding graphical editors that can be used. Here we apply the activity diagram notation based on the OMG Unified Modelling Language (UML) with Eriksson Penker business process extensions (see Eriksson and Penker 2001). Both the service processes and the corresponding customer processes and their proposed changes should be modelled. The process diagrams specify the logical process model denoted by M.

3.2. Analyze the Process Performance

For performance analysis we use the queuing network solution G for the model M to calculate the throughput and waiting times of events, or tasks in the process and the utilizations of the resources related to the activities of the processes [6]. When the processes are analyzed using the queuing network model, the modelling results can be calibrated with the real system. The calibration often reveals problems or unknown features in the system, and a discussion with the process personnel is needed to solve possible inconsistencies. Only after successful calibration the possible process changes can be modelled and their effects analyzed.

3.3. Calculate the Activity Based Costs

In the cost analysis the fixed costs in the processes are related to the costs of the fixed resources, as well as to the fixed quality costs and fixed risk costs. The variable costs of the processes are related to the product of the utilization and the cost per time unit of the variable resources involved as well as to the waiting costs, quality costs and risk costs that depend on the load of the system. The cost function F divided by the number of service transactions and calculated as a function of load, represents the average variable cost curve generated by the production function of the system.

3.4. Combine the Three Models

In the Three Viewpoint Model (3VPM) approach the three viewpoints: 1) diagrams; 2) performance and 3) cost are related to each other with common variables (*figure 2*).

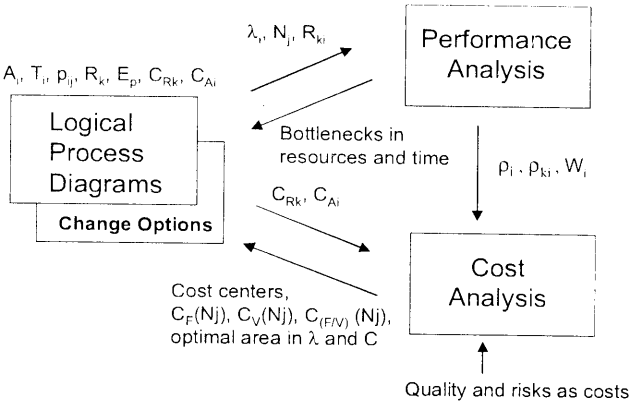

Figure 2. The 3VPM approach

In the process diagram the activities (A_i), related resources (R_k), tasks or customers (E_p) served and the corresponding task arrival intensities (λ_i), routing probabilities (p_{ij}), service times in activities (T_i), population sizes (N_j) and costs of resources (C_{Rk}) are given for the model M. The results are calculated in the 3VPM analysis using the queuing network solution denoted by G and the cost analysis solution denoted by F. The variables used as input and results obtained as output are displayed in *table 1* and they are related as shown below:

$$M = (A_i, T_i, r_{ij}, E_p, C_{Rk}, C_{aj});$$

$$(\rho_i, \rho_{ki}, W_i) = G(\lambda_{ij}, N_i, R_{ki}, M);$$

$$(C_F, C_V) = F(r_i, r_{ki}, W_i, M).$$

4. ICT Service Outsourcing

Our modelling target is to compare three ICT service strategies for local Small and Medium Size Enterprises (SMEs):

a) ICT services run by own personnel in each SME.
b) ICT services outsourced from the SMEs to a separate service firm.
c) ICT services outsourced to IT and network service firms.

Table 1. Input and output parameters in the 3VPM analysis

Inputs		Outputs	
Activities	A_i	Customer time in activity	W
Task classes	E_p	Customers p in activity i	N_{pi}
Routing probability	p_{ij}	Utilization of activity	ρ_i
Service time in activity	T_i	Utilization of resource k	ρ_{ki}
Arrival intensity	λ_i	in activity i	
Customers p in system	N_p	Fixed costs	C_F
Resource	Rk	Variable costs	C_V
Resource time in activity	R_{ki}		
Resource k cost in time	C_{Rk}		
Activity i other costs	C_{Ai}		

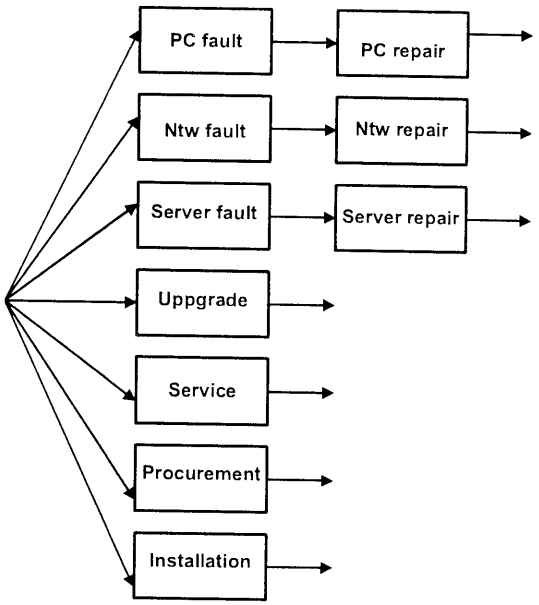

Figure 3. The ICT service activities in a firm

Table 2

Activity	Time	Intensity	Cost
Procurement	4	1	50
Installation	2	2	32
Service	8	10	32
Uppgrade	2	3	32
Network fault	2	2	400
Network repair	2	2	32
Server fault	2	2	400
Server repair	2	2	32
PC fault	2	9	65
PC repair	2	9	32

Table 3

Activity	Time	Intensity	Cost
Sales and consulting	16	0,167	50
Delivery	2	1	32
Travelling	1	3	32 or 50

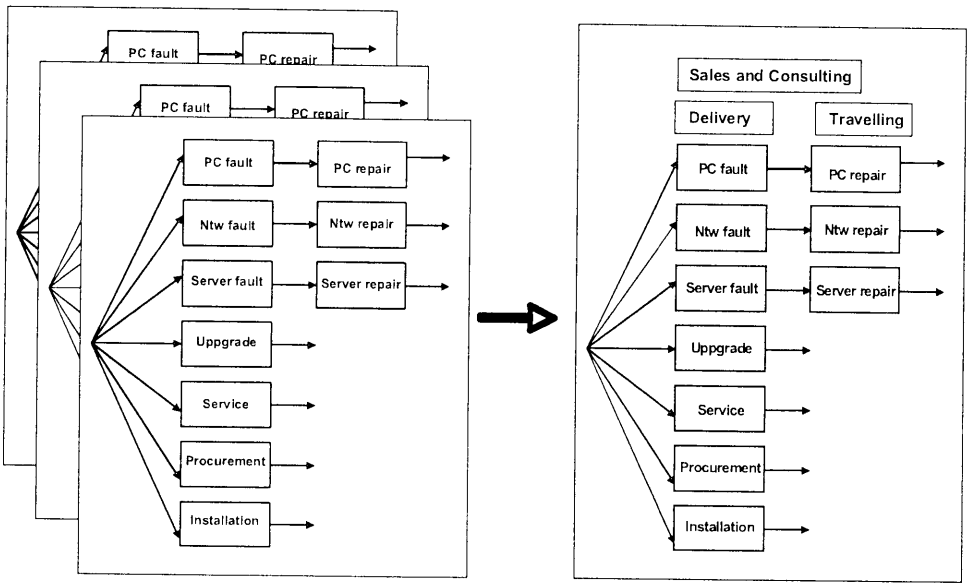

Figure 4. Outsourcing the activities from SMEs to a service firm

The ICT service activities are grouped in the following ***Table 2***, where the average times in hours, occurrence intensities during a month and involved costs per hour are depicted.

The costs in the table are calculated from the service personnel salary (32 eur/hour), manager salary (50 eur/hour) and average waiting time cost per hour for different faults (65 or 400 eur/h). The interrelation of these activities is shown in *figure 3*.

When these service activities are outsourced, then also the following management activities in the service firm are needed (*figure 4*).

If the IT and network services are outsourced to separate firms, they both have their own management activities.

5. Process Analysis

The chosen three ICT service strategies are modelled using the 3VPM-approach as follows:

a) All ten independent SMEs are modelled as shown in *figure 4*. The service costs from the activities in *table 1* and the waiting costs related to failures are paid by each firm. The service personnel includes one manager (30% of time) and one service expert in each firm.

b) The service activities of *figure 4* are now carried out by a service firm that has outsourced them from the previous ten SMEs. The service firm has the activities of *table 1* and *table 2*. The costs related to failures are paid by the SMEs and the activity costs by the service firm. The service personnel consists of one manager and ten service experts in the service firm.

c) Instead of ones service firm there are now two service firms, one for network services and another for IT services. The service personnel consists of one manager and four experts in the network service firm, and one manager and six experts in the IT service firm.

We have calculated the total costs of service personnel and the failure waiting time costs for other personnel in each strategy with the given event intensities. To analyze the flexibility of the strategies, we also calculated the same with 10% and 20% increased event intensities.

The interesting result from these model calculations was that outsourcing per se does not decrease the service costs unless we use cheaper labour. Service standardization, specialization of experts and increasing knowledge base in the service firm may improve the service as such. However, the argument of clear service improvements from expert specialization was not supported by the interviews we did in several ICT service departments. On the other hand, outsourcing had a clear effect in decreasing failure repair times. This means, that the cost of waiting time resulting from failures decreased considerably. The cost calculations of the three strategies outlined above are presented in *figures 5-7* and their comparison in *figure 8*.

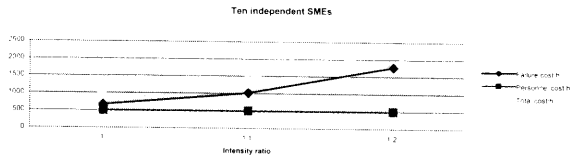

Figure 5. Costs from strategy (a)

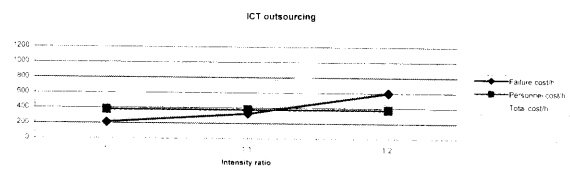

Figure 6. Costs from strategy (b)

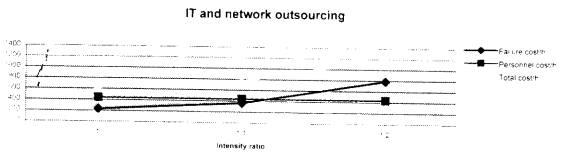

Figure 7. Costs from strategy (c)

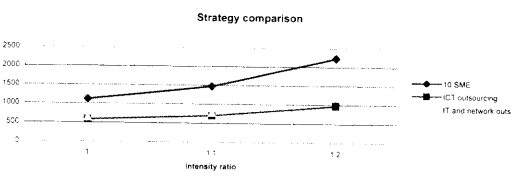

Figure 8. Comparison of strategies (a), (b) and (c)

6. Conclusions

By modelling the process changes which take place in ICT service outsourcing, we have shown that the outsourcing does not decrease the service costs unless we use cheaper labour. Outsourcing decreases the need for managers and increases the average utilization of service personnel. This can be interpreted as follows outsourcing reduces costs by lowering knowledge needs. Service standardization, specialization of experts and increasing knowledge base in the service firm may improve the service itself. However, the argument of clear service improvements from expert specialization was not supported by the interviews we did in several ICT service departments during the study. On the other hand, outsourcing had a clear effect in decreasing failure repair times. This meant that the cost of waiting time resulting from failures decreased considerably in both outsourcing strategies and hence the total cost in an outsourced service system was lower than in ten independent firms running the ICT services in house. Further study is needed to find out optimal Service Level Agreement (SLA) models for these outsourcing cases. Penalties from service failures and downtimes of services depend on the failure intensities and repair times. In the interviews the penalties defined in SLA specifications were recognized as a major new cost factor in service provisioning.

References

1. Alasalmi, A. and O. Martikainen. Multichannel Contact Strategy helps Outpatient Healthcare Access. – *The Journal of The Institute of Telecommunications Professionals*, 2, part 2, 2008, 43-47, ISSN 1447-4739.
2. Davenport, T. H. and J. E. Short. The New Industrial Engineering: Information Technology and Business Process Redesign. – *Sloan Management Review* 31(4), 1990, 11-27.
3. Davenport, T. H. Process Innovation. Harvard Business School Press, 1993.
4. Davenport, T. H. Putting the Enterprise into the Enterprise System. – *Harvard Business Review*, July 1998.
5. Eriksson, H.-E. and M. Penker. Business Modeling with UML: Business Patterns at Work. Wiley, 2001.
6. Gelenbe, E. and G. Pujolle. Introduction to Queueing Networks. Wiley, 2001.
7. Hammer, M. Re-engineering Work: Don't Automate, Obliterate. – *Harvard Business Review*, 68 (4), 1990, 104-113.
8. Hammer, M., J. Champy. Reengineering the Corporation. – Harper Business, 1993.
9. Harmon, P. Business Process Change. Morgan Kaufman Publishers, 2003.
10. Maliranta, M. and P. Rouvinen. Productivity Effects of ICT in Finnish Business. ETLA DP 2003, 852.
11. Maliranta, M. and P. Rouvinen. Informational Mobility and Productivity – Finnish Evidence. ETLA DP 919, 2004.
12. Martikainen, O. Productivity Improvements Enabled by ICT based Process Transformations. 3rd Balkan Conference in Informatics BCI'2007 Sofia 27-29.9.2007, 1-8.
13. Object Management Group: Business Process Modeling Notation Specification. Final Adopted Specification dtc/06-02-01, OMG, Feb. 2006
14. Reijers, H. A. Design and Control of Workflow Processes: Business Process Management for the Service Industry. Springer Verlag, 2003.
15. Remenyi, D. The Elusive Nature of Delivering Benefits from IT Investment. – *Electronic Journal of Information Systems Evaluation* (EJISE), 3, 2000, 1, URL: http://www.ejise.com.
16. Rummler, G., A. Brache. Improving Performance. Jossey-Bass, 1995.
17. Choenni, S., R. Bakker and W. Baets. On the Evaluation of Workflow Systems in Business Processes. – *Electronic Journal of Information Systems Evaluation* (EJISE), 6, 2003, 2, URL: http://www.ejise.com.
18. Smith, H., P. Fingar. Business Process Management. Meghan-Kiffer Press, 2002.
19. Van der Aalst, W. M. P. The Application of Petri Nets to Workflow Management. – *The Journal of Circuits, Systems and Computers*, 8 (1), 1998, 21-66.

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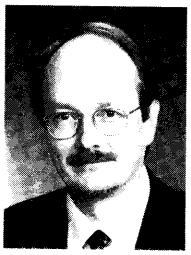

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