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Abstract

Services are playing an increasingly important role in present society, constituting the major part of economic activities. For several years, VTT has been a central developer of services and, in many sectors, taken the lead in service research in Finland. VTT is also becoming a well-known actor in this area at international level, and it aims to further strengthen its role, highlighting, in particular, the importance of service innovations. The relevance and benefits to Finnish industry and society continue to be the guiding principles in these efforts.

In August 2011, VTT organized the second Symposium on Service Innovation to disseminate information about central topics and the recent results of its service research. This symposium was a continuation and extension of the first service symposium organized in 2008. Whereas the first symposium was internal, this time VTT opened its presentations to existing and potential clients and other stakeholders. The aim of the symposium was to draw on ideas from different disciplines and foster fruitful dialog between them. The topics covered the whole service value chain and the spectrum of different types of activities, from the production of 'pure' services to the delivery of product-service offerings for which part of the interest lay in service-enabling technologies. Business-to-business and business-to-consumer services were covered, as well as the private and public sectors. The papers presented in the symposium were grouped under three titles: 1) servitization and deepening of service-dominant logic, 2) customer needs and user-driven service innovation, and 3) new approaches in service research. The material of the symposium has been compiled into this publication.

Preface

Service, the magic word, is suddenly everywhere. Services are a rapidly growing field both in business and in science, with remarkable influences on processes and operations in companies and other organizations. The transition from a manufacturing economy to a service economy, and from goods-oriented hardware suppliers to service providers, is ongoing and gaining momentum. This transition not only touches the industry but also society as a whole, influencing everyday life for all of us. It has even been argued that service relationships form the basis of economic and social exchange. Essential perspectives on service business are: [1] understanding customer value creation so that the provider knows how to support it, [2] efficient service processes that use the competences of both the provider and the customer, and [3] value capture and benefit sharing.

VTT has taken the above-described development and the increasing relevance of service research into account. It has included services in its technology and innovation strategy to emphasize the importance of this research area. An internal network 'Service Science and Business (SSB)' – which has continuously attracted new members and gained visibility outside VTT – has received support from VTT's management. As a result of these solutions and activities, VTT has become one of the central developers of service business among practitioners and taken the lead in many sectors in service research in Finland. VTT is also becoming a well-known actor in this area at international level. It aims to further strengthen its role, highlighting, in particular, the importance of service innovations. The relevance and benefits to Finnish industry and society continue to be the guiding principles in these efforts.

The allocated resources are one manifestation of the emphasis on services. The volume of services R&D at VTT began to increase five years ago. At the initial stage in 2006, VTT allocated internal resources for this purpose, but external funding also soon became available. The growth was more remarkable in

2009 when VTT succeeded in doubling the volume of external funding for services R&D. Since then, this volume has increased steadily, and this trend is anticipated to continue – strong signals indicate growing demand for research and development in this area. In order to strengthen its capability to answer this demand and widen international collaboration, VTT has taken the leading role in preparing a Strategic Research Agenda (SRA), supplemented by an action plan, together with the other European research and technology organizations. The aim is to provide input for national policies that support services R&D and for the preparation of EU research programmes, particularly the forthcoming 8th Framework Programme.

In August 2011, VTT organized the second Symposium on Service Innovation to disseminate information about central topics and recent results in its service research. This 2011 symposium was a continuation and extension of the first service symposium organized in 2008. Whereas the first symposium was internal, this time VTT opened its presentations to existing and potential clients and other stakeholders. The symposium provided an overview of VTT's service research and included several perspectives:

- How to combine the goals of customer centricity and efficient service production
- How to develop a system of interacting parts that include people, technology and business
- How to foster mutual understanding between the customer and the provider and develop co-production in service practice.

The symposium was based on ideas from different disciplines and aimed to foster fruitful dialog between them. The topics covered the whole service value chain and the spectrum of different types of activities, from the production of 'pure' services to the delivery of product-service offerings for which part of the interest lay in service-enabling technologies. Business-to-business and business-to-consumer services were covered, as well as the private and public sectors. Presentations were grouped under three main titles: 1) servitization and deepening of service-dominant logic (SDL), 2) customer needs and user-driven service innovation, and 3) new approaches in service research. The first title – servitization and SDL – focused on the transfer from a product-based business to service business and on the deepening of service-orientation in a way that results in profitability and productivity. The second title tackled the acquisition of understanding customers' service needs and the practices of co-innovation, i.e. the

involvement of customers and users in service innovation processes. The new approaches grouped under the third title included the building of capabilities for systemic changes and the application of dynamic modelling to services.

We thank all the contributors for their distinguished achievements in the field of service research. We hope that this volume – which includes the symposium presentations that introduce research results and results of developmental activities – will be of interest to a wide variety of readers: business managers, public service managers, experts in technology and service development, and researchers.

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NEW APPROACHES IN SERVICE RESEARCH

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Abstract

Service research is accumulating rapidly, and an increasing number of scholars from different disciplines are contributing to this research. Interest in services has also grown among practitioners, implying that policymakers and managers of private companies and public organizations expect applicable research results. VTT aims to answer these expectations while simultaneously strengthening its role as a well-known research partner in the scientific community. In the following, we summarize current and emerging topics and approaches in VTT's service research. In order to link our work to more general efforts in the international research community, we first present a brief overview of general trends in this research area.

General trends in VTT´s service research

Service research is carried out at societal level, sector level and organization level. *At societal level*, the growth and dominating role of services in the economy has brought with it several phenomena that are not sufficiently well understood and have resulted in practical challenges. Important research targets include development trends in international service markets (e.g. global sourcing) and the need for new policy instruments to scale up good practices that are typically local in the context of services. Productivity of services is a particularly urgent issue: several studies have indicated that services are laggards in this respect compared with manufacturing industries. On the other hand, criticism is increasing against traditional ways of measuring productivity: recent research

has highlighted that the focus should not only be on the provider's efficiency but also on effectiveness for the customer (which is the core of many services).

In addition to the macro-level issues of the service economy, development in *specific sectors* is the target of many studies. Since the mid-1990s, knowledge-intensive business services (KIBS), in particular, have aroused interest. Empirical studies have indicated that KIBS play a central role as sources, carriers and facilitators of innovation [1]. Their expert-based offerings have broken down earlier prejudices against services as a low-tech sector with a low educational level. In addition to KIBS research, the renewal of public services and the growing versatility of industrial services are actively examined. The renewal of public services calls for new types of innovation practices based on broad participation by employees and users [2]. Also the inter-linkages between service and social innovations, and between different social systems, are topical research issues. Besides service sectors, services play a critical role in the advancing development of the manufacturing sector. In this context, the broadening of offerings from product-related services (e.g. maintenance) to process- and business-related services (e.g. optimization and consultancy) is an on-going trend [3].

At the organizational level, the accumulation and implementation of user understanding are currently one of the main interests among researchers and a primary challenge among practitioners. The so-called service-dominant logic (SDL) perspective has essentially influenced the rise of this topic to the fore [4]. Vargo and Lusch, the promoters of SDL, point out that the value of service is always co-created by the provider and the customer – the customer (user) determines the value in a specific context. Recent studies have also highlighted that gathering of customer information does not guarantee its purposeful application. To be applicable, customer information has to be structured, elaborated, interpreted and shared within the organization. The formation of shared understanding of the interpretations and implications regarding customer information is often much more demanding than the gathering process as such; however, it is crucial for successful practical operations and organizational strategy.

Other perspectives at the organizational level include the role of strategy in service development and the interaction between strategy and managerial practices (regarding both operations management and innovation management). From the traditional view, which highlights the strategy that an organization *has*, the focus has moved to the analysis of strategy as practice: something that people *do* [5]. In service organizations, strategy also has a central role in the integration of innovative ideas, as these organizations only rarely have separate R&D

resources. Besides the encouragement of the creation of new ideas, there is a need for control, i.e. the management system has to sort out the ideas in accordance with the strategy. This kind of 'balanced empowerment' [6] fosters the emergence of an institutionalised learning process – continuous learning from mistakes and successes. In servitizing manufacturing, there may be separate R&D resources, but the organization of service business and service development in practice is often challenging. A central challenge is the necessity to develop completely new types of capabilities and organizational culture.

The brief summary above reveals the need for multidisciplinarity in service research: the central issues cannot be solved on the basis of any single discipline, but we need dialogue between economics, engineering, social sciences, behavioural sciences, etc. Reconciliation of the views of various 'schools' of thought is also important; we need dialogue between the service marketing 'school' (highlighting the customer perspective) and the service engineering and operations management 'schools' (highlighting the provider's perspective).

Strengths and emerging topics in VTT's service research

Our summary of VTT's service research includes two inter-linked perspectives: the sector perspective and the perspective of research topics. We start by analysing separately the research into industrial services, which is a specific strength at VTT. We then present an overview of other sectors. Here, we concentrate on rapidly growing research in the areas of public services and KIBS. Most topics can also be applied (and are applied to some extent) to private consumer services. We end with an analysis of research focusing on innovation, foresight and impact evaluation. These are strong research areas at VTT, but their application to services is only starting.

Industrial services and the phenomenon of servitization

For several years, VTT's core area in service research has been to deepen knowledge of *the nature and development of business models, value chains and networks*. This approach has been applied first and foremost to industrial services. Today, servitizing manufacturers produce and deliver their offerings in business contexts that include several different actors. The demand and supply

chains may both involve sequential producer-customer dyads, or the actors may cooperate in a complex network. On the demand side, there are, typically, the customer's customers and end-users in addition to the provider and the immediate customers. On the supply side, outsourcing and sub-contracting extend to new functions; strategic partnerships have become general but partners may simultaneously be competitors in some respects.

The involvement of these various actor groups means that the needs that form the basis of collaboration may be very different. An interesting new area of VTT's service research is *needs analysis in the B-to-B context*. Traditionally, the concept of need has been linked to the behaviour of individuals, and research into needs – and their manifestations as expectations, desires and requirements – to the world of consumers. However, this perspective also has practical implications in the B-to-B context: for instance, diversity in the purchasing behaviour of organizations is a typical and often poorly understood phenomenon. More generally, the growing emphasis on customer- and user-based approaches as the best way to achieve success in the long term makes it necessary to understand the needs of customers also in a situation in which the customer (client) is an organization. This understanding is a prerequisite for the selection of proper ways to acquire customer information and involve customers in co-production and co-development of services.

At the level of service offerings, integrated solutions, also called 'turn-key solutions' or 'full-service contracts' [7], have attracted increasing attention during the last decade. They focus on the client's activities and business processes, addressing customer needs in a holistic manner. At VTT, this development has been linked to the development of business models: *integrated solutions are examined in B-to-B service networks*. Another important aspect is the new challenges that solutions business poses for a company that has already provided services linked to individual products (e.g. maintenance and repair). It means an essential deepening of service- and value-oriented business logic and the requirement to develop a genuine service culture. The *development of service capabilities* that enable this kind of culture is an area that VTT researchers are actively studying; efforts to classify these capabilities are one specific issue here. One emerging trend is the *spread of servitization to process manufacturing* (e.g. the forest industry). This creates a new challenge regarding the nature of offerings: as there is not an installed base, companies have to transfer directly from 'pure' product business to 'pure' service business. Managing this transition is an area that VTT is tackling as a pioneer: research into it is scarce.

Public services and KIBS

While industrial services are the context in which VTT's service research is particularly advanced, studies on other kinds of services are also accumulating. In the *public sector*, health care services, educational services and transport services are examples of areas in which there are several ongoing research projects. Combining the viewpoints of *user-based and employee-driven service development* is one of the new initiatives that VTT is examining together with its research partners. The dominant paradigm of public services, which considers citizens as customers and aims at high performance and quality on the basis of hierarchical systems, has turned out to be inefficient and ineffective in some respects. New service models have been suggested that rely on more horizontally organised systems and highlight partnerships, co-production and self-regulating networks.

A central problem of the development of public services is the lack of scalability. The way health care systems are renewed is an illustrative example: there are numerous development projects that often result in a novel, good practice in one organization or local community but do not spread to others. *Societal embedding* – building up flexible stakeholder networks for scaling up novelties – is an interesting approach examined and applied by VTT researchers. Corresponding to studies on industrial services, we also analyse value chains and networks in public services and examine the enablers of and obstacles to collaboration in them. We also apply *the eco-systems framework*. We are currently interested in the interaction of systems at different levels, for instance: new combinations of smart infrastructure, information systems and social systems.

Human-technology interaction is an important general strength of VTT's research, and today it is also increasingly applied to the field of services. From usability studies, the focus has moved to the broader examination of *user experience*. Extensive ICT-related research at VTT has been the basis for several types of case studies that have examined *co-design of services* and often included the development and testing of facilitating tools. A web application for schools can be mentioned as an example. This application combines user-created multimedia with learning processes. Studies and tools linked to the use of *social media* are a growing field. Here, an example of the facilitating applications developed at VTT is Owela (Open Web Lab), an online co-design platform that allows consumers to participate in idea generation, concept evaluation and testing of various services [8].

ICT services are one sub-sector within *knowledge-intensive business services (KIBS)*. Despite this sub-sector (and the media sector linked to it), VTT has not been among the most active research institutes in KIBS research. Today, the situation is changing. For instance, the role of consultancy companies as facilitators of the co-development of multiple actors in a value chain has been perceived as an important research gap and is tackled in a project. A study focusing on the transformation process of 'routine' business services into knowledge-intensive ones (so-called 'kibsification') is another example of the growing interest in this service sector. These initiatives are important because KIBS research is a core area in studies on service innovation.

Innovation, foresight and impact evaluation

VTT has the potential to become an important actor in *service innovation research*. In Finland, VTT is the leading institute in general innovation research, and it is also well known internationally. Active research in this field has been carried out for decades, both at the organizational/managerial level and at the societal/policy level. In services, we still need much theoretical work in order to clarify the basic concepts and understand the differences – but also similarities – of innovation processes compared with technological fields. For instance, the need to bring novelties into the markets more rapidly and to balance in-house activities with the practices of open innovation is a common challenge. There are also several issues linked to the drivers of innovation, including the above-mentioned perspectives on user-based and employee-driven innovation. VTT has the opportunity to carry out not only qualitative case studies but also quantitative research on these topics. Its own SFINNO database supplements statistical sources, and even though this database currently focuses on technological innovations, it could be extended to services in the future.

The importance of *futures thinking* has been emphasised in innovation research and innovation policy. In order to foster innovation activities, views are needed concerning the future of different sectors. As many areas in society develop in increasingly faster cycles, comprising a number of uncertainty factors, the conventional forecasting methods have proved to be insufficient for acquiring futures intelligence. An approach in which the primary object is not to identify the most probable state of affairs in the future, but to understand the new processes initiated, has gained ground. The central ideas of this approach – foresight – are preparedness for many different futures and 'making the future'. *The*

long research tradition in foresight is a unique strength at VTT. Competences in this area are particularly valuable for strategy development and organizational learning. Linkages to service research are only emerging at VTT as well as in other domestic and international research institutes. Foresight projects have mainly focused on technological sectors, but pioneering service projects show that the basic methods of foresight are also applicable to services. These methods include scenario writing, trend analysis and weak signals mapping, among others.

Impact evaluation is another area in which VTT has long experience and which is promising from the viewpoint of service research. The assessment of impacts has traditionally been based on the legitimization of innovation policy instruments, and these instruments have relied on the linear (R&D focused) view of innovation. Together, these have made it difficult to extend impact analysis to the area of services, in which impacts are always co-produced by several stakeholders (private companies and public organizations, individual citizens/users and their communities). Today, systemic views of innovation provide possibilities for new broader approaches in impact analysis. The evaluation of impacts is informed by theories of learning, and it produces knowledge to support the continuous improvement of the activity of the organizations in question.

Three pillars guiding VTT's research practice

Increasing the awareness of emerging service research in different knowledge centres at VTT is important both internally and externally: it fosters in-house collaboration and supports the building of scientific and practice-oriented partner networks. In addition, it is important to *systematise and make visible our research practices*. These practices are based on three pillars: 1) utilization of technological excellence, 2) focus on real-life issues, and 3) linkage to the scientific community (see Figure 1). Balancing these three pillars enables the achievement of both scientific and societal goals in service research and fosters the utilization of VTT's long research tradition in technological fields. A common view among service researchers today is that studying and developing technology and services are not opposites. Services development should not be reduced to the introduction of technical systems, and focusing only on technological development is too narrow a perspective. On the other hand, the exaggeration of the specificity of services is not reasonable either; we need *a synthesis ap-*

proach that seeks common frameworks for the analysis of both manufacturing and services without denying the existence of some differences between them [9].

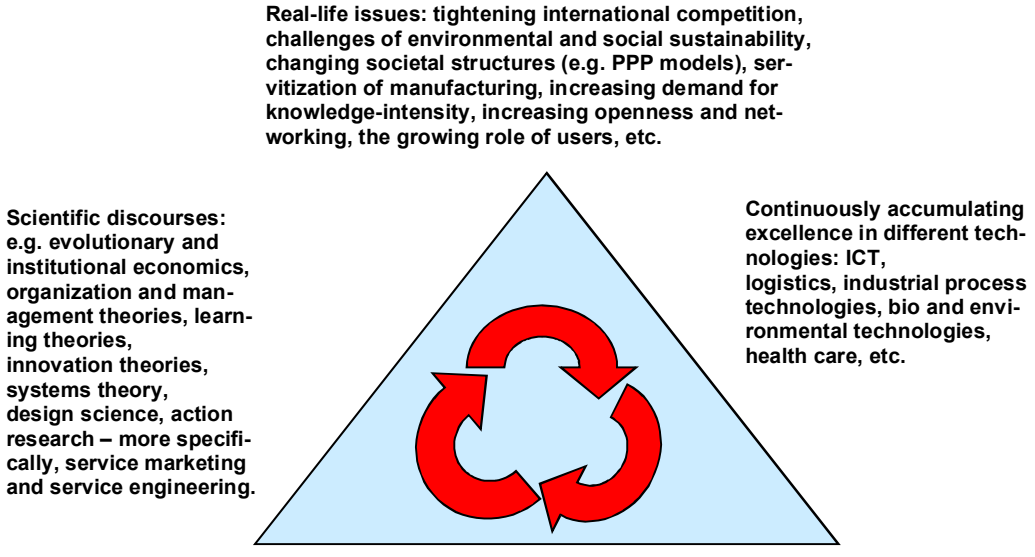

Figure 1. Three pillars in VTT's service research: utilization of technological excellence, focus on real-life issues and linkage to the scientific community.

VTT's basic nature as a technological research centre is an advantage that is important to use also in the development of service research. VTT is continuously accumulating excellence in *technologies that are tightly linked to service business and service offerings in the public context*. Examples are ICT, logistics, industrial process technologies, bio and environmental technologies, and health care technologies. Technologies may essentially facilitate the delivery of services, and based on them, new types of customer interfaces can be developed. In addition, technology as such may be the basis for new service business, with services linked to the promotion of sustainable development being an illustrative example.

VTT focuses on applied research, which means that *research tackles real-life problems, and solutions are sought together with companies and organizations*. Today, companies face many types of challenges that cannot be solved without the facilitation of external experts. These challenges include, for instance, tight-

ening international competition, requirements for environmental and social sustainability, changing societal structures (e.g. PPP models), servitization of manufacturing, increasing demand for knowledge-intensity, increasing openness and networking, and the growing role of users. The way in which VTT's service researchers cooperate with companies and organizations is based on *mutual learning*, not on the linear transfer of expert knowledge. Diagnosis and problem clarification on the basis of the newest knowledge are an essential part of the contribution that researchers make to companies. On the other hand, research develops when the general knowledge has to be used for solving concrete, context-specific problems.

Action research and case studies are typical approaches in VTT's service studies. In addition to interviews and company workshops, which have traditionally formed the core of these approaches, several new ways of working have been developed, and new tools are also available. Service design, rooted in the practices of industrial designers, provides tools for visualizing the service concept to be developed [10]. Service blueprinting technique facilitates the development of user-orientation by analysing in detail the customer's path and the value that is co-created [11]. Today, VTT's service researchers use these new techniques and tools actively. In the collaboration with companies and organizations, results are presented in a form that can be used concretely by practitioners. An important benefit for companies is the benchmarking possibility: companies participating in VTT's services research projects collaborate with and learn from other companies in the same project.

VTT's researchers contribute to scientific discourses in the services field both thematically and methodologically. Multidisciplinarity, which was highlighted earlier in this paper, is a characteristic of this research area within VTT: research is based on evolutionary and institutional economics, organization and management theories, learning theories, innovation theories, systems theory, design science and action research. One aim is to integrate theories and models of service marketing (focusing on the customer) and service engineering (focusing on the provider). In management research, integration is sought between strategic management, operations management and innovation management. The development of new approaches is pursued by combining the perspectives of innovation, foresight and impact evaluation. Of the individual methods that seem particularly promising, system dynamics and modelling can be mentioned as an example. It has been used for optimization and anticipation purposes in industrial services and health care, for instance.

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Strategic research agenda and implementation action plan for services

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Abstract

Today, services constitute approx. 70% of the total employment and GDP generated by the EU27. The share of services is growing everywhere in the world. The on-going transition from manufacturing economy to service economy and from goods-oriented hardware suppliers to service providers is gaining momentum. This change not only touches industry but also society as a whole. However, the European service sector is not performing as well as it could, as its productivity is not particularly high. The Strategic Research Agenda and Implementation Action Plan for Services (Services SRA) in association with the Associated European Research and Technology Organisations (AERTO) were therefore implemented. The key objective was to identify and justify the most important research themes and development needs of services and to issue recommendations for the volume and organization of service-related research in Europe. The main function of the Services SRA is to guide national funding organizations and to provide input for the preparation of EU research programmes, in particular the forthcoming 8th Framework Programme.

Introduction

Today, services constitute an increasing part of the EU's economic activity at approx. 70% of the total employment as well as the gross value added generated by the EU27 (Pro Inno Europe, 2010). More generally, the share of services is also growing worldwide in almost every country. The ongoing transition from

manufacturing economy to service economy is gaining momentum. This change does not just concern industry but society as a whole.

Europe appears to be facing a relative decline in manufacturing industries. This is not only a result of the triumph of the service economy but also of the emergence of Asia and, especially, China, as the world's major manufacturing base and growth centre. Europe's competitive position is at stake and so is its ability to generate enough economic wealth to secure a decent standard of living for its citizens. Most European economies are also heavily indebted as a result of lax budget discipline in the past and the massive remedial actions necessitated by the recent financial crisis. Such challenges place increasing demands on Europe's private sector.

Services have real potential to contribute. Deloitte, a consultancy company, concluded in its study of services in the manufacturing industry (2006) that 'the average profitability of the service businesses benchmarked is more than 75 percent higher than overall business unit profitability, and accounts for an estimated 46 percent of total profits generated today.' Deloitte also concluded that 'in many manufacturing companies there would be little or no profitability without the service business.' By offering services, companies pursue the facilitation of product sales, expand the scope and lifetime of their customer accounts, lengthen product life cycles, create new growth possibilities on already partly saturated markets and respond to customer demands (Neely, 2008; Baines et al., 2009).

Service research is continuously growing and extending to new themes. It aims to solve complex problems of the service economy by applying an interdisciplinary approach to the analysis and development of services, often in collaboration with academia and practitioners. One of the key challenges for service research and associated research disciplines is to develop precise concepts, methods and instruments that take into account the special requirements of service innovations such as the important role played by customers and employees as well as the immediate nature of service provisioning (e.g. Teboul, 2006).

Service research (recently studied, among others, under the heading 'Service science') has expanded to cover all the major aspects of business, technology and workplace development. The list of ten overreaching research priorities listed by Ostrom et al. (2010) provides a good example, including such themes as creating and maintaining a service culture, enhancing service design, optimizing service networks and value chains, effectively branding and selling services, and leveraging technology to advance services.

The development of services is at the core of national and EU-level policies. However, services have been largely neglected in the EU Framework Programmes. A recent study carried out by Tekes revealed that only 2% of the FP7 project summaries explicitly referred to service innovation. Furthermore, service innovation was not the main topic in any project (Tekes, 2011). Yet Europe needs to make sure that the amount of money allocated to service research and development reflects the relative importance of the area to European economies and citizens. Hence, the concrete goal of this study was to develop a Services SRA to strengthen the role of services in European research programmes to contribute to the growth and competitiveness of Finnish and other European economies. The major objectives of the Services SRA were to: 1) identify and justify the most important research themes in services, 2) issue recommendations for organization and funding research, 3) strengthen the status of services in EU-funded research (FP8), and 4) provide guidance for national funding agencies. This paper focuses on service research themes.

Research methods and data collection

Important research themes are likely to contain the features of the wider socio-economic environment in which service innovation is expected to take place. Given the diverse nature of the EU27, it is no wonder that European policymakers and representatives of EU-level and national funding agencies have stressed the importance of effective networking and coordination, development of regional competence centres, small business support, public-private partnerships, and 'platforms thinking' to foster the creation and exchange of knowledge and knowledge-intensive products and services – just to mention a few examples (Pro Inno Europe, 2010). It is self-evident that to support service development the European research agenda must in one way or another also address structural issues, including the rules and arrangements surrounding the framework programmes. The scope of the Services SRA does not exclude any particular type of research or application area (industry branch) but covers both basic and applied research as well as generic and industry-specific research themes.

The work is managed by VTT and is conducted in association with key AERTO member organizations, especially TNO, Fraunhofer ISI and IAO, TECNALIA, SINTEF and SP (referred to as partners). VTT and its partners provide the main input to the process generated by means of on-site interviews

of workshop participants. Supporting methods include a review of relevant research and policy papers, identification and review of relevant technology platforms such as ECTP, ERTRAC, MANUFUTURE, Net!Works (also called e-Mobility), NEM and NESSI, as well as exchange of information with the EPISIS network of national funding agencies. The latest service research, especially that addressing further research needs, industry-academia cooperation and the effectiveness of research, was reviewed, as well as relevant EU-level and national policy papers. Comments from selected industry associations in each partner country were also elicited.

Trends affecting services

To identify and justify the most important research themes and development needs in services, trends affecting services first have to be mapped. The rationale of charting trends is twofold. First, we need to understand the present drivers, challenges and development needs in services to set up the starting point. Second, we need to be able to anticipate what is going to happen in the foreseeable future. Trends in the global economy, consumer behaviour and markets have been condensed and further processed by Ahola and Palkamo (2009). Those trends that have significant impact on services are considered and justified here. Trends in ICT and services have been identified and formulated by the project team in association with AERTO partner organizations. ICT in particular is emphasized as it can have a marked effect on the efficiency of service production, the availability of services and the profitability of service business in domains with services of a knowledge-intensive or routine-like nature. Trends have been divided into four topics: 1) Megatrends in the global economy and production, 2) Megatrends in private consumption, 3) Megatrends in ICT and its service-enabling features, and 4) Generic service-related trends.

Megatrends in the global economy and production describe the changing nature of the geography of economic growth and production. The direction is from the West and North towards the East and South: the centre of gravity has moved to Asia and developing countries. Most of the trends indicate that the world economy continues to grow and that the growth is generated mainly by the BRIC countries and elsewhere in Asia. Rising energy prices pave the way for alternative energy technologies. Alternative technologies that have been developed for a long time, but have not so far been profitable, will gain momentum.

The basis is that the ICT will enable industry sectors to be connected smartly (smart grids, smart manufacturing, smart buildings and smart lighting) to provide sustainable energy services by combining dynamic tariffs, smart metering, consumption forecasts and energy trading. The demand for energy saving products and services exceeds the supply.

Megatrends in private consumption in general deal with consumption as it spreads over the world as a way of living. Consumers are becoming increasingly individualistic but, at the same time, they want a new kind of communality and they use other consumers' views as a reference. New consumers want influence. Consumption as a lifestyle is expanding everywhere and almost all human existence and activities can be analysed and interpreted through consumption. Immaterial consumption increases overall consumption**.** The economic life cycle of devices continues to shorten and the number of devices per households continues to increase**.** Production and consumption are separated geographically. More money is spent on free-time activities.

Megatrends in ICT and its service-enabling features are linked to ICT and its potential to enable new services, although the elaboration and implementation of services take place at a considerably slower pace than technology allows. Data intensiveness, decentralized system architectures and the fusion of 'real' and 'virtual' in the context of ICT can have a particularly marked effect on the efficiency of service production, the availability of services and the profitability of business both in knowledge-intensive and routine services. Cost-cutting and productivity demands are striving for the human interface to go into hiding. Almost everything possible is becoming automated. This is characterized by a transition from 'service' to 'self-service'. In the future, perhaps only privileged customers (i.e. those who are most profitable to the service provider and who demand personal service) may have access to personal service. Examples are easy to pick, e.g. retail telecom/Internet/travel services etc. Societies are heading towards Web-based organization of work and life with an increasing need to manage social robustness.

Generic service-related trends encompass a shift from 'operand resources' (value in property) to 'operant resources' (value in use). Customers demand value-in-use while service providers struggle to develop pricing models based on the value delivered. The so-called service-dominant logic perspective even argues that service, rather than goods, is the basis of economic and social exchange (Vargo and Lusch, 2004). Sustainability as a necessity is a gradually evolving concept that covers not only environmental but also social, economic

and cultural sustainability. It is not yet a core driver for service innovation, but it can be expected to emerge as an important feature of most products and services in the mid-term future. Everyone is into services. It is becoming increasingly difficult to achieve visibility, resulting in marketing imperative. Companies can be expected to invest time and money in differentiation.

Proposed research themes

The world economy is currently transitioning from a goods-based economy into an economy in which value creation, employment and economic wealth depend on the service sector. So far, interest in services has focused on marketing or management as well as on service sector economics. Innovation activity is one central direction in which service research could go. In industry, there has also been growing recognition in the past decade that service innovations are now as important as technology innovations (Demirkan et al., 2008). Knowledge-intensive business services (KIBS), in particular, have been found to function as sources, carriers and facilitators of innovation (Miles, 1999). On the basis of the preliminary results of the work that aims to develop a strategic research agenda and implementation action plan for services, we propose the following high-level research themes: 1) value-in-use, 2) verification and validation, 3) data management, 4) efficiency and productivity, 5) utilization of new technologies, and 6) sustainability-in-practice. In addition, 7) policies and regulation as well as 8) research methodology are considered.

The value-in-use theme focuses on customers who want to pay for the solution or outcome. Naturally, fitness-for-purpose and availability when needed are expected as easy, reliable and transparent transactions. Challenging research topics include value creation and capture logics as well as configurability and scalability of services. Identification and transfer of good practices (e.g. web banking) to other domains will be studied. Integrating 'design thinking' into service practices, processes and systems, and aligning service design approaches with existing organizational structures will serve the creation of holistic service experiences for customers, clients, employees, business partners and/or citizens.

Verification and validation analyses whether the vendor/service provider can be trusted, and hence they focus on concepts and technologies to support the verification and validation of services (incl. functionality, robustness, data secu-

rity, vendor background, etc.), and to find out what else the service does that is not disclosed, e.g. does it collect and send my personal information such as contacts to third parties. The agenda will focus on concepts and technologies to support the verification and validation of services as well as collaborative and group testing. A comprehensive evaluation of web services is also included, even if their source code is not available.

The Data management theme concentrates on acquisition and analysis of customer data to support diagnostics, maintenance, operations, etc. (especially in the B2B sector and in the case of expensive investment goods). Follow-up of use patterns to support product (service) development and the development of systems that can automatically adapt to user preferences is also included. Research is needed in theories and technologies to support rich data mining and a comprehensive approach to data privacy, security and ownership issues.

Efficiency and productivity is concerned with relatively expensive labour in Western Europe. The general fear is that European firms face harsh global competition: how can they produce more value with manageable costs? Furthermore, small firms lack economies of scale. One important challenge is also the protection of service innovation. The solution will exploit modelling, simulation, modularization and automation technologies. Possibilities for intellectual property management in services also have to be identified.

Utilization of new technologies focuses on more applicative themes, such as the application of cloud computing/web service technologies. New technologies may have many potential strengths, but they often create new challenges in the areas of technical and semantic interoperability and quality of service, especially in the case of mission-critical applications. Challenges lie in issues such as who sells what to whom, who carries out the 'packaging' and the division of costs, revenue, responsibilities and liabilities.

Sustainability-in-practice focuses on growing awareness of the environment, scarcity of (critical) materials and energy, market and regulatory demands and how to proceed from marketing talk to real business and from the margin to the main street. Challenges encompass anticipation of changes in the market and regulation, perhaps also an active review and development of related policies, and how to help companies build business cases on sustainability. Despite much work, there is a clear need to develop and lobby metrics for sustainability.

Policies and regulation are required to cope with many de facto barriers to free service trade within the EU, including official monopolies but also hidden protectionism contributing to the 'productivity gap' and discouraging entrepre-

neurship. Hence, a critical review of legislation and business practices at EU and national levels, identification of effective barriers to services trade, constructive critique and promotion of free service trade within the EU are needed to make them less fragmented and regulated along national lines as well as to increase cross-border services. On the other hand, when everything is more or less ICT-based, this dependence may result in vulnerability of society and endanger critical societal functions in the case of a major system breakdown. Thus, there is a need for plausible prevention and mitigation plans.

Research methodology is needed to develop new service-specific methods from a scientific perspective to tackle issues such as the shift from products as a unit of analysis of collaborative value creation and determination; refocus on operant resources as a source of value; diminish the antagonism between producer and consumer; improve the innovation culture; shape interactions and emotions; model and simulate services; 'co-create value'; as well as for governance, organization and processes.

Conclusion

This paper presented the major trends identified in services as well as overriding socio-economic and ICT-related megatrends that currently influence the development of services. These identified trends will provide the starting point and justification for the proposed research themes. The high-level research themes are 1) Value-in-use, 2) Verification and validation, 3) Data management, 4) Efficiency and productivity, 5) Utilization of new technologies, and 6) Sustainability-in-practice. In addition, 7) policies and regulation as well as 8) research methodology are considered. The work is conducted in association with AERTOs' ERA-NET Coordination Action. A number of workshops have been held with AERTO members. A more complete presentation of Services SRA is under way and due for completion by the end of 2011. Trends will also constitute an integral part of this final report, as they provide the starting point and justification for the proposed research themes in services to be supported by EU-level activities and issue recommendations on how to enhance the effectiveness of research in this area through various EU-level instruments to ensure sound economic and societal impact. The promotion of service innovation within the frameworks of social and organizational innovation and the broadening of analy-

sis from services to immaterial values in general would be interesting. The identified service-related trends and the derived research themes aimed to provide funding for service system research through industry-academic collaboration and to strengthen European service research with an international orientation to integrate a rather fragmented service research structure within the different EU member states.

The Services SRA provides guidance for the preparation of future research programmes and calls for proposals at EU level. Research institutes and universities can use the coming deliverable as part of their planning activities, e.g. in relation to setting research priorities, competence building and allocation of resources. For companies, the deliverable provides an overview of the focus areas of services research in the mid- to long-term future and, expectedly, also new ideas on how to use research to solve demanding business development challenges in an effective manner.

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List of abbreviations

AERTOs	Associated European Research and Technology Organisations
BRIC countries	Brazil, Russia, India and China
ECTP	European Construction Platform
eMobility	Mobile and Wireless Communications
EPISIS	European Policies and Instruments to Support Innovation in Services
Fraunhofer IAO	Fraunhofer Institute for Industrial Engineering
Fraunhofer ISI	Fraunhofer Institute for Systems and Innovation Research
MANUFUTURE	Future Manufacturing Technologies

NEM	Networked and Electronic Media
NESSI	Networked European Software and Services Initiative
SINTEF	The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
SP	SP Technical Research Institute of Sweden
SRA	Strategic Research Agenda
Tekes	The Finnish Funding Agency for Technology and Innovation
TNO	Netherlands Organisation for Applied Scientific Research
TECNALIA	Fundacion Tecnalia Research & Innovation

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Building capacities for systemic change: a diversified roadmap in the context of VTT's service research network

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Abstract

The organisational and geographical scales of innovation systems are now more interlinked than ever. This means that the ramifications of systemic transformations flow through this meta-system faster than before and that these flows have complex effects. Due to this systemic complexity, the implications are also harder to anticipate. Research and technology organisations (RTOs), as key nodes in the innovation meta-system, should therefore develop at least two systemic capacities: 1) partial structural openness and fluidity that enable flexibility in responding to the systemic flows and 2) a horizontal anticipatory culture that integrates the critical knowledge in an RTO to build an internal future-oriented agency, anticipatory capacity and foresight sensibility.

In this paper we propose that practices of technology roadmapping could be applied to building these strategic capacities in an RTO. We exemplify these roadmapping practices by briefly analysing a selected development process at VTT, namely VTT's Service Science and Business Network, as a case study.

Introduction

The organisational and geographical scales of innovation systems are now more interlinked than ever. This means that the ramifications of systemic transformations flow through this meta-system faster than before and that these flows have complex effects. This interrelatedness poses specific challenges for the organisations striving to navigate the landscape of myriad impulses. Navigation calls for specific strategic capabilities and resilience. Organisations should, first-

ly, crystallise their own purpose and role in this landscape. Secondly, they should have some kind of filtering mechanism to identify more crucial impulses from less important ones, and, thirdly, as this landscape is constantly evolving, they should possess an adaptive capability to alter their course. In other words, organisations face a somewhat paradoxical situation: strategies should be robust and spring from unique organisational culture, yet they should simultaneously foster openness and adaptability. Hence, the starting point for our paper is the question of how to construct these kinds of paradoxical strategic abilities in an organisation.

In the paper, our focus is on research and technology organisations (RTOs). Arnold et al. [1] present a broad definition of RTOs, which can be summarised as follows: RTOs are organisations whose predominant activities are to provide research and development, technology and innovation services to enterprises, governments and other clients.

RTOs also navigate the rugged landscape depicted briefly above. We therefore suggest that RTOs would benefit from developing two systemic capacities: 1) partial structural openness and fluidity that enable flexibility in responding to systemic flows, i.e. interaction taking place on the interface between the outside world and the organisation as well as inside the organisation, and 2) horizontal anticipatory culture that is based on internal future-oriented agency, anticipatory capacity and foresight sensibility.

We explore the questions of systemic transformations in the context of a Finnish RTO, namely VTT Technical Research Centre of Finland. We propose that practices of technology roadmapping could be applied to building these strategic capacities. We present a diversified roadmap concept that adapts the scope of traditional technology roadmapping and widens its horizon towards such directions as visionary strategic management, network building and development, organisational learning and adaptation. We exemplify these novel roadmapping directions by analysing VTT's service research network process as a case study. This article is based on a submitted journal manuscript of Ahlqvist et al. [2], which presents a more detailed description of the diversified roadmap concept at VTT.

Components of systemic transformation capacities

Three basic temporal levels condition the strategic options of an organisation: 1) potential futures (anticipated, plausible, implausible and unknown), 2) past decisions that affect organisations both explicitly and implicitly, and 3) present, in which all decisions are realised and put into action. It is critical to understand that the unrealised options in the past, as well as the potential ones in the future, also affect the present decisions [3].

Organisations navigate, as argued above, in the strategic landscape that increasingly demands specific systemic capacities. For example, Geels [4] uses the term 'socio-technical system' to describe a complex systemic interaction that encompasses production, diffusion and use of technology. His insight is to connect micro-scale technical niches into macro-scale currents he called 'landscape developments' through a middle-scale of a socio-technical regime. Smits and Kuhlmann [5] argue that innovation is a systemic activity that 'involves a variety of actions within the system, of which the innovating organisation or innovator forms part'. They propose a notion of 'systemic instruments' that endorse the building of what we here call systemic transformation capacities.

We propose that systemic transformation capacity is built on, at least, two components. The first component is a partial structural openness that enables flexibility in responding to the systemic flows, i.e. changes in the business environment and in customers' innovation processes. In order to build systemic transformation capacities, the organisation should understand itself as a system, i.e. a construction of multiple actors, different trajectories and temporal dimensions. The notion stems from the complexity theory. From this perspective, organisations are perceived as complex systems in which transformations emerge partially through self-organisation and partially through deliberate interactions of multiple trajectories and actors working in divergent temporal dimensions. These dimensions could be, e.g. linear, visionary or disruptive. Combining these varied frames of activities is a fundamental strategic challenge for organisations. In fact, the combination requires the organisation to be structurally open. For example, Aaltonen [6] calls these sites of combination chronotope spaces. Thus, the capacity to transform lies in the organisational ability to combine different elements in its field of strategic alternatives.

The second component is a horizontal anticipatory culture that connects the critical knowledge in an RTO. The anticipatory culture catalyses the future-oriented agency that is internal to the organisation. The future-oriented agency

can be defined as a strategic capacity of an organisation or a community to construct feasible targets for the future through shared dialogue and to implement actions on this basis. Anticipatory culture also catalyses anticipatory capacity that is closely linked to the future-oriented agency. We define anticipatory capacity as a capacity to continuously reflect on one's own actions against a systematically formed strategic view of the future and to change one's behaviour and/or strategic view of the future when necessary. The future-oriented agency and anticipatory capacity, when bridged, result in a foresight sensibility, i.e. a holistic sense of the organisation's orientation towards multiple futures (anticipated, plausible, implausible and unknown). Foresight sensibility then feeds back into strengthening the anticipatory culture. It is useful to acknowledge that anticipatory culture is conditioned by the contextual history and traditions in an organisation. Hence, the anticipatory culture means that organisations are understood as kinds of 'continuums' between future options, present decisions and past development paths.

We further suggest that in the context of roadmapping, the building of systemic transformation capacity can be realised via the following three steps: 1) identification of relevant roadmap knowledge spaces, 2) specifying relevant roadmap scope, and 3) building managerial orientation to deal with the outcomes. These ideas and concepts will be elaborated on below.

Roadmapping as a method for building systemic transformation capacities

Using roadmaps in strategy processes

Roadmapping is considered both as a line of strategic thought and as a process methodology[1]. Roadmapping combines different modes of knowledge with specific thematic layers [7,8]. In other words, roadmaps are strategic tools for the crystallisation and combination of organisational knowledge that may seem 'unlinkable' with other strategic methods.

[1] In this paper it is not possible to provide a review of the origins and different dimensions of roadmapping. For useful reviews, see, e.g. 7, 8, 9, 10, 11 and 12.

There are several approaches to the way a roadmap can be used in strategic thinking. Naturally, it is generally useful to enter the future-oriented exercise, if it is done in a fashion that discusses the taken-for-granted axioms of a topic or an organisation. The actual roadmapping process, if it is well planned and executed, is also very useful for opening new perspectives towards the future.

Another application for the roadmaps to strategic thinking is to use and read the outcomes of the roadmapping process, i.e. visual roadmaps, in different ways. The first way to use a roadmap is to create a common vision. Basically, roadmapping is a collaborative long-range strategy process that endorses a vision to which each stakeholder can commit. The second way is the identification of societal needs that drive the development processes. When there is a specific need to link technological development with an understanding of its relations to societal needs, e.g. on the issue of so-called 'grand challenges' like climate change or ageing people, roadmapping is a useful strategic instrument. The third way to use roadmaps is to articulate demand in the context of, e.g. some product or a service. When executed well, roadmap synthesises a common understanding of the participants about future societal and market needs. The fourth way of interpreting roadmaps is what we call visionary strategising. This means knowledge cumulating out of understanding the systemic interfaces and linkages between roadmap layers, for example, societal drivers, markets, solutions and technologies in a certain timeframe. The fifth way is to identify single targets in the roadmap structure. Single targets could be useful for, for example, drawing up a subcontractor strategy. The sixth way is to read roadmaps as temporal sequences, i.e. to identifying logical temporal sequences in a specific roadmap layer, e.g. enabling technology.

Diversified roadmap concept: knowledge spaces and roadmap scopes

In this paper, we suggest a diversified roadmap concept for an RTO. Our suggestion builds on the idea that roadmaps could be used in strategy processes to create a future-oriented agency in the organisation. We assert that the future-oriented agency has a key role when constructing systemic transformation capacities in any context.

The next question is one of how to combine the roadmapping methodology with the creation of a future-oriented agency. In order to realise this, we propose a model that separates what we call *roadmap knowledge spaces* from *roadmap*

scope. Here, knowledge space refers to a domain in an organisation or in a community in which a future-oriented agency can be mobilised. Knowledge spaces therefore depict key spheres in which the systemic transformation capacity is realised. Roadmap scope (below) refers to the level at which the roadmap is aimed. Scope is a more traditional insight into roadmapping methodology that separates, e.g. technology roadmaps and market roadmaps. Our model makes a distinction between roadmaps with R&D scope and roadmaps with systemic scope.

We have singled out four knowledge spaces that are important in the context of RTOs (see Table 1). The first knowledge space is *technology space*, which basically covers a domain of technical knowledge, e.g. different technologies, gadgets and their development. The second is the *social/actor space*, which covers all the issues that are primarily dependent on relations between different actors inside and outside the organisation. This space covers organisational development, markets and also more macro-scale societal phenomena (societal drivers and megatrends). It should be noted that the division between these two spaces (technology and social/actor) is mainly heuristic because technologies are naturally formed in social interaction and markets are created by socio-technical relationships. However, in the context of the RTO (with strong emphasis on technology development) this separation is in our view quite credible. The third knowledge space is *strategy space*, which tries to take a holistic view of the research object and perceive it as a strategic entirety. In this space, the technology space and social/actor space are linked to a strategic perspective of the future. The fourth knowledge space is *visionary space*. This space is devoted to the exploration of futures on different scales of (un)certainty. Our model starts with a presupposition that in technology and social/actor spaces the exploration of more radical futures is usually restricted by the overall need to identify certain actions in the present and therefore the exploration of the futures does not usually play a key role. However, in visionary space this exploration is the key issue. Table 1 describes the basic aims of the process and provides some views on the use of roadmapping material.

Table 1. Diversified roadmap concept I: knowledge spaces.

Knowledge space	Description	Key systemic capacities associated with the space	Uses of the knowledge
Technology	• Covers a certain domain of technical knowledge, e.g. different technologies, gadgets and development, usually on three temporal scales (e.g. present; short- to mid-term; long-term)	• Capacities for the renewal of the technological basis: R&D, adoption, etc.	• Building a technological vision • Scoping new enabling technologies or new products • Identifying temporal sequences • Identifying singular elements, like separate technologies, application and solutions
Social/actor	• Covers issues that are primarily dependent on relations between different actors inside and outside the organisation	• Capacities for aligning development activities with societal drivers • Capacities for market creation or entering into existing markets as a novel player	• Building a market vision • Identification of novel market features and actors • Articulation of demand • Identifying societal and market drivers
Strategy	• Strategic and holistic view of the research objects • Technology space and social/actor space are linked to a strategic perspective of the future, i.e. a strong target	• Strategic capacity of the organisation and/or entity • Building strategic transparency • Communicating strategic aims	• Holistic roadmaps to be used in long-term strategic planning • Building synthesising vision (vertical, horizontal) • Visionary strategising • Aligning roadmap knowledge
Visionary	• Exploration of futures on different scales of certainty	• Systemic openness towards future possibilities • Capacities for resilience	• Drafting novel concepts • Identifying wild cards • Focuses primarily on vision building: business-as-usual vision, disruptive visions and improbable events

Table 2 presents the ideal scopes of roadmaps in a schematic form. The first roadmap scope is R&D I with a perspective on a single technology or object. This is quite a traditional technology roadmap that aims to build a future perspective for a singular technology to stimulate the organisational capacity in that field. The aim of the roadmap is to identify specific action steps towards the future. This scope is parallel to the technology knowledge space. The second roadmap scope R&D II focuses on a perspective of a single organisation or firm. Basically, the view is similar to the first one but instead of a technology domain, the focus is on the organisation. In the process, different roadmap knowledge spaces may be combined, although the perspective is mainly of a single organi-

sation. The third scope is systemic I, which emphasises the business perspective. Roadmapping is aimed at network and/cluster scales. The roadmap aims to develop capacities for the network or a cluster and combines roadmap knowledge 'spaces' depending on the specific aims of the process. The aim is to endorse business decisions on the basis of the roadmapping. The fourth scope is systemic II with a policy perspective. This category could contain, for example, an emerging methodology of innovation policy roadmapping developed at VTT. It is constructed to produce synthesising policy perspectives for public actors. The aim is to form policy conclusions on the basis of the roadmapping.

Table 2. Diversified roadmap concept II: roadmap scopes.

Roadmap scope	Description	Process aims	Primary use of the roadmap
R&D I: R&D perspective on a single technology or object	• Roadmapping singular technologies from a certain perspective	• Enhancing organisational capacities in a certain technology field	• Building vision and associated steps mainly in the technological space • Drafting *action steps* to advance the implementation of the technology in question
R&D II: R&D perspective on a single organisation or firm	• Roadmapping organisational capacities in developing new competencies	• Roadmap for developing organisational / firm capacities	• Combination of roadmap knowledge 'spaces' depends on the specific aims of the process • Forming *practical organisational conclusions* on the basis of the roadmapping
Systemic I: business perspective	• Network roadmapping • Cluster roadmapping	• Roadmap for developing capacities for a network or a cluster	• Combination of roadmap knowledge 'spaces' depends on the specific aims of the process • Making *business decisions* on the basis of the roadmapping
Systemic II: policy perspective	• Innovation policy roadmapping	• Roadmap for developing synthesising policy perspectives for public actors	• Combination of roadmap knowledge 'spaces' depends on the specific aims of the process • Forming *policy conclusions* on the basis of the roadmapping

Case example of roadmap diversification at VTT: Service science and business roadmap

The selected example integrates roadmapping in the context of an organisational development process aimed at establishing a service research network at VTT. Service research is an emerging field of research requiring intensive collaboration across disciplines and lines of business. In order to create VTT's Service Science and Business (SSB) network, we combined foresight and organisational learning methods in a workshop process. During the workshops, some thirty VTT researchers and management representatives were able to find a shared understanding that led to a service research strategy for VTT. The workshops were designed to facilitate dialogue between the users of the research, potential collaborators such as universities and funding agencies, as well as the societal actors in the field of service science. The piloting phase of the process took place in spring 2009 and consisted of five full day workshops. Halonen et al. [13] have described the process in detail.

The roadmapping part of the piloting process was divided into two phases that were run in the second and fourth workshops. The first roadmapping phase aimed to trace the big picture of the service landscape from the present moment (2009) until 2025. This workshop was dedicated to identifying opportunities and challenges of service research in the long term, sharing views between the participants who were new to each other, presenting different approaches to service research and development, and finally linking, scaling and prioritising emerging service research issues.

The second phase of the roadmapping process took place two months and a workshop later. This workshop had a more focused nature. It was carried out in small groups, each of which had a specific theme identified on the basis of earlier workshops concerning the impact evaluation (the past) and service landscape (the future) of the service research. Each group aimed to refine its shared knowledge on the given topic and sketch how to proceed with this topic to make it an actual research project at VTT. The results of the earlier roadmapping phase were given to the groups as a starting point. The results of the second roadmapping phase formed the basis of the next step of the whole process, i.e. producing eight research plans on selected future-oriented service research topics.

Process summary. The SSB roadmap can be perceived as an R&D II type of technology roadmap aimed at contributions in the strategy space and social/actor

space. It charted the potential for novel development trajectories at VTT and enhanced the organisational capacities of adopting a novel service science approach. The knowledge spaces of the project can be summarised as in Table 3.

Table 3. Summary of the knowledge spaces Service Science and Business network.

Knowledge space	Description	Key systemic capacities associated with the space	Uses of the knowledge
Strategy	• Exercise defined the emerging field of service research and its future possibilities. • Explicit focus on establishing a service mindset in the organisation	• Capacities for gathering existing service knowledge and creating new service knowledge internally at VTT • To fortify VTT's brand as a service research organisation by stating the VTT state-of-the-art and vision for the future	• Knowledge generated via roadmapping was used iteratively throughout the strategy building process, e.g. definition of service, identification of the most important research needs, generation of project proposals
Social/actor	• Identification of the most important players in the field of service research internally and externally • Markets for new services and service providers in the field	• Capacities and methods for linking and sharing existing knowledge internally, both across disciplines and organisational functions • Capacities and methods for creating new knowledge in the network • Endorsed a view of VTT as a key player in service research both in Finland and Europe	• VTT's vision of service was built on the basis of past development paths, current service trends, opportunities and challenges • Identified VTT's own capacities, and potential development paths • Identified societal and market drivers

Concluding remarks

In this paper we discussed the construction of the systemic transformation capacities in an RTO by roadmapping. We proposed that, basically, two kinds of systemic capacities are of importance: 1) partial structural openness and fluidity, and 2) a horizontal anticipatory culture based on a future-oriented agency, anticipatory capacity and foresight sensibility.

We presented a diversified roadmap concept that adapts the scope of traditional technology roadmapping and widens its horizon in such directions as visionary strategic management, network building and development, and organisation-

al learning and adaptation. Our diversified roadmap concept distinguished between roadmap knowledge spaces and roadmap scope. In our model, knowledge space referred to a domain in an organisation or in a community in which a future-oriented agency can be mobilised. Knowledge spaces therefore depict key spheres in which the systemic transformation capacity is realised. Roadmap scope referred to the level at which the roadmap is aimed. Scope is a more traditional insight roadmapping methodology that separates, e.g. technology roadmaps and market roadmaps. Our model separated roadmaps with R&D scope and roadmaps with systemic scope. We also presented VTT's Service Science and Business (SSB) Network as a case example of a roadmapping process.

The key results of our paper are threefold. Firstly, the paper provides paths to enable an anticipatory culture in RTOs and other organisations. Secondly, the paper widens the scope of roadmapping towards the field of organisational development and visionary planning. Thirdly, the paper presents a diversified roadmap model that can be applied to specific organisational settings. The key issue from the policy perspective is that the generic ideas of this paper can be also be used in several policy fields.

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Servitization and deepening the service-dominant logic

Developing integrated solutions within B-to-B service networks

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Abstract

The growing trends of outsourcing and specialization have led many industrial customers to centralize their purchases and seek suppliers that can provide more extensive solutions [1; 2; 3]. The focus in the solutions marketing literature has been inherently product-centred, and there has been a shortage of research into solutions originating in the service sector [4]. Companies may face a number of challenges developing and delivering integrated service solutions in co-operation with several companies. As a result of our qualitative, multiple case study of two b-to-b service networks, we addressed the value of integrated service solutions to all the network actors as well as the key challenges companies face in delivering and developing integrated solutions within b-to-b service networks. As a practical result, we developed two frameworks to systemize and facilitate service business development in companies.

Introduction

The growing trends of outsourcing and specialization have led many industrial customers to centralize their purchases and seek suppliers that are able to provide more extensive solutions [1; 2; 3]. A single company may not be able to answer customer needs and, thus, companies may form partnerships that provide complementary products and services [5]. Given the remarkable growth of ser-

vice industries, more and more companies are now engaged in offering integrated *service* solutions together.

A solution is defined as: a) a bundle of products, services and/or software, b) solving customer-specific problems and c) consisting of relatively broad and complex offerings focusing not only on technical integration but also on the whole usage context [e.g. 4; 6; 7; 8]. The main body of solutions research is involved in integrating services with products [e.g. 5; 7; 9; 10; 11] and there has been a shortage of research into solutions originating in the service sector [4]. The intangible and interactive nature of services [e.g.12], compared with tangible products, may pose special challenges to developing integrated solutions within networks, but there is currently a shortage of empirical research addressing such challenges.

In recent years, a number of studies have been conducted into the role of customers in service development [e.g.13]. Apart from a few exceptions [e.g. 14; 15; 16], the role of other stakeholder groups has been dismissed in research. Authors in different domains have emphasized the collaborative, systemic nature of value creation [17; 18; 2] and called for more research into value creation at the level of service networks and value chains [5; 10; 19; 20; 21]. Although the demand for a systemic and collaborative development approach has been recognized by both researchers and practitioners, there is a lack of methods and tools to enhance collaborative, systemic development of service business in companies.

The aim of this paper is to increase knowledge of the development of integrated solutions within b-to-b service networks. More specifically, the purpose of this paper is 1) to address the value of integrated service solutions to all the network actors, 2) to address the common challenges faced in developing and delivering integrated solutions within b-to-b service networks, and 3) to provide two frameworks to systemize service business development within b-to-b service networks. This paper is based on the results of the VersO-project (2009-2011) and it collects some of the central research findings and conclusions published by VTT and Turku University School of Economics in the course of the project [22; 23; 24].

Methodology and case selection

The research strategy employed in our study was a qualitative, multiple case study. Case studies have been the dominant methodology used by qualitative researchers in industrial marketing [25] and are considered a particularly useful approach to increasing understanding of topics that were previously under-investigated [26] and in situations in which there are complex and multiple variables and processes [27]. In general, case studies are the preferred strategy when 'how' and 'why' questions are posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon within a real-life context. Compared with a single case study, the advantage of a multiple case study is that it gathers evidence from multiple cases and is thus regarded as more robust [27]. The main data collection method in our study was in-depth interviewing. Additional data were collected in company workshops.

To investigate the development of integrated solutions in b-to-b service networks, we identified two cases in which various resources and competences are combined as an integrated solution. The selection criteria for the cases were a) the companies operate on b-to-b markets, b) the companies deliver and develop integrated solutions together, and c) they do so for common customers.

The studied networks represent inter-organizational business networks consisting of several service provider companies and selected customers. The two selected cases represent different industry branches and services. Case A (pseudonym 'Marketing Solution') is a solution that combines the resources and competences – marketing, advertising, business consultancy, media planning, market research and printing – of six service provider companies. The three customers involved in Case A represent the food industry (two companies) and the tourism industry (one company). Case B (pseudonym 'Industrial Solution') is a solution that combines robots, machine tools and repair and maintenance services offered by three companies. The two customers in Case B represent manufacturing companies.

The data collection process included 38 in-depth interviews (28 service provider company representatives and 10 customer company representatives) and observations of 16 company workshops or meetings (Table 1). Internal as well as inter-organizational workshops were arranged, and real customer negotiations were observed. Interviews were audio-recorded and transcribed. Meetings and workshops were documented. The period of data collection was 11/2009-05/2011.

Table 1. Overview of the in-depth interviews.

	n ('Marketing Solution')	n ('Industrial Solution')
In-depth interviews (service providers)	16	12
In-depth interviews (customers)	8	2
Total (n)	24	14

Case findings

Perhaps the most common view of the marketing literature is that customer-perceived value can be defined as the trade-off between the benefits and sacrifices perceived by the customer [28; 29]. To analyse the value of integrated solutions, we acquired knowledge on companies' motives, *why* they purchase and deliver integrated service solutions. As a result, we discovered that integrated service solutions accrue benefits for customers, as service providers combine versatile competences and reduce the sacrifices related to service procurement and managing the network of several service providers. In addition to the value perceived by the customers, we analysed the value perceived by all the service providers. For example, co-operation with other service providers complemented the company's own resources and competences, supported growth in service business and allowed it to enter new markets. Sacrifices were also recognized, such as the risks of the partner operating on the common customer interface and a shared image risk [23].

It was recognized that the common solutions of ideation, sharing customer insight and reaching a broader customer interface via a network might offer opportunities for a bigger role in the customer value-creating process. However, it is down to the customer what kinds of solutions are desirable or even possible to offer. For example, the customers' business model, strategy, procurement organization and organizational culture affect their ability and will to involve service providers in 'value co-creation', and these factors finally affect the service outcome and the value of the service [23].

Secondly, we acquired data on *how* companies develop and deliver integrated service solutions in practice. Our data indicated that the salient challenges of developing and delivering integrated solutions within b-to-b service networks were:

- Agreeing on the role and task division between the service provider companies: which company takes the lead on a project and is in charge of the entity and customer relations?
- Managing the common customer interface: which companies operate on the customer interface and what kind of service experience is delivered to the customers in the daily service operations?
- Convincing all the actors in the network of the value of an integrated solution: why should a *customer* purchase a 'total' solution from a group of companies instead of independent service modules from individual service provider companies? Why is the co-operation beneficial to the network for each one of the *service provider* companies? [22; 23].

Discussion and conclusions

The novelty value of our study is derived from the notice that the solutions marketing literature has mainly been preoccupied with research concerning product-service bundles [e.g. 5; 9; 7; 10; 11] and not with the integration of services into a solution by several service provider companies. Firstly, we contribute to solutions marketing literature by suggesting that, compared with product-service bundles, the management of the common customer interface represents a key challenge for companies delivering integrated *service* solutions: how can the roles and tasks be shared between the partners and how can a coherent service experience be delivered by several service providers?

Secondly, our research contributes to value creation literature by providing empirical insights into value co-creation, which has predominantly been discussed on a theoretical level, and by extending the perspective to encompass multiple actors in a business-to-business service network. We explored the service encounters between all the network actors and thus contributed to value creation literature by addressing the value of integrated service solutions to *all* network actors: service providers and customers [23].

The definition and organization of the service operations and processes as well as the delivery of a coherent service experience by several service providers pose special management challenges in the b-to-b service network context [22; 23]. Thirdly, we contribute to service business management literature by suggesting that the development of successful b-to-b service concepts requires a collaborative, systemic and multi-disciplinary development approach [23]. Due

to the interactive and intangible nature of services, it is important to engage both customers and own personnel in service business development. According to our case studies, the collaborative development approach between companies and different organizational groups (e.g. between sales and repair & maintenance) enhances the creation of a common view of service concepts and motivates for striving common development aims [23].

As a practical contribution, we developed two frameworks to facilitate service business development in companies. By combining our empirical results with the definitions of a service concept found in service literature [30; 31; 32], we developed a framework for *a network service concept* [22]. It consists of the following elements: core solution, service operations and processes, customer experience and service value. We suggest that the elements of a network service concept should be discussed, defined and documented in co-operation between all the network actors – service providers as well as customers. It is especially important to agree on how the common service encounter is managed to deliver a coherent service experience and service value for the common customers. In our case study, all the elements of the network service concept were defined in company workshops in co-operation between several actors. We also collected and used customers' views on service concept development, for example, their views on the benefits and sacrifices (i.e. service value) attached to a service. A service blueprint [33] was used to map the service operations and processes. Apart from a few exceptions [e.g. 34], this was one of the few attempts to use a service blueprint in a b-to-b service network context.

As the second managerial implication, we created a framework representing *the dimensions of service business development* (Figure 1) that outlines the multiple challenges that need to be tackled in service business development. The development of service business includes strategic decision-making, concept development, and planning of service operations and processes. We emphasize the meaning of balancing the strategic level aims, concepts and actions with everyday service operations and operative processes. Special attention should be paid to the way the service encounter is managed to deliver the service outcome that the customer expects and values. [24]

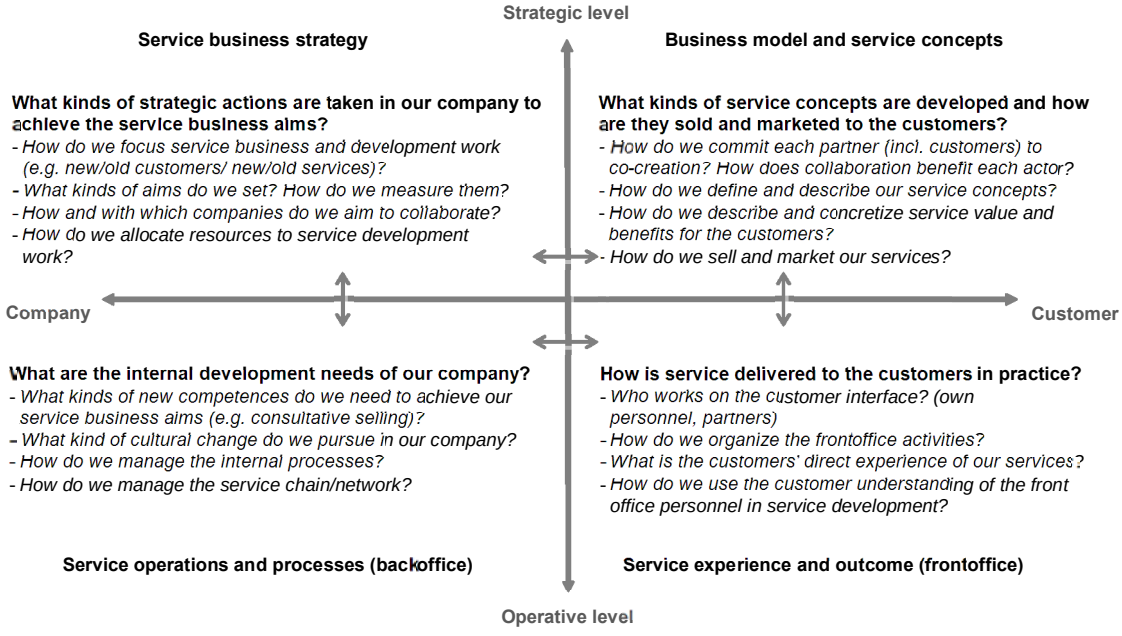

Figure 1. The dimensions of service business development [24].

Exploitation Potential

Our research suggests that the same kind of management approach may not be adequate for the development of integrated *service* solutions as for developing product-service bundles or infusing services into products. The more knowledge-intensive the service, the more systemic, collaborative and interactive the approach the development process may demand. For example, providing the customer with the expected value and coherent service experience of several service providers may demand profound co-ordination and sense-making between all the network actors. The two frameworks represented in this paper help companies to systemize and facilitate the service business development work carried out in co-operation between several companies and organizational groups.

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Capabilities in developing knowledge-intensive service business

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Abstract

The development of an innovative service concept and superior customer value is a key success factor in the current business environment. In parallel with new service development, companies need to develop innovative business models to create value for the services. A key question in this development is what kind of capabilities companies can use to develop their knowledge-intensive services and service-based business models. The aim of the study presented in this paper is to identify and categorize the key capabilities needed. The empirical research consists of qualitative semi-structured interviews conducted in five companies currently developing their service business. As a result, the study presents a classification of the types of capabilities in service business development. This classification helps companies create and acquire the necessary capabilities and develop service-based business models.

Introduction

Companies are increasingly developing new service offerings, as services need to be at the centre of the company's business model [1]. A business model can simply be regarded as 'the architecture of the revenue' [2], though most definitions consider the business model more broadly as the value-creation logic or architecture of the company. Moreover, the business model is increasingly seen as a useful unit of analysis [1; 3] for understanding a company and its business.

A variety of capabilities is needed to develop successful service business. Capabilities have not been given enough attention with regard to business models [4] or service business in general however. Hence, based on the elements or components of a business model, we aim to identify and analyse key capabilities in developing service business.

The paper is organized as follows. First, literature on business models and capabilities is reviewed to understand the nature of the capabilities necessary in developing business. Second, the qualitative research approach used in the empirical part of this work is presented. Third, the empirical results are presented and analysed, followed by discussions and the conclusion.

Related work

The business model framework [e.g. 5; 6] provides a basis for identifying and analysing the key capabilities of a firm in developing service business. The existing literature identifies and offers classifications of the key elements of business models. One of the best-known and most used classifications is provided by Osterwalder [5; 7] who emphasizes nine building blocks or elements that a business model has to address: value proposition, target customer, distribution channel, customer relationship, value configuration, core competency, partner network, cost structure and revenue model. A change in one element of the business depends on corresponding changes in other elements [1] and, hence, they are interrelated and need to be viewed holistically to develop a business.

The capabilities of a firm are central to understanding and analysing its business [4]. The discussion on capabilities is strongly based on the resource-based view (RBV) of the firm. Rajala and Westerlund [4, 9]) distinguish differing per-

spectives on capabilities: organizational vs managerial capabilities [e.g. 10], static vs dynamic capabilities [e.g. 11] and internal vs external capabilities.

As companies are increasingly focusing on their core competencies, they need to develop essential capabilities through networks [4]. Network competence, as Ritter and Gemünden [12] put it, includes the necessary knowledge, skills and qualifications as well as their effective usage. Möller et al. [15] distinguish between traditional business capabilities and the capabilities needed in managing relationships and business nets. Different kinds of managerial capabilities are needed in various modes of net management [14]. In fact, different types of nets require different types of managerial capabilities: the more complex the value system and the more actors involved, the more versatile the required set of capabilities becomes [13].

Companies also need to develop capabilities for business model development [15]. According to Rajala and Westerlund [9], different types of business models require different specific internal and external capabilities that need to be addressed to gain a competitive advantage via business model innovation. Possible capabilities needed in developing business models are creativity; insight; customer, competitor and supplier information and intelligence [16]; and a change of organizational processes. Companies need to adopt an effectual attitude towards business model experimentation, identify internal leaders for business model change and adjust the culture to embrace the new model [15]. However, creating and acquiring these capabilities represent major challenges to business model innovation [9]. This study aims to fill this gap.

Research methodology

The current study adopts a qualitative research approach to identifying and analysing the key capabilities in developing service business and service-based business models. The empirical research consists of interviews and workshops. The primary data collection has been from semi-structured interviews in five companies currently developing their service business. Four of the companies operate mainly in the software industry and one in the field of heavy industry. The integrative factor for the interviewed companies is that they are all developing new, knowledge-intensive services and, hence, in parallel their service business. The interviews covered themes concerned with service business, the devel-

opment of services, and characteristics of service business. Overall, nine interviews were conducted, six of them by the authors and three by other researchers in the research group.

During the research process, two workshops were held with company representatives and researchers. In the first one, a scenario-based approach was used to vision the future business models for services under development. In the second workshop, the companies were offered the chance to give feedback on the identified capabilities concerning the development of service business. In addition, a third workshop was held with the research group, which produced additional data on service business elements based on existing theoretical knowledge. The workshops provided additional understanding of the phenomenon of developing service business.

The empirical interview data were analysed by content coding and theme-based categorization with the help of NVivo software. The business model elements provided the basis for the analysis. The analysis was not limited under these exact themes; however, other relevant issues were allowed to be raised concerning the phenomenon.

Results and analysis

Our empirical findings indicate that several capabilities are vital to service business development. Their importance may vary between companies however. Some of the capabilities perceived as most important to the case companies are discussed in detail below. These findings are categorized in the next section and summarized in Table 1.

Organizational culture is an essential building block in the development of successful service business. Our empirical findings suggest that there are many different ways in which organizational culture can either foster or hinder the efforts of creating prosperous service business. From the capability viewpoint, in particular creativeness, open-mindedness and risk-taking, which foster the innovative culture in the organization, were seen as highly important and a potential source of creating a competitive advantage.

> *"…a great shift in attitudes is required to become a service business forerunner… courage to challenge and change old routines" <Company1>*

A ***customer-oriented mindset*** is one of the key characteristics of the service culture and a cornerstone of successful service business. Customer understanding is critical at all levels in the organization and throughout the value network. The capability to understand customers should stem from the culture in a way that makes all the employees of the organization, especially the management and front-end employees, devoted to creating value for the customer and everyone know his/her role in this.

> *"you need to understand your customer's business, markets, market changes, position in the value network and how the network changes, revenue logic and, for example, how to share benefits with the end customer" <Company2>*

New service development **(NSD)** is one of the core activities in service business. Hence, capabilities and processes related to new service development have a high impact on success in services business. Cross-functional teams and systematic processes were considered important factors for service development, though the systematic NSD processes were not very common among the case companies. Sufficient resources were also regarded as highly important factors when aiming for new service business. Therefore, adequate allocation of financial and human resources on service development should be guaranteed.

Resources and activities related to actual ***service production and co-creation*** are extremely important in the sector of knowledge-intensive business services. The superiority and scarcity of high-performing employees provide opportunities to create a competitive advantage that is very difficult to imitate. Yet the challenge is to develop the skills and expertise of individual employees and to transfer this development for the benefit of the whole organization as organizational capabilities. Without succeeding in this, the competitive advantage may be as fragile as the commitment of the individual employee to the company.

For this reason, capabilities in ***human resource management*** are core issues in keeping employees satisfied, developing and sharing their competence and recruiting new talents into the company. Expectedly, success in human resource management was seen as a critical factor for the development of new service business.

Sales- and marketing-related resources and capabilities were also regarded as highly important factors for companies aiming to succeed in service business. For example, capabilities to develop new innovative offerings and ways to sell services were considered important to forerunners. The brand was also seen as a highly valuable strategic asset, as communicating intangible benefits of new

knowledge-intensive business services can be very challenging. ***Brand management*** capability thereby provides a potential source of sustainable competitive advantage.

> *"being a forerunner… it's about how you succeed in branding your service" <Company3>*

Brand management is closely associated with ***managing customer relationships***, which is a key element of sustaining long-term relationships and creating superior customer value. Most of the case companies aimed to understand the customers' business through close partnerships with their key customers. Involving these customers in the service development processes was seen as important, and most companies also envisioned that customers would be more intensively involved in their service development in the future. Capabilities to acquire new customers and nurture existing long-term relationships were considered cornerstones of successful customer relationship management. Knowing the customer's business to the core, customer trust towards the service provider, personal relationships and operating in the same geographical location are very valuable, especially from the sales viewpoint.

> *"quite often our customers are almost like our friends... we are naturally in close contact with them, which leads to more profound conversation about customers needs..." <Company1>*

Technological capabilities are highly important for creating technology-intensive services, but the case companies thought that these kinds of capabilities should be provided by those partners in the value network that do it most effectively. In software business in particular, it is practically impossible for one company to master all the technologies and produce the service effectively. For this reason, ***network development and management capabilities*** are highly important to the KIBS companies. The value-creation network should be extensive and active, and the necessary resources and capabilities should be found quickly when needed. Hence, the importance of the value network, network management, and sharing revenues and risks with network partners is becoming increasingly important in service business. It is essential to define the position and role of the company in the network however.

> *"Our network has to be extensive and active so that we can quickly find the right resources and competences when needed..." <Company4>*

Furthermore, ***managerial capabilities and practices*** are very important to the development of service business. The importance of strategic management to service business success was highlighted in every interview. Commitment of the top management to the promotion of service business, for example, via ***strategic planning and implementation,*** was seen as a critical success factor. Without clear strategic focus on developing service business and a strong vision of the future position in the market, efforts to promote service business were experienced as trifling.

> *"Service business has to be internalized by top and middle management... it has to be included in the business strategy" <Company1>*

The strategic ***capability to foresee*** market opportunities and potential changes in the business environment and realign the company's strategy on that basis was considered vital to service business companies. The capability to detect the right timing to seize the opportunity and conduct the change in strategy is also critical. The ***capability to implement and manage the change process*** of the strategic renewal quickly (if necessary) was found to be highly important. This agility in strategic renewal is one of the cornerstones of gaining a pioneering position in service business. Continuous reshaping of the strategy may also be needed in order to sustain the competitive advantage.

Lastly, the ***fit between strategy and the organization's culture, resources and capabilities*** is key to ensuring that the company can commit to the new strategy. This is often easier in the case of incremental service development in which the necessary changes in the current organization are not substantial. When change is more radical and new resources need to be acquired, capabilities developed or culture adapted, change management becomes a challenge. The situation may be even worse if existing business and new radically different service business has to be managed at the same time (change-and-run). This kind of business transformation was considered very challenging, and managerial capabilities to manage the transformation are extremely valuable to the company.

Following on from the above, ***renewal capabilities*** are essential in developing service business. Companies need to understand the limitations of their current business models and continuously seek to develop their services and service business. Future visioning and risk-taking are necessary capabilities for a company to be a forerunner that actively acquires and uses resources in new, innovative ways. Consequently, the courage to renew business in a way that challenges

the current ways of thinking is an essential difference between a follower and a forerunner.

> *"a company that develops its operations and services continuously. It doesn't stop when something has been achieved but continues to move on, seeks something new, is hungry in that way." <Company1>*

Discussion and conclusions

Based on the theoretical and empirical data, we have identified and categorized the key capabilities in service business development. These capability categories were considered the most important areas in which companies should aim to differentiate themselves in order to create a competitive advantage. In addition to the identified capabilities, we have analysed potential mechanisms to acquire the capabilities. The identified capabilities and the examples of mechanisms are presented in Table 1.

The study contributes to the discussion on service business and to the understanding of service-based business models in the following ways. Firstly, the key elements of service business are organizational culture, the customer, service development, management and strategy, and renewal. Secondly, under each element, there are specific capabilities that are important in developing service business as well as service-based business models. In addition to identifying the necessary capabilities, acquiring and enhancing them is an essential capability. Mechanisms to acquire and enhance necessary capabilities partly overlap and may require other capabilities. Hence, some of the capabilities can be considered a prerequisite for acquiring the necessary capabilities and developing service-based business models. For example, the network provides the means to acquire, e.g., technological capabilities and other resources needed in service development. Moreover, organizational culture and renewal are key prerequisites for success in all areas (e.g. renewal of culture, relationships and strategy). Finally, based on the findings of the study, companies can analyse their existing service business and develop new service-based business models by understanding the required capabilities and elements of developing knowledge-intensive service business.

Table 1. Classification of capabilities in developing knowledge-intensive service business.

Elements of service business development	Required capabilities	Examples of mechanisms to acquire and/or enhance capabilities
Organizational culture	• Shared customer understanding • Shared understanding and commitment to service business • Capabilities related to innovative culture	• Knowledge sharing • Commitment of top management • Fostering creativeness, open-mindedness and risk-taking
Customer	• Understanding of customers' business and processes • Customer relationship management capabilities • Value co-creation	• Customer-oriented culture • Close partnerships with customers • Using innovative ways to communicate with customers
Service development	• Capabilities to develop innovative offering • Substance capabilities (e.g. technological expertise) • Business development (e.g. pricing, marketing) • Network development capabilities	• Re newal • Cross-functional teams and systematic processes • Adequate allocation of financial and human resources • Partnerships, personal relationships
Management & strategy	• Network management • Cost management • Knowledge management • Human resource management • Brand management • Change management • Strategic management	• Defining positions and roles in the network • Methods for sharing employees' tacit knowledge • Recruiting new talents • Communication of strategy • Alignment of strategy with the organization's culture, resources and capabilities
Renewal	• Future visioning • C reativeness • Capability for continuous improvement • Capability for radical renewal o Identifying market opportunities o Challenging current thinking o Detecting the right timing for change • Capability to manage and take risks	• Quick reaction to changes in customer needs and markets • Ex perimentation • Accepting failures • Appointing change champions • Management commitment

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Managing opportunities and uncertainties in new service business creation

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Abstract

The focus of this paper is on the creation of industrial service businesses by companies transforming from manufacturers into service providers. This enormous change brings not only new business opportunities but also significant uncertainties to be managed. In order to simultaneously manage the risks and identify the business opportunities, systematic management approaches are needed. In this paper, we address the need for various applications of uncertainty management based on four case studies.

Introduction

The transformation from goods-dominant logic to service-dominant logic has continued in many industrial companies. However, the companies still lack systematic methods at the front-end of their service development processes, and practical means for learning about the value chains, identifying new business opportunities and implementing uncertainty management. In this paper, we aim to point out the various challenges facing the machinery and process industry in its attempts to rejuvenate its business. The applications of uncertainty management are considered from three perspectives. The first perspective of uncertainty management that is discussed is how service offerings are composed based on new knowledge of customer value. Secondly, customer-specific offerings are considered. Thirdly, we consider the risks and opportunities in an industrial sector in which the provision of services is new.

In this paper, we present some results from earlier projects combined with novel results from an on-going research project called 'ServChange – transformation power for the creation of new service business'. Thus, in this project we provide a holistic view by combining the perspectives of uncertainty management in the innovation process with service culture and capability in a transformation. A long product history is deeply embedded in the mindsets of many manufacturing companies and is not easy to change according to the demands of service business. An old product-oriented organizational culture can inhibit efforts to use existing competences and collaboration relationships in service development as well as restrict the overall capability to identify business opportunities. The importance of an organization or corporate culture in the transition and service business development of manufacturing companies has been noted by several writers [7, 8, 9].

The challenges related to organizational culture have to be solved in order to implement service business successfully, as cultural change and the identification of service business opportunities are intertwined. In this paper we focus on the best way to support decision-making quickly and effectively when uncertainties arise in service business opportunity identification (an area recently studied by, e.g. Paasi & Valkokari [5]). The applications of uncertainty management presented in this paper are based on four case studies, three of which have already been carried out and one that is currently ongoing.

Approach

Service business development

The importance of industrial services as a source of revenue has increased for many companies, primarily due to globalization and the changing environment of traditional manufacturing [e.g. 1, 2]. As manufacturing companies increasingly focus on their core business, the interest in using external services increases [2, 3, 4]. Understanding the meaning of customer collaboration and customer value as well as the development of systematic management practices, models and service culture is a common challenge for many industries.

The creation of new service concepts may have a strong basis in existing product-dominant businesses. For instance, existing competences and knowledge related to the core product may be underexploited due to insufficient information

on the possibilities that the business environment and value chains can offer. Thus, new forms of collaboration with other players in the value chain can be found to be profitable if the value for all the parties can be identified and shown. On the other hand, new opportunities for increasing collaboration in a value chain and with the customer are needed in order to gain a better understanding of the value creation potential. Customer collaboration, knowledge of the customer value, the management practices of new service business creation and the change in the entire organizational culture are common challenges for a variety of industries.

Taking a new role as a facilitator of customer value creation by providing services requires the creation of new knowledge and capabilities. Understanding the customers' business and their needs is thus vital. There are several motives for learning more about the various aspects and elements of customer value [e.g. 10]. This is crucial when developing new services and also important from the marketing perspective, as service marketing essentially includes 'making promises about the value that can be expected to be captured from the service' [11]. We may conclude that there is a need to arrive at new approaches and tools to analyse customer value, and we need to find ways to support the creation of customer-value-driven service offerings.

Uncertainty management

Overall, companies lack practical methods and tools in their innovation processes to ensure that the offering corresponds to the actual market needs. As we discuss the applications of uncertainty management in the machinery industry and the opportunities for applications in the pulp and paper industry, the overall goal is to use our existing methodology and to develop it further in order to explore the possibilities outside the known market space, or the red ocean as referred to by Kim and Mauborgne [6]. The 'blue oceans', on the other hand, can provide the industry with a possibility of solid growth, away from the 'bloody competition'. We also need to address the challenges of how the current business units should consider new opportunities and rethink the business in contrast to relying on business innovations being created merely in separate, new business development units.

We conclude that risk management knowledge can be applied in various ways: for instance, when identifying new business opportunities, developing the service content, productizing the services or composing customer-value-driven

offerings. On this basis, we demonstrate the multidimensionality of uncertainty management with four case studies in the following section. In the case studies, we have focused on business risks and successfully contributed to the first three stages of a risk management process (see Figure 1); however, we have not specifically addressed the implementation and follow-up stage. Therefore, this paper does not cover the experiences of the implementation and follow-up in detail.

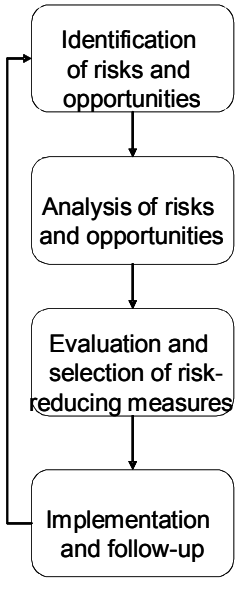

Figure 1. Main stages of a risk management process, adapted from [14].

Case studies

Assessment of customer value in asset management service business development

The first case study presented in this section aims to support companies in their efforts to improve their understanding of what it is in services that is valuable to customers. The methods presented improve the companies' abilities to develop the customer-value-driven services and communicate with the customers about the assumed effects of the services provided in their businesses.

To assess the value of maintenance and asset management services, we propose that a qualitative Service Quality Function Deployment method and a quantitative Service Business Value Assessment method be applied. Thus, our approach has two main phases [12]:

- qualitative analysis of the content of the service portfolio, the customer needs and the value creation mechanisms
- quantitative analysis of value fulfilment with the focus on the most significant value elements identified in the preceding phase.

In order to address systematically the various customer needs it is useful to categorize them in a systematic manner. During our case study, the following categorization was applied to the asset management services: 1) better overall asset performance and efficient management of assets, 2) life cycle cost management and 3) informativeness and proactivity. The main customer needs in these categories were applied to eight service concepts and their features in the whole service package. The matching between customer needs and service concepts was done by identifying either strong, medium or weak links between them based on the traditional principles of QFD. The descriptions of the value mechanisms ('How does the service meet specific customer needs and other related requirements?') were then explicitly written to explain the link. In fact, one of the significant benefits of the application of the method is the detailed documentation of the development process.

Life cycle profit (LCP) analyses were applied in order to quantify the value of the services considered. When looking at overall equipment efficiency (OEE), we can identify the significance of maintenance and other industrial services in each of the subfactors, namely, availability, quality and performance. To address the value of a service from the perspective of availability, we must understand what it costs for a customer if the considered production equipment cannot fulfil its function. Thus, we must quantify the availability of the system considered. In practice, doing this may depend on the business. In general, however, the planned production volume (or equivalent) must be evaluated, the actual loss (material, energy, work, profit) determined and an estimate made of the cost related to a stoppage for a chosen time unit (an hour, for instance).

In our approach, we address the way the services reduce unavailability by decreasing the probability and severity of undesired events. Furthermore, the method allows various other value elements identified to be addressed. Thus, we can estimate the value in monetary terms by combining information on the vari-

ous value elements. The result of the case study plays a role at an early phase of the innovation process but it is also useful for the argumentation of the practical benefits of services in the selling processes.

Managing uncertainty with formalized procedures in information-based industrial services development

The second case study presented in this paper is related to developing a service that supports customers in their decision-making by providing new information on their assets. The product manufacturer was hypothesized to have a significant success factor because it had access to a large amount of installed base information. The case study started with the product manufacturer having a successful technological solution developed for gathering various data from customers' production processes, but with insufficient understanding of all the possibilities that these data may offer. The case study thus focused on identifying these possibilities and further developing the way the data items would be used to provide the actual information-based service.

The development of an information-based service requires thorough familiarity with the customer's processes, however, in order to create interfaces with the service content and the customer's decision-making. Making structured data available is only one step. Integration of the service into the customer's processes is made easier when the service provider has the opportunity to demonstrate how the features of the service support the practices in the customer's organization or the functionalities in the production processes.

Our approach to the development of an information-based service for asset management decision-making is based on two main phases the first of which aims to describe the customer's production processes with a Structured Analysis and Design Technique (SADT). The analysis results in a baseline for identifying where existing information items can best be used and for finding the points in the process where a lack of information is a special problem. The second phase of the approach consists of the following tasks:

- identifying the focal needs for information in the customer's operative management
- analysing the failure behaviour of the target system from the viewpoint of which information items are needed when searching for solutions to failures and problems occurring
- giving a profile of the normal use and operation scenarios of the machinery and identifying the needs for related information.

As a result, the exploitation paths of data and information items are described and a list of development targets related to data collection formulated. Exploitation of the data from various sources may require the use of advanced methods to convert the data into applicable knowledge. The data analysis was not the focus of the case. Nevertheless, good preliminary results were received from the exploitation of the method described above.

Development of a criticality evaluation for a service offering definition

Challenges related to recommending and offering well-founded maintenance services for the large installed equipment base at the production plant are the foundation for the third case study presented in this paper. In this case, the most significant uncertainty of offering justifiable maintenance services comes from the fact that the equipment provider does not know in detail which of the installed equipment is operating critical functions of the plant. For the production plants, the typical criticality attributes are safety risk, environmental risk, production loss (volume), quality loss, repair and consequential costs.

To manage the described uncertainty, we co-created a criticality evaluation approach with the representatives of the company. The PSK 6800 standard [13] was applied as a reference method for the development. This standard defines the Criticality Classification of Equipment in Industry. The objective of the development work was to create a practical method that supports the decisions to be made on the recommended maintenance strategy for target equipment in a transparent and standardized manner. Transparency was required, as the criticality evaluation should be carried out with the customer within two working days.

The criticality evaluation aims to identify those equipment items in a plant whose correct performance is important to attaining the objectives relevant to the plant and which may thus deserve special care to ensure their performance. As a

result of the criticality evaluation, all the target equipment items are ranked based on their criticality. This ranking is then used when defining plant-specific maintenance programmes (i.e. maintenance levels) for the equipment items and when allocating spare inventories. The maintenance programmes focus on the preventive maintenance resources and actions for the most critical equipment items and, together with the spare inventory allocation, aim to maximize the availability of the production process.

Since the criticality evaluation is carried out in close collaboration with the customer based on the objectives of the plant, this approach provides an efficient way to manage the uncertainties of a customer-specific maintenance offering definition. Furthermore, the approach offers a means to manage the risks related to a new service contract.

Identification and assessment of new service business opportunities

In this section, we consider the service business opportunities in an industrial sector in which the provision of services is fairly new. The case study described briefly here is part of an on-going research project and deals with new business creation in packaging business. The case study explores the transition from pure product-based business towards service logic by supporting the creation of new knowledge of the opportunities and development of customer-value-based service businesses.

Various authors have addressed the business models and the need to find new innovative business models. The Business Model Innovation (BMI) concept explored by Johnson et al. (2008) presents a business model with four elements: customer value proposition, profit formula, key resources and key processes. In our research, we address the customer value proposition by supporting the following aspects:

- exploring the needs of the end customer segments of the existing value chain
- analysing the existing value chain/network in order to identify the needs for services and the value potential at each stage
- coarsely conceptualizing the new service candidates based on the new knowledge of the business environment and value chain,
- further analysing the customer value related to each potential service.

There may be several reasons for companies having resources and competences that are not fully exploited in their current businesses. The potential of existing knowledge, competences and human resources and thus the key resource aspect of the business model innovation are addressed by us when exploring how existing resources can be combined in order to meet the requirements of the new business potential. Furthermore, we address the key process aspects of BMI by modelling the building blocks for generating these key processes in the value chain. Thus, we emphasize the need for collaboration between the various members of the value chain when identifying the opportunities, outlining the value for the members and thus formulating the basis for future collaborative value creation. The profit formula aspects are not specifically addressed in our research, apart from having valuable new knowledge from the customer value based on qualitative and quantitative results from the customer value proposition stage presented above.

A current practical challenge is the lack of effective feedback channels from the wholesale and retail value chain to the packaging value chain. Furthermore, the players in the packaging value chain have not yet found ways to explore the retail value chain in more detail and to gather new knowledge in order to identify new opportunities and solutions.

In order to identify new service business opportunities, a clear understanding is required of the value chain or value web in which the company is involved. The provision of pure products has not provided manufacturers with sufficient knowledge of this kind. Thus, in our framework, the identification of new business opportunities in the presented environment started by exploring the existing value chains or networks. An example of such work in the packaging industry is presented in Figure 2. This enables customer value potential to be determined and creates new knowledge to be exploited in the conceptualization of new services. Our work provides companies with new methods to develop management practices, support the construction of a new service-oriented mindset, practical means for creating new knowledge of the business environment and tools for allocating resources to the most profitable service businesses.

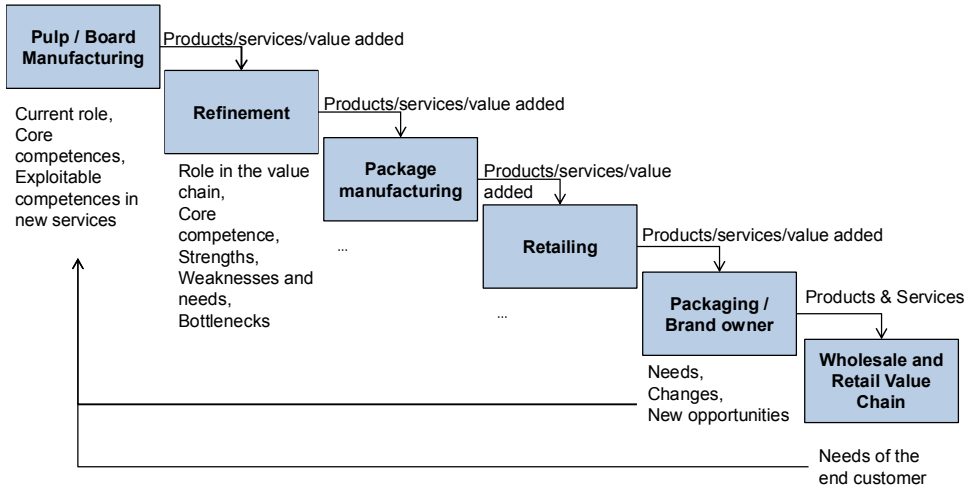

Figure 1. An example of a basis for a value chain analysis from a packaging industry.

Discussion and conclusions

This paper has presented three case studies in which risk management methodology has been applied to deal with the uncertainties of service business creation and a customer-specific offering definition. The following challenges were addressed in the case studies:

- How can the offered services be guaranteed to provide value for the customer?
- How can the service provider be supported in managing uncertainties when defining a customer-specific service offering and managing the risks related to a new service contract?
- How can life cycle information be exploited better in the development of knowledge-based service business?

Current research provides us with an opportunity to gather new experiences of applications of existing methods in various industrial sectors and businesses and further develop the uncertainty management methodology based on these experiences. Based on our experiences from the case studies, the following benefits can be listed from the companies' perspective:

- new tools for the identification of new service business opportunities
- a systematic management model for composing the service portfolio
- methods and tools for composing customer-value-driven service offerings
- improved understanding of the requirements of service business and means of adopting a new customer-oriented mindset.

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Framing the challenges of the transformation in three industries towards the service business

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Abstract

This paper presents a multidisciplinary framework for supporting a transformation towards business practices based on customer value. The framework aims to evaluate the development state of the company and guide its transformation. We apply the framework to three different industries: installed base manufacturing, pulp and paper, and technical trade. The main research problem studied here is *what are the main challenges in the transformation from a product- to a customer- and service-oriented way of doing business in these three industries?* We used three theoretical perspectives to sketch a tentative frame, their elements and the targeted transformation within them. Based on our previous studies the three perspectives were 1) service culture and capabilities, 2) business model renewal and 3) uncertainty management. We developed the frame in the analysis of fifteen cases, which were collected in previous and on-going projects. The results sketch unique characteristics as well as similarities between the industries. The study also resulted in a tentative framework that integrates the three perspectives. It proved promising for analysing the state of development in companies and was able to offer a frame for a more systematic comparison of different industries and their challenges in service business development. Additional new case studies representing each of the three industries and the systematic use of the framework will therefore be essential to further development of the framework.

Introduction

Manufacturing and technical trading companies are increasingly investing in developing service business, especially industrial services. Industrial services have typically been developed as an extension to products, for example, life cycle services to support the use of products. More commonly, companies also expand into services outside their traditional product business area in order to seek new business opportunities in a more customer value-oriented way. In addition, service business may constitute an important role in the growth and maintenance of competitiveness in industries in which there is no product-related service history, such as the pulp and paper industry.

The transition of companies from technology and product providers to service providers can be considered a stepwise, strategic development. Entering the level of service partnership requires strategic changes to the business models and service offerings as well as intentions to build an industrial service culture and capability. The main challenge is for the profound change from a technology- and product-oriented company to one that is customer value-oriented to be achieved without losing profitability. Services are often easy to add to the offering, the challenges lie in scalability or incurred higher costs that do not generate correspondingly higher returns, creating the so-called service paradox [1].

The boundaries between industries are becoming increasingly blurred, especially at company level. The catch-all definition ‘customer solutions business’ or equivalent is used to describe the industry the company is in. However, the changes are more profound and challenging than has been realised. Several authors have expressed fundamental differences between ‘traditional’ business and industrial service business, for example, in strategic planning and management, offerings, pricing and required competence [2;3;4;1;5;6]. These differences can cause many contradictions and conflicts, thereby hindering the targeted growth in service business. Adopting service-dominant logic [7;8] and interpreting the business transformation in a new, holistic way could serve as a stepping stone for the renewal of practices and culture as well as the development of new competences. However, theoretically argumented and practically tested approaches are needed to support companies in the transformation. Thus, we are developing an integrated approach to bring new insight into overcoming the challenges by studying them from three different perspectives: 1) service culture and capabilities [9;10], 2) business models [11] and 3) uncertainty management [12]. In this study, we used the new approach to recognise the main challenges faced by fif-

teen companies in the development of service business. We will describe these three perspectives, illustrate the nature of the challenges recognised by each of them with empirical data from the companies, and finally present a tentative framework in which we have combined the relevant and supplemental features of the three perspectives. We will conclude the main barrier for each industry that characterises it in relation to the others. Furthermore, we will discuss the potentials of the new framework.

Three perspectives

Service culture and capability

The service culture concept is broadly used in the traditional customer service industry, e.g. hotels and restaurants, tourism, retail trade and heath care. The service culture concept typically refers to those attitudes and behaviours that are present in a customer-serving event. There are several reasons why these approaches may not be applicable to the industrial service context. Firstly, services in the manufacturing, technical trade, and pulp and paper industries are 'business-to-business'. Secondly, industrial services are strongly based on technical competence and expertise. Thirdly, the problem of organisational culture highlighted by manufactures and technical traders is related not only to the customer relationship but also to the whole 'mindset' of the organisation. Therefore, we chose an organisational culture perspective and developed a new approach based on the related frameworks of Contextual Analysis of Organisational Culture [13], Core Task Analysis [14] and Expert Identity [15]. It has also been affected by several other theoretical backgrounds: Organisational Capabilities [16;17], Service Quality [18] and Service Management [19;1;3].

The industrial service culture concept is defined as an organisation's learned manner of responding to perceived changes in the demands of the core task when aiming to develop the service business. Industrial service culture manifests itself in:

- Service capability (how the demands of a new service-related core task are recognised and taken into account)
- Experienced and ideal values within the work community and with customers

– Work motivational factors: sense of meaningfulness, match between requirements and available resources, and the sense of having control over one's work.

Industrial service capability consists of commonly developed operational, cognitive (and cultural) solutions that manifest themselves in four elements:

1. Understanding of service business
2. Service business management practices
3. Development practices of service business and services
4. Customer relations [9;10].

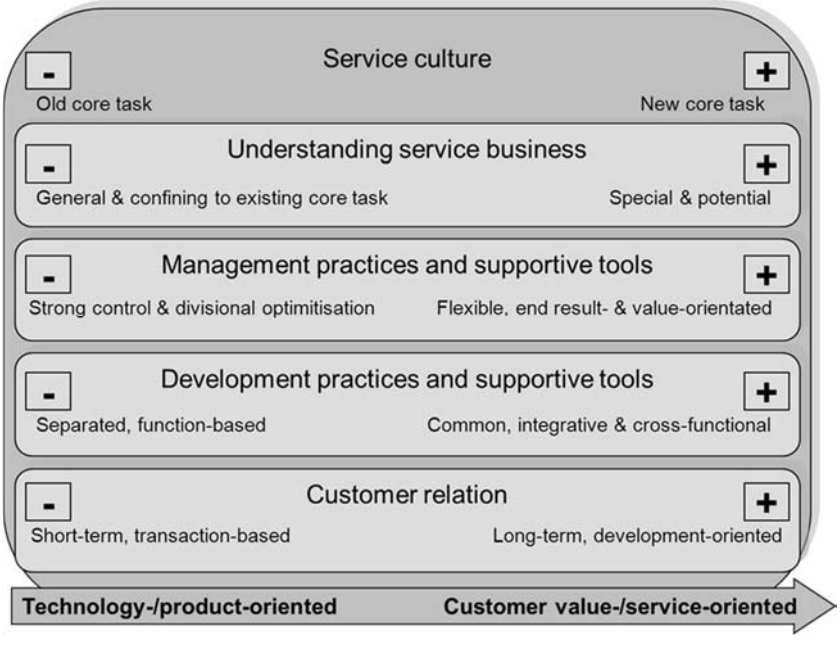

Figure 1. Service culture and capability approach [10].

In order to be able to support change and guide the transition process, we should have a perception of the change needed and its elements. On the basis of the literature and earlier studies on industrial service capability and culture [20;21;9;], we formulated a tentative hypothesis on which kinds of general transformations are needed in every element.

In the *industrial service culture*, the transformation is defined from an old product- (selling-) oriented core task, for which service is seen as a support function to a new, more customer- and service-oriented core task, for which service

is seen as a central part of creating value for/with customers and as a catalyst for growth. In *service business understanding*, the challenge is to move from a general understanding of service business and its strategies to a deep insight into the company's own potential and what it means in practice with particular customers, competences, offerings, organisation, etc. *In management practices and supportive tools*, we define the transformation from strong control and divisional (or function-based) optimisation towards a more flexible end result and value-oriented way of managing. *In service development*, the transformation is defined from separated and function-based development to common, integrative and cross-functional development together with customers. Finally, *in customer relations* we define the transformation from short-term and transaction-based relations towards long-term, development-oriented relations. We see that the development of the customer relationship is a precondition of the development of other elements that are interrelated [22].

The idea of the service culture and capability approach was adopted as a starting point for our new framework, aiming for a more comprehensive evaluation model with the following two new perspectives: business models as well as risks and potential in new business creation.

Business model renewal

The business model is a commonly used concept providing a rather practical view and including the essence of business: creating and capturing value. There is no one and only, commonly agreed definition of a business model. A business model exists even if it has not been explicitly articulated. It can be defined by, e.g., its functions [23]: to articulate the value proposition; to identify a market segment; to define the structure of the firm's value chain; to specify the revenue generation mechanisms; to describe the position of the firm within the value network; and to formulate the competitive strategy. A business model is often described at the level of competition, and there is a theory arguing that it is actually the business models that compete and that an effective business model results in cycles that provide a competitive advantage [24]. Some definitions are more about tools for building a business model, providing the questions that the model should answer [25] or a view of the elements it ought to contain [26]. There are also tools for assessing where the current business model stands in relation to its potential and then defining the appropriate next steps for the further advancement [27]. One practical business model construct [28] consists of

four elements, which, taken together, create and deliver value: customer value proposition (CVP), profit formula, key processes and key resources. According to this framework, reinventing the business model takes three main steps:

1. Developing a strong customer value proposition (CVP): 'How can a real customer who needs to get a real job done be satisfied?'
2. Defining how your company will fulfil that need at a profit (the other three elements of the model)
3. Comparing the model with the current one and seeing how much it has to be changed [28].

This view of transformation is used to build the framework in this paper.

Service business is considered an attractive opportunity for steady growth as it is seen as less prone to economic fluctuations. In practice, the product- and service-oriented business models coexist and evolve in companies. Turning services into business requires rethinking of the current way of operations and building of new kinds of business models. The value-creation logic and necessary key competences may be completely different in product- and service-oriented business models, even when the product and service are tightly interlinked. In previous case study research, the comparison revealed that the differences and new knowledge needed may relate to several elements of the business model, e.g. an understanding of customers' core operations, production or business process, the market in which the customer operates, the customer's customer needs or the company's own cost structure [11]. The case study companies all offered large technology investment goods or turnkey projects in which the profit formula differed greatly from the profit formula of the services.

Uncertainty management

In this paper we regard uncertainty management as an integrated part of service business management practices. The creation of new business and innovations requires taking directions that include several uncertainties. The management of uncertainty in the early stages of the innovation process is an increasingly interesting area in a rapidly changing business environment, including the company's need to remain in a strong position. Uncertainty management applied at different phases of the front-end has been addressed before in a management model [29]. Overall, from both the research and practical perspective, it is interesting and important to apply risk management knowledge [30] in a way that gives compa-

nies new tools to identify and respond better to new opportunities and risks. Thus, by uncertainty management, in this context, we mean addressing the multiple dimensions of risks, namely technological, market, organisational and resource uncertainties [31;32]. Since, according to the current understanding, risks are defined as events that have either negative or positive impacts, we are able to exploit the risk management methodology in new ways and as a systematic and integrated part of companies' processes in identifying business opportunities and potential threats. Thus, uncertainty management related to service innovation management can be regarded as rather multidimensional. As an example of the multidimensionality, we can think of the importance of methods to customer-value-based service business development [12], since they are applied in an attempt to decrease the possibility of customer needs not being taken into consideration sufficiently and to make it easier to evaluate the potential of the services in the early phases of the development. When the company defines its role and services as the facilitators and co-creator of value [2], systematically identifying and assessing the value elements at a very early phase reduces the uncertainties related to the new business development process [12].

Since the starting point for the creation of new business is the identification of the new business opportunity, we are especially interested in the methods for creating new knowledge for this stage of the process. The shortage of reliable information on customers' value creation processes also makes it difficult to assess the value potential influencing customers' processes. The importance of these aspects is emphasised, especially in an industry with only limited experience of services but a great need to carry out a transformation.

Finding a way to create value with the customers is a prerequisite of successful service business. By improving knowledge about future requirements and customer demand, a significant part of the uncertainty related to creating new offerings can be managed. Once the service provider understands more about its value chain and the new dimensions in it, a more solid ground for identifying the new opportunities will exist. Different industries and companies vary in their knowledge of their value chains, however, and building new channels for such knowledge as a natural phase of the transformation is a shared challenge.

Methods

The research strategy was mainly an exploratory case study, although it also consisted of explanatory and descriptive phases [33]. A case study-based approach [34] was applied in order to construct a new holistic framework to analyse the transition with its main challenges. At the beginning of the study, the research question was (only) tentatively driven by the main theoretical perspectives, which were specified during the research process. *The research questions were: What are the main challenges of the transformation in the three industries? What are the main areas to take into account in development? What are the main differences and similarities between the industries?*

We created the preliminary frame and then tested it in the analysis of fifteen cases. The frame was based on the service culture and capability frame in Figure 1, which was further developed and complemented with business model and uncertainty management perspectives.

The empirical data come from interviews, workshops and management meetings in the companies. The dynamic and iterative process of data collection and analysis was essential, as a new framework gradually emerged from the empirical data, and it was compared with the relevant literature. The case companies were all from the b-to-b sector. The division of cases into different industries, the case company descriptions and the typical services offered are listed in Table 1. The common denominator is that all the case companies are interested in developing service business.

Table 1. Case companies in different industries.

Industry	**Size** • **Personnel** • **Turnover**	**Characteristics**	**Typical services offered**
Installed base manufacturing 6 cases	300–over 1000 100M€ - 900M€	Technology and production orientation	Maintenance and other life cycle services
Technical trade 7 cases	10–200 1M€–70M	Heterogenic industry Customer and sales orientation	Consultative selling, wholesaling, logistics
Pulp and paper 2 cases	Over 4000 Over 3500M€	Volume- and process-intensive Service user	Product-quality-related services

Results

Firstly, we will present the challenges characterising each of the industries from the three perspectives: service culture and capabilities, business models and uncertainty management. Secondly, we will present the tentative framework in which we have combined the relevant and supplemental features of the three perspectives, and, thirdly, we will illustrate the areas of the new framework by giving examples of the similarities and differences between the industries.

Challenges of the industries

The challenges of the industries are presented in following tables. Although the differences between the companies in the same industry were sometimes quite remarkable, these challenges emerged from the data as illustrating the potentially industry-specific characteristics.

Table 2. Main challenges for the installed base manufacturing industry.

Industrial service culture	• Conceptions of the core task mainly related to product or technology innovations • Need for broader service offering is recognised. Typically, the development of service business is considered as beneficial but not yet vital • Technological leadership is strongly valued by customers and company personnel • Two types of firms were found: strong product-oriented culture and product+service-oriented culture.
Business models	• Good general understanding of service business but differences between companies in company-specific understanding of business and pricing models etc. • Finding balance with present competences, strengths, customer needs and future (service) business potentials • Separate product and service offerings (some examples on integrative, solution-based offerings) • Understanding of customers' core operations, production, and business process • Earning model and profit formula (e.g. capital investment vs profit sharing) Risk of service paradox still high.

Uncertainty management	• Product development process are often carefully thought over and systematically planned, however, the fuzzy front-end has not been specifically addressed • Models for uncertainty management at this stage are either lacking or underused • Growing customer understanding and data gathering provide the front-end processes with increasing amounts of new knowledge and information.

Table 3. Main challenges for the technical trade.

Industrial service culture	• Typically, still a strong product-oriented culture, but a more service-oriented culture is emerging. Customers are highly valued but there are contradictions within companies concerning the best way to approach customers ("services as added vs value-added services") Two main types were identified: • Personnel typically still consider the core task to be product selling, but managers are searching for a broader role in the customers' business. • Product selling and services are seen and operated separately with different aims, business models and units.
Business models	• Sales orientation (salespeople on commission) encourages 'safe' selling • Understanding of customers' core operations, production and business process • Customer orientation is seen as service • Target to become more customer-oriented but little freedom of action (subsidiaries) • Earning model and profit formula (services included vs profitable service business).
Uncertainty management	• Broader understanding of customers' processes is under development, making it increasingly easy to identify new possibilities. • Identification of new business opportunities is somewhat integrated in the current approaches but procedures and incentives regarding the services are not clear. • The changing role of the company may cause uncertainty in responsibilities and, for instance, undesirable competition in the value chain (brand owner-importer-service provider).

Table 4. Main challenges for pulp and paper.

Industrial service culture	• Conceptions of the core task are mainly related to the physical product although there are suspicions of its competitiveness in the future. • The development of better products and production systems still broadly considered a main strategy for improving competitiveness. • The role of a service user is more familiar than that of a service provider. • Services are not yet strongly valued because of their vagueness..
Business models	• Service business is often regarded so differently that separate ventures have been established to pursue the new possibilities • The current customer base vs the end-user, understanding the value chain, customer needs and expectations (CVP) • Earning model and profit formula (mindset of high volume, low price).
Uncertainty management	• Emerging new ideas and breakthroughs regarding new solutions and add-ons based on the physical products take place while the creation of service concepts is a challenge. • No widespread success in applying service business models to the industry • Obtaining new knowledge about the requirements of companies' value chains and customers is a challenge, however, it offers a solid basis for creating new service innovations.

The framework

The tentative framework based on the three perspectives is presented in Figure 2. The framework aims to conclude the main areas to be taken into account in development when aiming at the transition towards business practices based on customer value.

Figure 2. The tentative transition framework: four main targets and the central development areas within them.

The three selected theoretical perspectives: service culture and capability, business model renewal and uncertainty management, provided a relevant and multidisciplinary frame for increasing understanding of the industrial service business transition at both company and industry level. Based on our empirical analysis, four main elements of the culture and capability perspective were manifested, defined as service business understanding, management practices, development practices and customer relations, all of which characterise the service culture of the company (see Figure 1). The perspective has been built in order to emphasise the complex cultural dynamics concerning the transition from product orientation to service orientation, which is still rather general.

The business model perspective therefore provides an insight into value-creation logic with implications for customer value propositions, earning and pricing models, and in management and development practices, i.e. rewards and incentives. The empirical analysis supported the importance of specifying these value-creation issues in our framework; avoiding the so-called service paradox and achieving profitable growth seemed to be the major obstacle to transformation in all three industries [cf. 1]. The uncertainty management perspective also helped to identify and specify the main managerial risks and potentials, especially those related to the early stages of service business development. The tentative framework in Figure 2 summarises the main aims, with central development areas in service business transformation from these three perspectives.

Similarities and differences between the industries: illustrating the framework

Each of the industries faces numerous challenges related to the service business development and transition. They all share, for example, the following characteristics and challenges (according to the main targets):

- Difficulties constructing a shared *understanding* of what kind of service business is best for them
    - How to find the 'blue ocean' – areas where competition is low?
    - Redefining the strategic role of the company in the value chain and recognising the potentials and possibilities
- *Management practices* tuned to product-based business but a different conception if the change is needed

    - Support from top managers is needed: vision, commitment and strong leadership
- Mainly internal *development practices* manifesting themselves in product design and development but differences in how much they are challenged
    - Technology push strong in service/product development, and customer pull still relatively weak
    - Overly restricted resources for development
    - Developing competence and practices for customer involvement/co-creation with customers at different organisational levels
- Co-operation with *customers* defined by a strong technology brand and product-based selling
    - Deepening the customer relationship; clearing benefits for both parties.

The overall *organisational culture* was under development towards a more customer- and service-oriented one. Understanding has increased of the profound change that is needed, but the targets and/or state of the transformation is different. For example:

- How the traditional way of thinking, in which service is a supportive function of selling or services are rare, minor and distant compared with big volumes of production and selling, be changed? (pulp and paper)
- How can operations be changed from a traditional 'buy/sell thinking' model to a customer-value-oriented one?
- Strong technical orientation and competence among personnel, weaker customer service orientation.

The main difference between the industries was in *the company-specific service business understanding*. The key question in the studied pulp and paper companies was: *How can a new strategy and services be found that interest customers and are based on present competences?* The installed base manufacturing and the technical trade industry shared a fairly good general level of understanding of service business but still had difficulties constructing a company-specific understanding that enhanced the identification of business opportunities. The installed base manufacturing and the technical trade also shared many other common challenges in service business understanding and other areas, for example:

- How to integrate products and services towards value-based business models and operative offerings
- How to make services profitable
- How to prove benefits and total benefit based on offered solutions and raise customers' interest in them.

Discussion and Conclusions

We aimed to learn about the main challenges of the transformation from a product- to a customer- and service-oriented way of doing business in installed base manufacturing, technical trading, and the pulp and paper industry. The results sketched unique characteristics as well as similarities between the industries from three perspectives: service culture and capabilities, business model renewal and uncertainty management. The study also resulted in a framework that describes the main areas to take into account in development, which we illustrated with further examples of the challenges raised from the data. In the following, we discuss briefly the results and then conclude the main barrier for each industry that characterises it in relation to the others. We will also discuss the potentials of the new framework.

Each of the industries faces numerous challenges related to service business development and the transition. Most of the examples illustrated in the framework were from the technical traders and the manufacturing companies, supported by previous studies [1;2;4;5;6;9;11;12]. However, service business development has been uncommon in pulp and paper companies, and thus our data were quite limited related to the issues. Our sample was also quite small and there were many differences between the companies within the industry. The studied companies only represent those that are interested in developing services. Thus, the sketched industry-specific characteristics and similarities are only tentative, and further studies are needed. However, we tried to summarise our rich study by formulating one main industry-specific barrier to service business development.

Condensing the vast results into one challenge, i.e. selecting and raising one challenge above others, is fairly straightforward, and we did that with respect to our data. One of the biggest obstacles in the installed base manufacturing industry seems to be that the service business often appears in the strategic develop-

ment agenda during decline and disappears when sales grow. This reflects the strong belief in the products and technology leadership as key corners of future competitiveness that is common in the industry. However, there are companies that have changed their organisation to be more customer-focused and are developing integrated technological systems in order to serve their customers better. Too often, however, this broadening of responsibility of the customer's process does not include services other than life cycle support to those new technical systems. The potentials of new services related to, e.g., increased data and knowledge of the customer's business and process are not used because of the still strong product-oriented culture of the organisation.

The obvious strength of technical traders is that they believe they are – and many of them actually are – good at getting under the customer's skin, compared with the other two industries. This, however, could also be their biggest weakness – and the barrier to service business development. Aggravating a little, the base for selling is that you know what the customer needs and which products in your offering have the superior features that best match the particular customer values and needs. The only task is to convince the customer that this is what it needs and the role of service remains an add-on to the products. From this arrangement, it is not easy to start asking broader questions about the customers' processes or challenges, which could mean to you – and the customer – that you are showing ignorance.

The pulp and paper industry suffers heavily from its dark future forecasts, which limit its opportunities, both in terms of actual strategic choices and atmosphere (courage and will to commit to the change). The service business lacks the status of an accepted and possible survival strategy at the level of the industry and that creates the main barrier to service development. The industry relies heavily on the development of new biomass-based products as its potential saviour. We are not claiming that this is a wrong choice, but the service perspective could offer the extra ingredient needed to extend the potential by offering a broader and customer-value-driven basis for new product development. This could boost innovation and prevent drifting to development that is too narrow and technology-pushed.

A tentative framework seems promising when analysing the state of development in companies. It aims to enhance the parallel change in business logic, management practices and processes – and the whole mindset of the company, which we stated as one of the key challenges in developing a forerunner in service business. The framework could also offer a base for a more systematic

comparison of different industries and their challenges in service business development, thus enhancing, e.g., benchmarking possibilities. This study is based on previous and on-going case studies. For further development of the framework, additional new case studies representing each of the three industries and systemic use of the framework will therefore be essential. In addition, conceptual clarification is needed within and between the three perspectives and their elements.

Exploitation Potential

The main contribution at theoretical as well as practical levels will be increased understanding of characteristics relating to the service business transformation of each industry. Furthermore, the study provides benchmarking opportunities across industries, thus enhancing learning from each other.

On the basis of this frame we are aiming to develop a practical assessment tool to support the identification of relevant challenges and potentials related to the industrial service business transformation. With the help of the assessment tool, companies can analyse where they are, if they have shared the conception of their present situation, and if that is where they would like to be or if a change is needed. When change is targeted, it should be systemic, synchronised and based on the holistic view of the state of the company and the recognised opportunities. Solving contradictions between competing business models and encouraging controlled risk-taking are necessities for renewal. In addition, the framework can be used in further research as a base for studying particular aspects more profoundly.

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Multi-service model for mobility and logistics

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Abstract

A multi-service model combines different stand-alone transport services into a universal service platform and offers them to customers (private users, B2B customers, transport professionals and the public sector) from a one-stop shop. The efforts behind the multi-service model lie in creating a relevant value network, customer relations and a business model, not in technology. The model can be an ad-hoc service platform for limited products and a limited contract time or a complex virtual service enterprise for a wider variety of products and for many years. The development of a multi-service model can be seen as creating a new company with its business plan, staff, and different roles and tasks in service production (key players, subcontractors, customer care, etc.). It also comprises the design of service-offering concepts and business models for the whole multi-service value-network (common) and for the different companies and organisations involved (separate). This kind of new service production, based on the value network, needs a large amount of research and development work, which is carried out by piloting and testing services and by searching and using relevant back-up studies, theories and tools. In transport and logistics, the development of multi-service production is still at an early phase.

Introduction

Intelligent Transport Systems, formerly known as Transport Telematics, have mainly been public sector services like traffic management systems (traffic lights, variable message signs, road environmental monitoring systems, railway management systems) and enforcement (automated speed cameras etc). The best-known commercial nomadic (or in-vehicle) Intelligent Transport Services

for private car drivers are navigators (with or without real-time traffic information) and smartphone applications. For transport professionals, route optimisation, fleet management systems, heavy goods vehicle tolling systems and digital tachographs are familiar examples. For pedestrians, cyclists and public transport users, there are web-based route planners with stop information etc. All these systems and services are developed and managed separately by different stakeholders, and they lack innovativeness, e.g. in user interfaces, business models and the use of user-generated data. The keys to unlock these doors lie in searching for solutions in other sectors' services and solutions, combining service ideas and knowledge in value networks outside the traditional transport sector, and bringing in technologies such as global satellite positioning, new real-time data, mobile communications and social media. These have been the elements in the development of the multi-service model in the VTT lead Tekes projects PASTORI, SUNTIO and SUNTIO2.

Background

The mobile and location-based content market, including mobility-related content, has attracted great interest among telecommunication operators, companies, corporations, officials and media over the past ten years. The development of mobile handsets, vehicle devices, software and networks has continuously opened new opportunities. Innovations, applications and openings for new markets have been coming and going. Monetising many of these new opportunities has been challenging, however, as most of the other online services and the market have not exceeded the expectations set in the early days of the mobile content market. On the other hand, there are several successful players in the market and success stories should be respected in this demanding business environment. The mobile content market (the largest service categories by revenue included directory services, ringtones, public transport, and chat and communities; the fastest growing services are directory services, public transport tickets, vehicle registry inquiries and mobile auctions) in Finland has been approx 70-80 million euros. The figures for the most popular transport application, the navigator market, in Europe in 2010 are as follows: PND devices sold 17 million units, vehicle-mounted OEM 3.4 million units and GPS handsets with a navigator application12.8 million. The mobile location-based service revenues in Europe are fore-

casted to grow from 270 million in 2008 to 580 million by 2013, from an analysis by Frost and Sullivan. The fastest growing segment is mobile navigation [2] [3] [8] [9] [11] [12].

Content and technology, user interfaces and devices to serve the content to the customers are important, but the real challenge to attend to in mobile services is the business itself, the financing, cost handling and revenues, and the actual service process. Mobility is a complex and individual concept; people have different motivations and values behind their choices to commute to work and for their other travel. It is society's duty is to take care of the safety, environment and efficiency of the transport network (road, rail, air, maritime). In professional freight transport and logistics, the main concern is to have the necessary services and to cut the costs.

The current operational environment of Intelligent Transport Systems & Services (ITS) is facing radical changes all over the world. The stakeholders of the car industry, mobile and nomadic device industry, retrofit device providers, content providers, ICT industry and teleoperators are in search of new products and product processes, services and roles among Intelligent Transport Services. New Service platforms and 'Mobility Service Appstores' etc. are being developed by organisations like Genivi Alliance, SPITS, Nomadic Devices Forum, Autosar and R&D programmes such as Future Internet. The Finnish authorities and insurance companies are now actively searching for ways to organise and use the new possibilities to collect usage-based charges and taxes and to control emissions. Location-, time- and distance-based charging will be here until the end of this decade. It is important that Finnish companies are also there to offer services related to this [8] [11] [12].

Methods

The development of the multi-service model has been iterative and gradual because of the complexity of the stakeholders involved and their motivations and needs, planning the necessary technology and the different roles in service creation. The original aim of the PASTORI project was to build basic public service frameworks (architecture and first specifications) for regulated services that were user-charging (so-called Pay-As-You-Go/Drive or congestion charges) and automated emergency calls (so-called eCall) and then gradually develop frame-

works for other commercial services with suitable business models. The methods were stakeholder interviews, expert discussions, workshops and literature reviews [8].

Service creation starts from the needs of the customers. Society's needs for better transport services lie in solving traffic problems, improving traffic safety, hastening logistics flows, improving information-mediation in traffic and transportation, finding new ways for traffic management and improving transport network functioning as a whole. Services can be diversified and transformed into further new mobility and transport-aiding services for end-users (consumers), B2B customers and authorities.

Alongside the Pastori project was the SUNTIO project in the ICT SHOK Tivit Cooperative Traffic programme. It focused fully on real customer cases and piloting the service ideas. The stakeholders in both projects were from the public sector and commercial, service-providing sectors. This formed a very fruitful dialog of needs, motivation, benefits, possible service offering, necessary quality, performance, etc. Services, especially those that involve mobile payments or data for creating invoices, need high-quality data provision and privacy protection. The study of the necessary amendments for privacy regulation for Location Based Services was carried out as an official duty in the Ministry of Transport and Communications. As a method, real-life piloting is vital in the visualisation of enablers and barriers, the actualisation of roles of the value network and provision of relevant verification and visualisation for further needs in service development [11].

The SUNTIO consortium develops and offers Finnish products for the ITS market as independent service providers and in cooperation with international companies and the car industry. ITS offers new roles for different players. Mobile operators, telenetwork producers, and device and software producers can find new operative roles in ITS. The project creates permanent services with the value network in which there are roles and new business opportunities for SMEs and big companies in service creation and sub-contracting as well as new business for third parties, i.e. any company that uses services in its own functions and as part of its own products (e.g. mobile work and insurance companies). Payment system providers can bring their knowledge into transport-related usage-based paying. This is 'recycling the knowledge' into new areas. SUNTIO has done the first demonstrations of user-based charging for the Finnish Transport Safety Agency.

The challenge is to evaluate and define the necessary tasks and performers and create the business plan for the process. The next phases include new technologies to be implemented into services such as Vehicle-to-Vehicle communications, more sophisticated and automated vehicle-sensor technology, environment-to-vehicle/user communications, etc. New phases bring new partners to the value network with their business logic. The challenge lies in keeping the network open and growing with certain rules and tools and at the same time taking care of the increasing value creation and business opportunities for old partners and new incomers. Issues like data ownership and service liability have to be taken into account. The used technology must be changeable for new possibilities and components coming to the market. The key issues should have standardised interfaces and linkage possibilities so that the services can always be provided in the most efficient manner and new applications can be integrated in a flexible manner on the common service platform.

Project methodology in short [8]:

- Define the service needs and background information (market reviews, interviews, etc.).
- Define a functional service architecture for producing a multi-service supply.
- Define, produce, provide and combine the basic elements needed for multi-services (vehicle and mobile devices and interfaces, location systems, data sources, software, back-end systems, communication systems, payment systems).
- Define and produce service concepts, business models and plans, the required service producers and potential enterprises for value networks with different roles, piloting cases, tests and implementations together with potential customers.
- As a final stage, produce the permanent service selection for the transport and mobility needs of the public sector, companies and end-users for domestic and international markets and export.
- Conduct evaluation and follow-up for future work and development.

Results

The SUNTIO project innovation lies in creating real service production based on networking different enterprises and actors in service development. The first year concentrated on testing the value network and information flows between the companies and systems in practice with first pilots and customers. The challenges for the second and third year will be to develop real business cases, business and revenue models for participating companies and localising the services to different areas (B2B, end-users, export, etc.) together with an analysis of what the real and realistic value creation is for the customers and the production network (companies, authorities and research).

The greatest challenges facing developers of ITS services are the lack of working business models (Table 1), the ambiguity and complexity of value networks, fixed standard practices through regulation or long history, and a lack of risk-allowing approaches that should be facilitated. The multi-service platform makes two-way data flows possible: sensor and location data for refining processes (raw material for different services and analyses) and pushing or pulling information and services back to the driver or travellers. The idea is that the customer can choose his/her favourite transport-related applications from a multi-service broker or operator as a package (as from the iPhone Appstore). The hypothesis is that this model will bring benefits to customers and service providers, such as decreasing costs. The model is simple for the customer (one-stop-shop), and service providers can combine production, marketing and selling efforts. The multi-service model makes complicated stand-alone services that talk to each other so that the user gets only what he/she really wants easily (good and beneficial user experience).

Table 2. Some possible business models for the Intelligent Transport Service value network [1][4][5][6][7.]

Brokering B2B	The broker brings buyers and sellers together. Facilitates transactions. Services: payment management, auctions, distributor, virtual market place, etc. Charge or fee for each transaction	**Sponsoring** B2C	Something given free for selling a more expensive product; real pricing is invisible to customer. Costs before income.
Subscription model B2C	Users are charged a periodic fee (daily, monthly, annual) Permanent relation to customers, predicted income, small margins, difficult initial sell	**Advertising** B2B	The advertising model works best for high-volume products. Contents free, advertisers pay for visibility. For LBS, interesting possibilities connected to localised and personified services.
Pay-as-you-use B2C	Classical model for road tolling and congestion charging Income varies and can be unpredictable – must be a flexible model to adjust or fixed fee + variable fee	**Infomediary model; user information for extra services** B2B ja B2C	Behavioural analysis, contextual ads, etc. Coupons and points for extra services Customer loyalty
Payment per device or licence B2C (B2B)	Clear for customer (preferred) Quick income, no existing relationship to customer, no repeated income	**Membership, affiliate, co-op models** B2C	Service for members with fee, not for volume products Membership fee + service fee
Bundling B2B	Revenue sharing: certain share of customer fees each in the production chain	**Community models** B2C, 'C2C'	User loyalty, marginal services, important for data input

The most important new features of the multi-service:

1) It connects a wide array of separated transport information and services (public and commercial) into a common service and creates new services on top of the built-up vehicle location data.
2) It brings different service providers, hardware and software providers, and mobile communications providers together into a virtual enterprise (value network).
3) Services are performed with a new business model in which combined services are more useful and more economical for customers than sepa-

rate services, and the service processes are also more efficient and economical compared with separate service processes. The important issue is to study the increased value of the network compared with the value of separate processes as well as how to distribute it in the most optimal way.

4) Services ensure information security and privacy as well as fulfilment of other legislative requirements.
5) Services use architecture solutions and interfaces that are as open and transparent as possible with the help of existing components and solutions and independent only of particular technology.

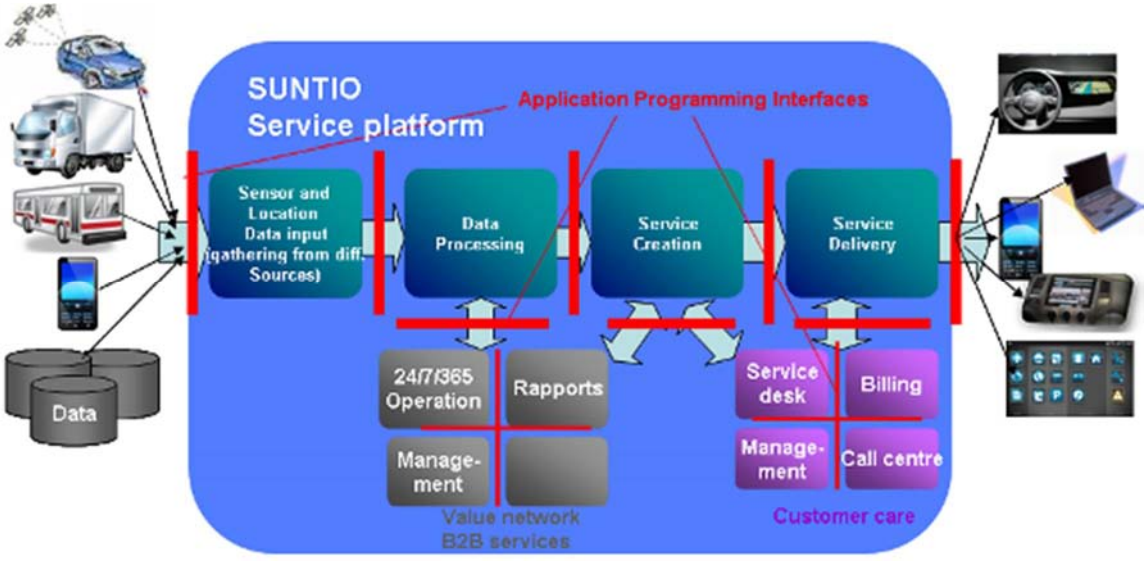

Figure 1. SUNTIO service platform.

Discussion and Conclusions

Individual companies, even multinational ones, cannot master internally all the relevant value activities and networks from product innovation to customer care, nor is it economically sensible for them to try. The only realistic way to develop new services for firms and other relevant actors, like authorities, is to create increasingly complex webs of knowledge, technological bonds and new types of procurement processes. Emerging networks of firms are replacing traditional

markets and vertically integrated companies. In a nutshell, it is a question of how to combine the value activities of multiple actors to form 'value-creating' end products. The goal can be multidimensional: to increase the functional efficiency of an existing value system as in many-tiered supplier nets, to develop better products and systems through new innovative ways (opening the processes, using social media, creating standardised interfaces, etc. with R&D and to develop completely new business concepts and possibilities. Only the future will tell [2][4][5][10][11].

The work continues with the multi-service model. The Ministry of Transport and Communications and its departments are now launching a national programme for public service implementation into a multi-service model in which our work is acknowledged as pioneering. The public sector sets its own aims for opening its interfaces for service providers. The SUNTIO project is continuing the multi-service model creation with a brand called Vedia and the value network will be open to newcomers. The business model work will require efforts in the following years, many things have to be verified and the service localisation in other countries has just started

Exploitation Potential

The PASTORI, SUNTIO and SUNTIO2 projects have brought much material and insight into future work: for service development, value networks, business models, interoperability issues, technical frameworks and, first of all, a living and developing group of companies and authorities together with VTT developing Intelligent Transport Services.

Service improves everyday mobility and makes mobility sustainable (information for smart choices). The SUNTIO service combines different, existing transport-related services and completely new services into a service platform and a one-stop shop. SUNTIO's idea is to produce a wide variety of mobility, transport and infotainment services with affordable consumer pricing (target group: end-users, consumers).

The project brings new business possibilities and assisting services for B2B customers, such as companies with mobile work/services (e.g. security services, outdoor ads, maintenance services), leasing and car rental companies, car parks, insurance companies, etc. It also brings new business to all companies that pro-

duce the services in the SUNTIO value network. The project brings service business out of new technology and makes production more efficient due to the combination of subprocesses in better ways. SUNTIO provides a new platform for regulated services for authorities. The creation of services and products for international markets and export are a very important factor and aim of the project.

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The Finnish ports – public or private service for the community?

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Abstract

Municipalities located on the coast have traditionally owned ports and provided favourable services to nearby industrial companies. Ports have been competitive factors and image creators. The set-up of port ownership and administration is now changing. Publicly owned ports will be corporatized into municipal-owned companies within a few years. There is also a growing trend towards privatization through concession agreements and public-private partnerships (PPPs). Municipalities have to consider the best way to arrange management of port operations and the optimal level of involvement in the port business. These factors can change the patterns of the provision of port services from the perspective of municipality owners, private service providers and customers.

Keywords: ports, port service operations, service networks, restructuring

Introduction

Ports are an important part of the municipalities' infrastructure networks. There are more than 30 seaports spread across the Finnish 1,100-km-long coastline (Figure 1). This number is large for a country with such a small population, inevitably resulting in most ports having small traffic volumes compared with other ports in the Baltic Sea region. The economical, political and institutional environment of ports is changing rapidly all over the world, and in Finland the port sector is about to go through substantial structural changes. Due to EU competition regulations, the traditional municipal ports and port enterprises will

be restructured into the company ownership model in the coming years. The public service philosophy will also need to change. Furthermore, the recent economic downturn and structural changes in industries have had a severe effect on the economic performance of ports, and local municipal governments are constantly seeking ways to reduce costs, improve efficiency and become more effective. They are also seeking ways to increase the efficiency of service delivery.

As owners, municipalities are looking for different solutions to restructure ownership and governance in all technical networks. Municipalities often try to alleviate the situation merely with staff reductions, substantially decreasing expenditure and reducing service levels. Now, some of them are looking for different solutions to restructure ownership and governance in all technical networks. Most of these networks need extensive maintenance, rehabilitation, upgrades and significant capital to meet today's standards and high customer expectations for service and mobility.

The port sector will offer interesting opportunities for that purpose, as the municipality owners have to adopt new innovative ways to arrange port service operations after the transition into companies. The port itself will no longer be a public service and, in turn, its business will be a 'service' for the community – especially if the business generates money for the public owner. These new operating models have to be introduced in order to maintain competitiveness in the tightening international competition between ports.

Figure 1. Map of major ports in Finland (Finnish Port Association).

Methods

The methodology for the research included an extensive literature review mainly from international sources: past studies related to the topic, collection of information via the internet and, probably most importantly, live interviews with infrastructure experts and managers of different technical networks and service providers. The reason for the personal interviews was the limited amount of publicly available information, several instances of old or out-of-date reports, and the fact that there is relatively little research on the sector of technical networks, especially ports in Finland. When it came to ownership and governance (O&G) model variant descriptions and qualitative analysis, the approach of the

research was first of all descriptive. The total number of empirical cases was about 50 (several public roads, 2-3 communal transport networks, a national rail network, 12-15 ports, 12-15 water utilities, 1-2 energy utilities, etc.). The interviews were designed to be in-depth and semi-structured. The final assessment and analysis was conducted by the researchers.

The project assessed the public and business risks of different O&G models and defined a common frame – business architecture – for these models. It also pointed out the weak and strong points of both market-oriented and public models of the networks and identified trends and prospective business potential in operating and owning the networks. The project emphasized practical alternatives to the management structures as well as new business opportunities from the service perspective. Examples of alternative approaches and the advantages and disadvantages of these methods were highlighted.

The main research questions were defined as:

1. Are ports more beneficial to communities (people and businesses) when they are owned and managed publicly (by municipalities) or should they be private businesses?
2. In what ways can port operations and services be organized and managed?
3. What are the restructuring needs and trends in the near future?

The service network

The Finnish port sector has very old traditions and a long history as an exclusively municipal industry. According to the oldest existing documents, towns such as Naantali and Rauma, on the west coast of Finland, obtained harbour rights as early as the 1440s. The harbour legislation underwent substantial changes in 1995, when in the enactment order of the constitution the Parliament repealed the privileges of towns to maintain a port. At the same time, the private public harbour act was passed. These actions opened the way for modern port reforms in Finland. Most ports are still owned by municipalities today, but there are some private ports owned by industrial companies. These private ports only handle goods and products from an industrial plant in the immediate vicinity of the port, but there are some privately owned public ports that also serve external customers.

In the Finnish set-up, the port acts as port authority and port administration at the same time. The port (which may have a different legal status) is in charge of the port and its activities. Even when the port is organized as a private company, it has the responsibilities and duties of a port authority. In Finland, it is in charge of running the port and its activities. Stevedoring is carried out by independent companies. There may also be a private tug company, which may or may not have an agreement with the port, as well as private warehouses in the port area or the port's own warehouses, which it leases (Notteboom & Winkelmans 2004).

A port differs from other municipal service providers in that it not only provides services to the inhabitants of the municipality but also to its clients. The port's income consists of payments and compensation for port infrastructure development and maintenance, and port services. The public ports in Finland usually pay a share of their yearly operating profit to their owners, i.e. the municipalities (Zachcial et al. 2006).

Port operators and other service producers are private companies, most of which provide not only stevedoring operations but also different auxiliary services related to ports and freight handling. Stevedoring firms have traditionally handled the physical movement of cargo, vessel loading and unloading, as well as terminal operations. Stevedoring firms have often advanced from several small companies into one single port operator. With a few exceptions, the present stevedoring firms in Finland are owned by the forest and steel industries, and shipping companies. There is no legal or administrative limitation on the number of port service providers. Some stevedoring companies operate in several ports. In Finnish ports, the stevedoring company is often owned by the main shipper customer of the port (mainly the forest or steel industry). One major stevedoring company is owned by a leading Finnish shipping line, and one towing company almost has a monopoly, offering towing services in most of the Finnish ports without any real competition.

The competition to provide cargo handling services in ports has increased, but it is still typical in most Finnish ports for one stevedoring company to have a monopoly or dominating market position. The reasons for this include small cargo flows in small ports, long traditions and ownership bases. The owners also produce the main cargo flows for many ports. The trend seems to be that stevedoring firms operate in different ports but, having the same owners, are being united into bigger units. The freight forwarders act as representatives of the cargo owners while the shipping agents act as representatives of the shipping companies (Zachcial et al. 2006).

The port infrastructure is built and maintained by the port owner, that is, the port authority. The incurred costs are covered by port dues paid by the port's customers. The fixed structures and equipment (including large ship-to-shore cranes) in the ports are generally owned (and their use charged for) by the port authority. Privately owned stevedoring firms normally finance and own all mobile cargo transfer and cargo handling equipment. In addition to port authorities, companies using the port may also build their own storage facilities.

The trend has been moving towards a landlord role for the port authorities, while private firms supply the port services. Thus, the port authority is increasingly concentrating on maintenance and development of the port infrastructure at the same time as the port operations are being outsourced or entrusted with the present companies.

The private sector invests in warehouses, machinery, other handling facilities, dock workers, mobile moving cranes, etc. Stevedoring and terminal operators are privately owned joint stock companies and are free to set their own prices and make special agreements with customers.

Figure 2 below gives a presentation of enterprises operating in ports, enterprises using ports, enterprises providing various services in ports and authorities operating in ports.

Interest groups in ports	
Port organizations Port companies - port authorities and enterprises - owner companies *Port operators*	**Users of ports/customers** Shipping companies Haulage companies Shippers Receivers of goods Passengers
Service producers Clearance Forwarding Provisioning Bunkering Service and repairs Towage Pilotage Icebreaking Seamen's service and mission	**Authorities** Navigation Customs Police Environment Frontier guard

Figure 2. Interest groups in ports (Finnish Maritime Society).

In addition, there can be various value-added network service providers such as logistics services, shipping agents, warehousing, insurance, labelling, security and dozens of other service companies. Inside one port there can be hundreds of actors that combine to form an important network of different services for shipping lines and other customers. This is one reason ports are so important to municipalities: they create jobs and business opportunities, directly and indirectly. Table 1 presents some of the service providers under different port management models (pu = public and pr = private).

Table 1. Prevailing service providers under different port management models (World Bank 2007).

Model	Port administration	Nautical management	Nautical infrastructure	Port infrastructure	Superstructure (equipment)	Superstructure (buildings)	Cargo handling activities	Pilotage	Towage	Mooring services	Dredging	Other functions
Public service port	pu	pu	pu	pu	pu	pu	pu	pu	pu	pu	pu	pu
								pr	pr	pr	pr	pr
Tool port	pu	pu	pu	pu	pu	pu	pr	pu	pu	pu	pu	pu
								pr	pr	pr	pr	pr
Landlord port	pu	pu	pu	pu	pr	pr	pr	pu	pu	pu	pu	pu
								pr	pr	pr	pr	pr
Private sector port	pr	pu	pr	pr	pr	pr	pr	pu	pr		pu	pu
								pr			pr	pr

Restructuring needs

Municipalities face several challenges external to them, yet, combined with restructuring and governance issues in their infrastructures, these challenges could become even more dominant in the future. The recent economic downturn has seen financial resources for municipalities become scarce, including tax revenues from residents, due to increasing unemployment and a large number of retiring workers.

The other set of constraints comes from the institutional arrangements. The problems arise, to a large extent, from limited understanding of asset management, which makes it difficult to plan fees and tariffs to match full cost recovery. This has led to problems in the valuation of the required maintenance and investment costs. Based on, inter alia, these issues, we found that some of the main driving forces related to the ports' pressures for change included:

- Renewal of municipal legislation driving ports to a company form
- Structural changes to the industries' and municipalities' finances
- Deteriorating infrastructure due to the municipalities' economic challenges
- National and international competition forcing ports to improve their efficiency and services.

The most topical issue currently concerning ports is the upcoming reforms in the municipal legislation. There are external pressures to move ports to a company model from other municipal ownership models in the coming years. All traditional municipal ports and port enterprises have to be restructured into companies, as the Finnish municipal legislation is subject to revision in the near future. The reform derives from the EU's decision concerning competition neutrality problems with municipal enterprises operating in competing markets. Ports operate in fully competing markets, which gives an advantageous position to the ports operating under traditional or enterprise models, mainly due to the tax exemption and bankruptcy procedure benefits. Those ports have to be restructured into the municipal company model or turned into private ports. Most of the studied ports have already started to plan the imminent restructuring process. It is going to be a challenge for them, but it also offers opportunities to develop the business operations and improve competitiveness. Most ports see the change as more positive than negative for them. From a wider perspective, the decision to harmonize the taxation practices and other competition factors is the right one.

Due to the recent economic downturn and the sudden decline in the volume of transported goods, ports have not been able to perform as well financially as in the past (Nokkala et al. 2011). To secure their ability to operate according to the current business model, Finnish ports need to improve their operations in order to ensure their competitiveness. Ports, especially those depending on the trade and transport of forestry-related goods, have been suffering from structural changes in the industry. However, it is not likely that the physical number of ports will decrease in the near future, even if the ownership models change.

Ports are important to municipalities in many ways: they create a positive image and competitive edge with respect to other municipalities. On the other hand, according to the analysis, there is growing interest by private sector actors to enter the business, especially when larger ports are concerned. Similarly, for smaller ports servicing mainly a single client, the matter of maintaining the municipalities' interest in the long run becomes questionable. Port operations and

their outsourcing should be analysed from the point of view of a pure business case to assess the rationale for links between local economic actors and the municipality. Some ports generate significant revenues for the municipalities but, for some future investment needs and municipalities, the continued involvement in the management of operations is a challenge.

Business strategies and future trends in port governance and service provision

The coming years will be challenging for ports but also full of opportunities. Ports have numerous different possibilities to develop their business during and after the transition process into companies. The development process will be faster and easier when the rigid municipal decision-making process no longer ties down the port administration. Municipalities have to consider seriously the level of involvement they want to have in the port business: after all, operating in fully competing markets cannot be considered the municipalities' main tasks. On the other hand, if the port business gives any added value to the municipality, financial or other, it will be more than happy to continue gaining the profits.

In order to improve the efficiency of the port sector, there are several possible ways forward that would reduce costs, make the ports more efficient and competitive, and, possibly but not necessarily, reduce their number:

- Marketing cooperation, alliances and joint ventures, or even direct mergers of port administrations
- Specialization to serve only one or a few cargo types
- New ownership models including an improved landlord-model, public-private-partnership (PPP) and concession-models
- Expanded ownership (for example institutional equity investors).

Economic analysis shows that an efficient and well-functioning port is not necessarily dependent on the prevailing ownership or governance model (Rönty et al. 2011). More important factors are, firstly, the field of specialization of the port and, secondly, the customer base. It was observed that specialized ports were performing better financially than all-purpose ports. The number and type of customer was also found to be meaningful.

Increased cooperation and mergers

There are a number of international examples of cooperation projects and actual mergers between ports. For example, in Sweden direct cooperation between ports is at an advanced level compared with that in the other Nordic countries, Germany and the Baltic countries. One important example is the port of Malmö where a combined tunnel/bridge project threatened to deprive a significant part of the traffic between the ports of Malmö and Copenhagen. The ports decided to merge into a single port company. The Copenhagen Malmö Port (CMP) company's eastern part is located in Sweden and the western part in Denmark. There has also been a port merger in the Stockholm region. The port of Stockholm is a joint venture combining three separate ports under a common name and administration. These ports, on the east coast of Sweden, are Stockholm, Nynäshamn and Kapellskär. The collaboration between Swedish ports is well advanced across the board. There are all sorts of cooperative organizations all over the long Swedish coastline (Naski 2004).

In recent years, direct cooperation between ports has also clearly increased in Finland. In spite of the tightening competition, sales and marketing cooperation is quite common between nearby ports. At regional level, there are many shared interests like shipping routes, fairways and quays, highway and railway connections, etc. The merger between the ports of Kotka and Hamina ensured the competitive strength of the Kymenlaakso route in south-east Finland and port operations and services far into the future. The role of the new port company was strengthened in the Gulf of Finland and the Baltic Sea as well as for transport to and from Russia. The merger created the largest general and export port in Finland and, of the 250 ports in the Baltic Sea, HaminaKotka Satama Ltd. rose to approximately 15th position and is now the third largest container port.

Decision-making in the new port company supports the industrial and commercial activities of the entire region and makes it easier for companies to establish themselves there. Resources can be allocated to what is essential, and traffic can be coordinated according to the needs of the customers in optimal locations. According to a survey conducted by the consultancy firm KPMG, the port merger would lead to total cost savings of up to EUR 60 million during the following decade as the need for port development investments decreased significantly. With the merger, the Ports of Kotka and Hamina would be able to specialize and boost their service provisions with reorganizations.

Other ports such as those in Pori and Rauma have also studied the possibilities of close cooperation or even a merger. The study revealed that the best solution for both ports would be a merger into a single company. According to the survey, they would emerge as Finland's biggest multipurpose port by traffic volume and would generate significant cost savings and other advantages: no overlap in investments in port structures, equipment and machinery, and lower administration costs. There would also be potential for improved land use. In this market situation, closer cooperation would benefit all sides, and ports could expect synergy benefits as a result of teamwork. This kind of activity is based on coalitions between neighbouring ports. In spite of the facts, cooperation between the ports is still quite undeveloped.

The trend towards specialization

Cooperation between ports, especially between those close to each other, could also lead to specialization in cargo or ship types, and pooling of hinterland transport facilities. It would certainly lead to an improvement in output and efficiency in many cases, when focusing on core competencies and cutting unnecessary operations that demand resources both in terms of capital and labour. According to the financial analyses (Nokkala et al. 2011), specialized ports are outperforming general cargo ports in financial terms. It is clearly advantageous to be specialized, especially for smaller ports that cannot compete on volumes.

At the moment, there are already some specialized ports in Finland and the trend towards cargo specialization is ascending. As an example, the port of Hanko exports paper and imports cars, Turku specializes in passenger traffic, Naantali in liquid fuel and bulk, and the port of Vuosaari in containers. Financial performance suggests that specialization could offer potential for other ports, especially from the regional point of view, to develop the existing business model. The ports in the Gulf of the Bothnia could each specialize in one type of cargo, for example, containers for the port of Oulu, minerals and mining equipment for Kemi, and steel products for Tornio. To benefit from economies of scope, these and some other ports could also merge in one location, as they are quite near each other.

New ownership models and expanded ownership

As discussed earlier, the ports in Finland will change into municipal companies during a period of transition. However, there is a further opportunity to consider

broadening the ownership by allowing private sector investors to become shareholders of the newly established company. There are two particular rationales for this:

- Those ports (for example Raahe and Tornio) that already have strong links to private sector entities in the region would benefit from additional resources.
- Those ports that have a well-functioning business model and steady revenue stream are likely to attract institutional investors as well as operators of similar types of ports in Finland and internationally.

The municipality could choose to hold a strategic share in the company or gradually move to full privatization depending on the choice of the decision-makers. It is recommendable that in cases in which the private sector can take over full responsibility of the port operations without a potential threat to existing clients and the municipality, privatization could be completed over a transition period. For instance, the ports of Malmö, Sweden, and Copenhagen, Denmark, have a joint management company.

The potential for a more elaborate landlord model could also be explored, as municipalities need steady revenues from ports without necessarily being involved in any operative work. The landlord model is widely used for port management across the world. It has also been an ascending trend in Finland. From the municipality's point of view, the landlord model means that the municipality will enter into a contract with a private sector entity to cover certain operations, in the most developed case the entire port operations management, including equipment. The municipality will benefit from the arrangement through a steady flow of rental income from the private sector entity (or entities) and through reduced investment and human resources liability.

The landlord concept can provide significant positive cash flow and savings impacts in the long run. The advantage of the landlord model is that the assets will remain on the municipality's balance sheet, unless otherwise agreed. This means that the contract will have an impact on the revenues shown on the income sheet while, at the same time, specifying the required investments that will maintain or increase the value of assets on the municipality's balance sheet. The public sector always has the option of completing the restructuring process by moving to a fully privatized service provision. In the case when the public sector already runs operations that produce the services in question, the privatization can be one of the options to be considered.

With respect to the option of expanded ownership, there are two main drivers for consideration by equity investors to extend their interest into the port sector in Finland. First, through the transition from enterprises to companies some of the ports will come to the markets for the first time. Second, globally, investors are struggling to find investment opportunities to balance their market-risk-based portfolio of investments. In particular, given the current low interest rates, finding investment opportunities that provide a relatively high return with low, non-market-based risk attached is rather difficult. This suggests that risk-averse investors should consider these types of investment opportunities.

To make the ports an interesting investment opportunity from the equity investors' point of view, they would either have to provide a high yield against the associated risk, a low yield against little risk or a combination of the two. As far as the institutional investors are concerned, given that their portfolio has a strong focus on financial instruments, such as stock-listed company shares, real estate and government bonds, the focus from their perspective should be on looking for an option that falls into the middle range of fairly high returns with relatively little associated risk.

Financial analyses have shown that there is great potential from the equity investors' point of view in the port industry in Finland. The results show that apart from traditional financial performance indicators, the ports also provide other types of revenues for the municipalities. As these revenues partially distort the financial performance analyses, we can conclude that those ports currently operating under the enterprise model will provide more than satisfactory returns to investors (Nokkala et al. 2011).

The biggest challenge remaining will be how to convince municipalities that partnering with equity investors is the right way forward. At present, municipalities are not considering broadening the ownership base. However, given the opportunities for investors in the sector, it would not be surprising to see more pressure to broaden ownership. The biggest carrot in this sense would be the fact that operating a port is not really within the core competence of a municipality.

Concession agreements

The 'Finnish port model' is based on the tradition of certain operator(s) working in cooperation with the municipality but with arrangements that do not meet the landlord model requirements. The potential for profit-making opportunities is limited, in particular in cases in which coexistence is a result of the port servic-

ing a few major clients provided (at least partially) by the major clients themselves or their representatives. Such cases require a thorough review of the current partnership and an assessment of opportunities for other service providers to cooperate with the municipality through a genuine landlord model. The landlord model is one of the two concession model variants frequently used in the international shipping business:

1. Concessioning of land to private terminal operators (basically the same as the landlord model)
2. Extensive concession agreement:
   - The concession holder is given the right to use the port's assets for a limited period, after which the assets return to the port authority
   - There is usually an obligation to maintain the port's assets (or to invest in new ones)
   - Holders of concessions are given freedom to carry out all aspects of their business (commercial freedom), subject to the conditions of the concession agreement and the law.

In the case of a public service concession, a private operator or other service company enters into an agreement with the port to have the exclusive right to operate, maintain and carry out investment in the utility for a given number of years. Other forms of contracts between public and private entities, namely lease contract and management contract, are closely related but differ from a concession in the rights of the operator and its remuneration. A lease gives a company the right to operate and maintain a public utility, but investment remains the responsibility of the public. Under a management contract, the operator will collect the revenue only on behalf of the municipality and will in turn be paid an agreed fee.

Conclusions

Ports are important to municipalities in many ways: they create a positive image and a competitive edge with respect to other municipalities. Ports provide essential services for local industrial companies. For mainly historical and political reasons, those services are often being sold at giveaway prices. By owning ports, municipalities provide distinct and conscious advantages to the businesses and, in return, businesses provide jobs for the community and thereby tax revenues

for the municipality. In addition, the ports themselves are often notable employers, directly and indirectly. In fact, ports are service networks combining public services (e.g. development of the land areas and transport connections) with private operators, stevedoring companies and other service providers such as ship agencies or logistics companies. According to the analysis, there is growing interest in more private sector actors entering the port service business, especially where larger ports are concerned. Similarly, for smaller ports servicing mainly a single client, the question of maintaining the municipalities' interest in the long run becomes questionable. Port operations and their outsourcing should be analysed from the point of view of the whole service network to assess the rationale for links between local economic actors and the municipality. Some ports generate significant revenues for the municipalities, but for some future investment needs and the municipalities, the continued involvement in the management of operations is a challenge (Rönty et al. 2011).

Ports as well as other communal technical networks will face challenges and reforms in the coming years. Upcoming changes to municipal legislation, continuous tightening of competition between ports, and the municipalities' financial difficulties are forcing port administrations to develop new ways to improve their efficiency and competitiveness. Ports will soon have to start the restructuring process into company form. Many of them have already started to prepare for the change and some have already changed. In most ports, restructuring is not only seen as a challenge but as a great opportunity to improve the administration and boost the operations.

The possibilities of increasing cooperation with other ports and entities are important issues for the near future. Mergers and joint ventures by port companies are ways to reduce costs, make the ports more efficient and competitive, and, possibly but not necessarily, reduce their number. This also gives the port companies opportunities to specialize their business in certain fields. A company or port cooperating with another company can easily optimize the traffic flows cost-effectively. Overlapping investments can also be avoided. The number and geographical location of ports is likely to remain as they are at present also in the near future. However, the number of port companies is likely to decline. This is likely to improve technical and economic efficiency according to scale advantages.

Financial analyses reveal that ports are at present a good revenue source for municipalities, and specialized ports generally produce better results than those with several types of cargo and/or passenger transport. Ports tend to finance the

bulk of their investment from cash flow, in some cases without compromising the owner's need to receive a fixed amount of return in any given year. The ownership and governance model does not seem to contribute decisively to financial performance, which makes it more challenging for municipalities to change their current business model (Nokkala et al. 2011).

There was strong business and market orientation across the project. Hence, the business community, e.g. large construction firms, service providers and port operators, should find the results useful in their business planning and development of new service innovations. Public sector organizations, e.g. municipal councils and management of utilities and services, should find the results, e.g. identified trends and new business opportunities, usable when assessing their restructuring needs and options for future management structures and innovations in the port service network.

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Service possibilities in the value chain of printed magazines

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Abstract

This paper aims to present possibilities for a renewal of the forest sector through innovative services in the value chain of printed magazines. The forest industry faces serious problems as digitalization affects the use of print products. In order to succeed in competition with digital media, the forest industry must examine thoroughly the whole value chain and its different roles in finding new possibilities for services. One way to emphasize a strong service orientation is the adoption of so-called service-dominant logic, which means that customer value (value in use) is the starting point of the development. In this study, possibilities for new services have been looked for through two different topics, one focusing on novel combinations of printed and digital content and the other on the launch of a new magazine title. Based on the results, there are clear customer needs that could be answered by providing knowledge-intensive business services (KIBS). Through close co-operation, the paper producer could offer knowledge that is very important to the publisher from the viewpoint of printed magazines. The publisher would need a more efficient process for launching a new magazine title as well as better arguments for promoting advertising in printed magazines. Both of these are areas in which the paper producer could take a role as a facilitator of innovation.

Introduction

The magazine business is set to change dramatically over the next decade. Not only will magazine publishers meet increasing competition from other media, the demand to target content at specific reader groups and offer advertisers a better reach to their customers will also force publishers to develop their product

continuously. The Internet has had a tremendous effect on media use habits of consumers, and the use of the printed magazine is no exception. Even though consumers still value magazines in printed form and relate issues such as slow living, excellent user interface and meaningful moments to them, there are several issues on which print media has not been able to compete with electronic media.

The current value chain of printed magazines is presented in Figure 1. The paper producer does not necessarily have any contact with the publisher. In some cases the decision of which paper to use for a specific magazine will be made without involving the paper producer in the discussion. However, it is very important that the magazine and the paper used in it convey the same message, i.e. the paper used in a gossip magazine is not of the same quality as that used for a fashion magazine (Jernström, 2000; Aikala, 2009).

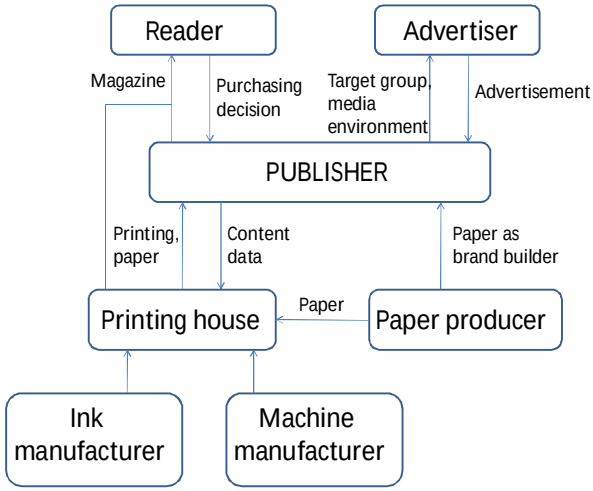

Figure 1. Current value chain of the printed magazine.

In this project we have focused on two specific topics in order to gain a better understanding of the service needs within the value chain of printed magazines. The first topic is *novel ways to combine printed and digital content* and what can be achieved through user data available this way. The second topic is *new title launch* and what kind of services could be useful for the customers. In both topics, the main aim was to look for possibilities of *co-creation of value* either within the value chain of printed magazines in general (novel ways to combine print

and digital) or through increased co-operation between the publishers and paper producers (new title launch).

Servitization of paper production

Even though both of the topics chosen for the study, combining print with digital and new title launch, are very interesting from the magazine publishers' viewpoint, very little research effort has been put into them previously. The data available are mainly from market research, for which there are long traditions, and the metrics are well known in the value chain. Understanding and answering the needs of customers, in this case the publishers, means that it is not enough to focus only on the development of the material product, but the offering has to be extended to services and integrated solutions. In our research context, different types of advisory and consultancy services are particularly important. They are also challenging because their provision means a considerable change in the paper value chain. As a sector of process manufacturing, paper producers cannot apply the stepwise servitization process, which is typical in the sectors in which the installed base enables a 'natural' move to maintain and repair the products sold (Oliva and Kallenberg, 2003). Instead, paper manufacturers have to develop much more demanding services right from the start: to identify, together with various value chain actors, possibilities for innovative uses of paper and facilitate the development and use of these new possibilities. In other words, paper manufacturers have to move from pure manufacturing to *knowledge-intensive services (KIBS)* in which mutual learning between the service provider and the client is a core characteristic (Miles, 1999). Another development direction is a move towards integrated solutions, which are *bundles of physical products, services and information*, seamlessly combined to provide more value than the parts alone (Brax and Jonsson, 2009).

The development of information and communication technologies (ICT) has and will further drastically facilitate handling, storing and moving of information. It has also considerably reduced costs in these respects. The real issue is no longer about how to transfer and compile information but how to find the essentials and analyse and interpret them, i.e. how, where and when to dip into the information flows. The importance of competences linked with locating and selecting the relevant information and using it in efficient ways has grown nota-

bly. This means increasing demand for highly qualified KIBS professionals who are able to provide comprehensive and customized interpretation of random data. Specialized experts have a broad view of the latest developments on the basis of their abundant contacts with various clients, which favours the use of external services instead of developing the corresponding competences in-house. The level of expertise, which has been found to be a central motive in the use of external services for as long as the topic has been studied, along with the development of ICT, is becoming an ever more decisive reason for using KIBS (Kox, 2002; Strambach, 2001).

In addition to individual service offerings or integrated solutions, servitization can also be considered a change to the way in which *the nature of value generation* is understood. The so-called service-dominant logic (SDL) perspective developed by Vargo and Lusch (2004, 2008) highlights that the customer or client is always a co-creator of value – both in the case of goods and services. The provider cannot offer ready-made value but only value propositions; the value is revealed only when a good or a service is used. Thus, the context of use (including different types of chains) is essential and has an effect on *the value experience* by the customer. Consequently, it is possible that a novelty regarded as an innovation by the provider (and being an innovation in the economic sense) is not experienced as a useful novelty by the customer. An important implication of the S-D logic is that *the boundary between manufacturing and services becomes blurred*. In both cases, the most essential point is to understand the use context and the use value of goods and services (which are often combined into a single solution) and to aim to create this value together with customers and other actors linked to the value creation system. We think that this kind of perspective is very applicable to the paper value chain in which the provision of the material product is no longer enough and the development of individual service offerings is much more difficult than in the context of the installed base.

In our research context, there are two important challenges linked to the use value: increasing the understanding of *customer needs* throughout the value chain and identifying the best possible *value offering points* with regard to B-to-B clients. The first is the area in which experience is highlighted. Far too often, companies carry out superficial customer surveys for needs mapping and neglect the deeper analysis of the lived experiences of customers (Helkkula, 2010). Today, however, there are several effective tools to tackle the experiential world, including the ethnographic approach of interviewing and observation used in this study. The second issue, the value-offering point (Holmström et al., 1999), refers

to the point at which the supply and demand chains of the provider and the client meet. When a provider adds services or integrated solutions to its portfolio, it should also re-consider the point in the client's value chain in which the offering is most valuable for both the client and the provider. This usually leads to a change to the value offering point either up-stream or down-stream.

Methods

The two topics chosen for this study, *novel ways to combine print and digital* and *new title launch* were approached very differently. A theoretical viewpoint was taken for the first topic and material was mainly gathered via literature, including technology forecasts. For the second topic, several publishers were interviewed.

The interviews were carried out as theme interviews (Hirsjärvi and Hurme, 2000). This method is suitable when there is some defined field of which the researchers want to gain more knowledge but completely new aspects are also expected to appear. The main emphasis is on learning to understand the practices and needs of the interviewee based on his/her individual experience. The themes of the interviews were prepared in advance and some questions were defined, though free discussion and new thoughts were encouraged during the interviews. The course of the interviews was allowed to vary, depending on the interests of the interviewee, and the remarks and the observations made during the interview.

The interviews were carried out in Finland and, hence, the results presented in this paper focus on the service needs in Finnish settings. As the project proceeds, interviews will also be carried out in Norway and the US to reach a wider perspective.

Results

Novel ways to combine print and digital

Technology to add interactive elements to printed products by combining print and digital has been available for several years, but applications that consumers find sufficiently interesting have only recently been presented. The tremendous

popularity of products and services such as Facebook, iPhone and iPad have had a clear impact on consumers' interest in using mobile Internet and downloading applications to smart phones and tablets. From a magazine publisher's viewpoint, this trend offers entirely new possibilities to increase the interactivity of printed magazines using technologies such as augmented reality, 2D codes or NFC technologies.

NFC tag portal TagAge (www.tagage.net), offered in co-operation between the paper producer UPM Raflatac and the printing house Hansaprint, is a good example of an existing interactive printed product online service. The service is built on Near Field Communication (NFC) technology, which enables data exchange between devices that are a few centimetres or inches apart from one another. TagAge was launched in September 2009 and the online portal was renewed in April 2011. The portal allows customers to create and buy NFC-integrated print products online. TagAge products include labels, patches, stickers and posters. All products can be customized and personalized, and the order volumes range from dozens to tens of thousands. UPM Raflatac develops and manufactures the tags used in the TagAge service, and Hansaprint is responsible for developing the technical structure of the portal and end production. Both companies consider the emerging NFC market to be economically profitable and promising. By introducing the TagAge portal, the companies seek opportunities to offer their worldwide customers tailored NFC products, even in small quantities.

Social media services can similarly be used as tools to offer interactive printed products to consumers. Different forms of social media services have been a rising trend for several years, and there is a myriad of services available to produce print-like products. It appears to be a popular trend to offer print products in these services. MagCloud (*www.magcloud.com*) and Printcasting (*www.printcasting.com*) are examples of online services that offer both consumers and advertisers the possibility to publish printed magazines. JPG Magazine, on the other hand, publishes collections of photographic art with a different theme in every issue. The service (*www.jpgmag.com*) invites anyone to join the process of producing a magazine: "Join the 251 526 photographers sharing their work and voting for the best in our themes. You could be published in JPG Magazine!" Social media services represent a natural platform for digital printing and, thus, an appealing platform on which to offer printed products, as products may be aimed at small circles of friends or small communities.

New title launch

Based on the interviews carried out in this study, the launch of a new magazine title in Finland is often a long process that is very much based on the personal views of journalists, market research, and trial and error. It is also very much influenced by the old traditions of the industry, as commented on by an interviewee: *"They [decision-makers with long-term experience of the media sector] don't question the current standards of activity or then they don't know or don't want other modes of operation."* Following these thoughts, in order to understand the underlying decision-making process of launching a new magazine title in the current business environment, it is necessary to look at the revenue stream of an average magazine: a bit less than one-third of income comes from selling advertisement space, and over two-thirds are subscription revenues. Development activities of magazines are more or less concentrated in two areas of interest: how to boost copy and subscription sales to augment circulation and how to get advertisers interested. The bad news is that from the longer-term perspective, advertisement money will slowly but inevitably shift from printed media to digital media unless radical changes are made. Furthermore, there is gradual erosion in readerships, and new magazine titles are aimed at ever smaller target groups. The 'cash cows', i.e. the big circulation magazines, have had a major role in financing the more experimental titles, but their share of total revenue will gradually decrease.

Due to these underlying challenges, the resources allocated to systematically developing new concepts and titles in media houses are said to have diminished or even vanished. Often, publishers lack an internal R&D incubator in which to build new concepts, and the development activity is most often left to editors-in-chief and journalists on top of their other duties. This has led to a situation in which there are often too few new title concept ideas available in-house. Based on our interviews, the launch of a new magazine title is very much dependent on a journalist's enthusiasm, intuition and sales skills: *"It all begins with one single person, an in-house journalist, who gets a brilliant idea, and pushes it forward to the right people…"* The publishers criticized themselves for not being innovative enough. Several of them talked about "lost possibilities", meaning that permission was not given to test an idea, or a new idea was not even thoroughly discussed.

The pressure is high to find the next "killer concept". However, according to estimates, launching a new magazine title takes from 1.5 to 2 years and invest-

ments of between 1.5 and 2 MEUR before reaching the break-even point. Compared with services introduced in digital media, the launch of a printed product is a much longer process with greater financial risks. Based on our findings, there are seven steps that a new concept idea has to go through from idea to realization, making it a long and heavy process.

1. Idea, enthusiasm and business intelligence: understanding consumers, consumer segments, subject areas and (global) trends, competition situation
2. Gathering all available research material about the consumer segment and trend at hand
3. In-house product and service concept and content development
4. In-house discussions with the subscriptions department, the circulation department and the media sales departments
5. Profitability calculations with a long-term (5 to 6 years) time span
6. Concept and title testing
7. Calculations, test results and launch plans brought to the management board for decision-making.

The development of a new title in this kind of business environment calls for some drastic changes. Here, we can look forward to a real change in the paradigm. First and foremost, the industry needs a more systematic approach to R&D activity. At the same time, top management has the responsibility to create an environment and offer inducements that inspire employees to innovate new ideas and bring them forward. Examples of an active and supportive environment could also be seen. In one case, the innovation process was supported using the SCRUM model and arranging Hack Days for wild ideas. In another case there was a systematic approach to testing the new concept idea with consumers. Until now, most of the new title concepts have been created at the professional end, but this is something that will inevitably change. Publishers will increasingly have to become organizations that look for signals outside home markets and from consumers, e.g. in social media. Other industrial fields should be benchmarked and best practices implemented. As suggested by an interviewee, publishers will have a new business focus, the ‘360 Magazine Intelligence’, which means that publishers will look for other means to engage consumers in media brands, in addition to printed products.

Discussion

Based on the findings in this study, there are examples from the paper industry of similar service-orientation as described by Brax and Jonsson (2009), i.e. integrated solutions that aim to provide more value than the parts alone. The TagAge online portal by UPM Raflatac and Hansaprint provides a service that is a bundle of physical products and services. It is also an example of a service that is provided by the paper producer and the printing house together, and a service for which the customer interface is very different to that which is traditional from the paper producers' viewpoint. A similar approach could very well also be taken in the use of other interactive technology, for which the final aim is a combination of printed and digital content. At the moment, the ecosystem for, e.g. routine-like use of augmented reality technology in print media, is evolving, and there could be great possibilities for renewal in the value chain. For example, care of content creation and data collection could be integrated into paper selection and printing processes.

From the viewpoint of social publishing, i.e. services offering printed products in social media and other digital services, there is no traditional value chain. The service business created there may vary tremendously as may the value created for the customers. There is great potential for new services in this area that could be built together within the value chain of printed magazines.

According to the interviews, very important areas for increased co-operation by the publishers and paper producers are making the process of launching a new magazine title more efficient and advertising in printed magazines more interesting for the advertisers. In both cases the approach is closely related to "kibsification". This means that the role of the paper producer would very much be as a facilitator of innovations, a KIBS function that is relevant when the service is based on analysis of data, diagnostics and interpretation. There is no shortage of market research data or trend data; the problem is more about how to analyse and use the data more efficiently. This can be seen as a practical implication of the study, a service opportunity that the paper producer could use by offering knowledge and support to the publisher's process.

The service possibility of making advertising in print products more interesting can be seen as a research implication of the study, as there are several aspects that are not yet known. Even though technology is available for interactive advertising in print, as pointed out in the *novel ways to combine print and digital* topic of this study, it is not yet known how well the interactive elements attract

the readers. There is great potential in getting the 'clicks' that can be measured, but if the readers are reluctant to click on advertisements on, e.g., news portals (Olmstead et al., 2011), would the same also apply to printed magazines? This is an area that would require more research to reveal its true potential. It would also be important to gain more knowledge on the meaning and importance of the data obtained through interactive elements to the whole value chain.

Conclusions

The services provided by the paper producers for their customers are traditionally related to technical sales. There is no previous data from the use of KIBS functions or service-dominant logic in the value chain of magazines. In this study, new service possibilities for the paper producer were searched for using two separate topics, one concentrating on combining printed and digital content and the other looking at the launch of a new magazine title from the publishers' perspective.

Based on the results of this study, there are several potential areas in which the paper producer could create new service business. The paper producer could take an active role in promoting novel ways to combine print with digital and in the evolution of the ecosystems around the new services. In addition, the paper producer could offer new services to the publisher by supporting the publishers' process of an efficient new title launch and for promoting advertising in printed magazines. There are clear customer needs that could be answered by providing knowledge-intensive business services (KIBS). Turning the service possibilities pointed out here into active services requires a close relationship between the paper producer and the publisher and, in some cases, also the involvement of other players from the value chain. This means that the role of the paper producer in the magazines' value chain would no longer be that of the raw material provider but that of a consultant that offers knowledge and support to the customers' processes. The viewpoints taken here to reveal new service possibilities in the magazine value chain are also very much in line with the service-dominant logic presented by Vargo and Lush (2004, 2008).

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‘Kibsification’ of private security services: Towards more knowledge-intensive security offerings

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Abstract

In response to many external pressures, private security companies are shifting towards more customer-specific and integrated security services. This paper discusses their transformation process towards more knowledge-intensive business services (i.e. ‘kibsification’) and adds a new profession and new area of support services to the debate on KIBS. The aim is to present the key challenges to accomplishing the kibsification process. The discussion is based on empirical data provided by three research projects and some company-specific development projects. To analyse the KIBS potential of security services, we take the three main characteristics of KIBS as the starting point and discuss how current security services comply with these characteristics. As a result, we identify three key challenges that security providers face in the kibsification process. We conclude that KIBS is a useful concept in security business, although some representatives of the industry show fewer KIBS features than others.

Introduction

Private security business is living in an era of change. The growth of the security sector is widely recognised [1, 2], and several external factors, like increasing crime rates, the perceived fear of crime, the spread of ‘mass private property’ (such as shopping malls and other communal spaces) and the demands for protection of citizens and organisations, are identified as the most influential drivers of growth [2]. The continuous growth is attracting new entrepreneurs to the

field, and security services are currently being merged with other industrial services, such as facility management and IT services [3]. In addition, the following global transformation processes specific to security business have been identified:

- traditional forms of security service replaced by automated security systems
- security privatisation and private policing (especially in the US and the UK, not in the same form and to the same extent in Scandinavia)
- technocratisation and depoliticisation of security practices [4]
- increasing citizen-involvement in security development [5]
- increasing regulation of private security business [1]
- increasing resistance to public securitisation [6]
- security reforms in developing countries [7]
- security services to end customers are transmitted more by 'middlemen', i.e. construction firms, IT operators, facility management, service integrators, etc.
- private security developing towards 'everybody's business'[2].

What is common to many of the changes mentioned above is that they require new competencies and a new mindset by the security providers. In the situation in which supply competition is increasing and rapidly developing technologies are equally available to all the players in the field, services are seen as a key to differentiation and higher margins. In response to these external pressures, security companies are shifting towards more comprehensive, customer-specific and integrated security service solutions. Now, they need to be able to integrate various different disciplines into a total security solution [3] and show special security expertise to differentiate themselves from their competitors. Furthermore, as the clientele of security companies extends to all sectors of society, the security companies also need to adapt to the global megatrends of servitisation and more customer-oriented business logic.

In current literature, service-dominant logic [8], product-service systems [9] and developing more knowledge-intensive services [10] are among the key expedients of increasing customer orientation in service business. In this paper, we take knowledge-intensive business services (KIBS) as our framework [11–13]. This study is situated in a context in which the investments in research and development are lower than average [14] and the education standard is low. The basis for the security offerings has remained almost the same during the last

decades, and the service development has been rather incremental and technology-oriented [15]. This paper discusses the prerequisites for the transformation process towards more knowledge-intensive business services (i.e. 'kibsification') in security business, and the aim of the paper is to present the key challenges in accomplishing this change. To work towards this goal, the paper is structured as follows. First, we briefly review the current literature on business services in general and, especially, knowledge-intensive business services. Next, we describe the methodological foundations of this paper. Then, we present security services in the light of business services and discuss how the security services comply with the principles of KIBS and what the key challenges are to more 'kibsified' security services. Finally, we discuss the implications for security providers and service researchers alike.

Business services and KIBS

Business markets refer to transactions of material goods and services between enterprises as well as governmental and other organisations within the non-consumer sector. Unlike business-to-consumer markets, the products and services are produced because they are required for the production or sale of other goods and services. [16] Therefore, in contrast to consumer services, it is important to distinguish between the ways business services are applied to the customer's own business processes. Business services are typically more customised and usually more technological or product-related than consumer services [16, 17], and, in a business context, it is more challenging to align the business strategy with highly complex markets [18].

KIBS is a subsector of business-to-business services. KIBS refers to companies that provide expert services to other companies and organisations [13]. The diversity of knowledge-intensive business services is wide, and, correspondingly, the definitions of KIBS vary. On a general level, KIBS are defined as 'services that provide knowledge-intensive inputs to the business processes of other organisations'. [11] Other researchers [19] suggest that the KIBS sector consists of companies 'whose primary value-added activities consist of the accumulation, creation or dissemination of knowledge for the purpose of developing a customised service of production solution to satisfy the client's needs'. This definition highlights the three specific characteristics of KIBS: 1) the knowledge-intensity

of the services provided, 2) emphasis on consultancy and problem solving for the customer, and 3) strong client-orientation of the service offerings [20]. Elsewhere, the knowledge-based origin of these kinds of firms is emphasised, and the KIBS sector refers to firms, that 'have emerged precisely to help other organisations deal with problems with external sources of knowledge'. [11] Additionally, many other features have been associated with KIBS, e.g. professional knowledge, expertise, non-routine services, joint value creation, intangibility, multidisciplinarity and innovativeness [12, 13, 20].

Materials and methods

This discussion paper is based on the empirical findings from three research projects. First, the SecLi research project[1] defined what constitutes security business in Finland [15, 21]. The SecLi project ended in March 2010. It was based on qualitative expert interviews and workshops. Second, in the ongoing ValueSSe research project[2] [22, 23], the focus is on value creation of security services, and novel security service concepts and a more customer-oriented approach are being developed with eight leading security companies in Finland. In the ValueSSe project, several qualitative methods are used to collect and analyse empirical data gathered from the security companies and their customers. Third, an ongoing SecNet research project[3] approaches security business from the perspective of business networks. In addition, VTT has completed some company-specific development projects that support the general findings of this paper.

[1] SecLi – Growth areas and opportunities of the security and safety business in Finland, http://www.vtt.fi/sites/secli/
[2] ValueSSe – The value of corporate security services, http://www.vtt.fi/sites/valuesse/
[3] SecNet – Global and local security networks, http://www.vtt.fi/sites/secnet/

Kibsification of security services

Security as a business service

The private security industry includes privately funded business entities and organisations supplying security-related products and services to specific customers for a fee [24]. The security industry's customer base is very wide, and it cuts through all market sectors and includes governments, and commercial and industrial enterprises [25] as well as citizens and private households.

In current literature, security is categorised into facility services [17], and most facility services can be classified as support services. According to the United Nations' International Standard Industrial Classification of All Economic Activities [26], security activities, including guard services and the operation of electronic security alarm systems, are classified into administrative and support service activities. The support service industry performs routine activities – like rental and leasing, employment activities, cleaning, facility management, and security and surveillance – that support the general business operations of their customers. The companies in this sector specialise in one or more of these support activities and provide services to customers in a variety of industries and, in some cases, to households. The support services are typically of low strategic importance to the customer. They are fairly simple and standardised services whose purpose is not the transfer of specialised knowledge [26] and, in most cases, there are many alternative providers in the market. Furthermore, no unique expertise or major capital investments are needed to establish a support service company [27].

Security as KIBS

In previous studies and statistics, security activities have been explicitly excluded from KIBS [11]. However, the security industry is searching for new ways to offer more value to their customers, and new services are being developed. The strengthening of security expertise and delivery of new security expert services are among the many ways with which the security industry aims to provide more value-adding services to its customers. To analyse the KIBS potential of the security industry, we take the three main principles of KIBS [20] and discuss how current security services comply with these principles and what challenges can be identified: 1) the knowledge-intensity of the services provided, 2) the

emphasis on consultancy and problem solving for the customer, and 3) the strong client-orientation of the service offerings. Based on these three principles, we ask three specific research questions and discuss the kibsification through them:

1) What constitutes the knowledge base of security KIBS?
2) What kind of service offerings can be built on this security knowledge base?
3) How is client-orientation present in the security markets?

The knowledge base of security KIBS

The most distinct characteristic of KIBS is the use of generic knowledge to solve specific customer problems. If we categorise security services, or at least some of them, as KIBS, we have to define what knowledge security KIBS use for the benefit of their customers. Different security services use different knowledge in their service processes and we therefore have to consider different security service categories separately. At least four types of security services can be identified that have different knowledge requirements. First, there are private security companies that offer basic security products and services, e.g. guarding services. The knowledge requirements of these services are low, and the price is the fundamental competitive factor. As the core of these basic security services has remained almost the same during the last decades, there has not been a significant increase in the knowledge requirements either. Based on the traditional guarding services and supporting technologies, novel security services have been developed, however, and there are examples of new kinds of security services that require very different expertise to the traditional security services.

The second group is systems of security products and services that consist of more complex and specialised offerings and solutions that already have some specific expertise integrated into them to support the customer's business. For example, alarming and surveillance systems have developed extensively during the past two decades. This has raised new demands for ICT and IP expertise, and led many security companies to withdraw from the guarding business and to specialise in delivering technical security systems with supporting services instead. The third group is security consulting and training services, which require deep knowledge and understanding of the security business, related legislation, best available technologies, and the customer's business context and processes. The last group is services in which security offerings and solutions are being

integrated into other businesses. In this group, security is added to several products or services as an integral element, or it can be the most important feature and the selling argument of the product or service [21]. This group of services extends the boundaries of security business to new areas, such as health care, education, logistics and machine building, and highlights the importance of security knowledge also in business areas in which security has traditionally not been in the core offering.

As the security sector is expanding and many businesses are developing towards offering more complex and customer-centric security solutions, the requirements for the knowledge needed to serve the customer in the best possible way are also changing. It could be argued that the knowledge requirements are also increasing – especially, if the security companies provide more than one type of services or, more importantly, if they provide new and unprecedented combinations of these. The growth of the knowledge-intensity adds the KIBS potentiality of the security business and challenges the industry to identify the current knowledge gaps and to profile the specialised knowledge related to each service.

Security offerings that can be built on the 'security knowledge'

The second central characteristic of KIBS is the emphasis on consultancy and problem solving. If we consider security services as KIBS, we have to define what kind of service offerings can be built on the security knowledge discussed in the previous section. Notable, security consultancy is not an integrated part of the current security service offerings. In Finland, security consultants are typically entrepreneurs who have previously worked for large security service providers or have made a career in defence or insurance business. The largest security companies currently only have a limited number of consulting services in their offerings. At the same time, most security service designs and service specifications are not based on security risk analysis or some other kind of security status quo reporting. We argue that in order to develop more knowledge-intensive services, security companies could strengthen their security expertise and provide more high-profiled security expert services.

One of the key challenges for security providers is that many customers perceive security problems as secondary to their daily business. Whether as a cause or effect, most security services aim to solve quite simple problems for customers. Guards are hired to prevent shoplifting and closed-circuit TV systems

(CCTVs) are used simply to monitor happenings at the plant yard. With more intelligent CCTV systems and more sophisticated data analysis services, threatening situations can be identified at an earlier stage, i.e. unauthorised persons or vehicles can be identified or unwanted behaviours and objects can be recognised even before they cause any harm. As soon as it becomes clear that the security service has a direct positive effect on the core business, the offering is of much more value to the customer. Some security offerings already aim to answer more comprehensive and strategic customer needs by using traditional security products and services, i.e. customer's customers' behaviour patterns and attention to specific items in a shop can be recognised and analysed. When answering the core security problem, the security services can also provide answers to the customer's business problems. Moreover, in some cases security offerings can be integrated into the customer's existing products or services. The security industry therefore has to identify what problems relating to the customer's core business they can resolve and, on the other hand, how they can demonstrate the benefits of the services to their customers.

Client-orientation in security markets

Our third question is: how is client-orientation present in the security markets? Strong client-orientation is a central prerequisite of KIBS and, if we are considering security services such as KIBS, we have to take the issue of client-orientation into account. Our general finding from the Finnish security service industry is that the majority of the service providers does not use the full potential of customer relationship management. In the context of security guarding, for example, it has been noticed that good buyer-seller relationship practices are of particular value in security guarding and that business-to-business customers of these services seek not only the actual security outcomes but also service providers that understand the value of service-orientation, fluent communication and listening to the needs of the customer [22]. We have no reason to assume that the situation would be different with other forms of security services. Too often the focus of the service providers is only on the service operations and security provisions, e.g. on the technical aspects of the security systems provided or the tasks of the security guards. We do not want to underestimate the role of the clearly defined service operations and security provision, however. They are of course the essence of these services, but we would like to highlight the importance of the buyer–seller relationship practices as well.

From the KIBS perspective, occasional contacts between the buyer and seller can form a considerable challenge. The basic stance of any KIBS is that they acquire information from the customer and process it into customer-specific solutions [20]. If there is no continuous dialogue between the security provider and the customer, there are no possibilities of information gathering and, hence, no possibilities for customer-specific security solutions either. Our finding is that it seems quite typical in security markets for the customer to specify the service content very strictly and often very little room for the service provider to take part in this process. This is a major challenge for service providers because they are not able to use their full knowledge potential for the benefit of the customer. It is also a considerable obstacle to the development of new security KIBS because it means that in these situations, customers tend to buy CCTVs or security guards instead of security expertise or knowledge.

Discussion and conclusions

This paper is the first attempt to study security services as knowledge-intensive business services. We agree with previous studies and statistics on the fact that the security industry as a whole does not yet fulfil the criteria of pure knowledge-intensive services as such. The traditions of security services lie behind simple, high-volume, low-value services, although the forerunning security companies are now trying to get out of this box. They are searching for new value-adding features in their services and new ways of demonstrating this new value. More knowledge-intensive security services are being developed in parallel with existing standardised services. Thus, we argue that kibsification is an emergent trend in the security industry.

Security services provide an interesting and topical example of support services. As a research finding, we identified three key challenges in their kibsification process that may also be similar to other support service industries. In order to develop more knowledge-intensive services, support service companies could:

1. Strengthen their service-specific expertise and add high-profile knowledge-intensive expert services to their current service offerings
2. Identify what problems relating to the customers' core business they can resolve and how they can demonstrate the benefits of the solutions to their customers

3. Develop customer relationship management practices in order to provide more client-oriented services.

In spite of many challenges, there are some positive signs that could eventually lead to unprecedented security KIBS development. The most important factor is without a doubt the security industry itself, which has acknowledged the need for change. Most of the companies are now actively seeking new business opportunities and new forms of competitive advantage in services. In this process, KIBS is a prominent concept, although not necessarily the most suitable for all the members of the industry. We acknowledge that all security services do not have the potential of knowledge-intensive service, and even the simplest security services, in their current form, are still needed. We argue that it is important to identify the kibsification potential and to focus on the right development measures. Kibsification will enhance and expand the current security service offerings and open up new possibilities both for security service providers and their customers to make full use of the security expertise. Consequently, further research is needed into the customers' role in this process: without aware and knowledgeable customers, there will not be significant demand for more knowledge-intensive security services.

As the security business is extending in many different directions and also attracting companies from other industries, a new approach is required: the security companies need to acquire new knowledge in order to compete with the newcomers, serve their current customers in the best possible way and attract new customers. With a wider security knowledge base and a deeper understanding of their customers' business, security providers could solve more complex security problems *together with* the customer – not only *for* the customer.

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Customer needs and user-driven service innovation

Involving users in service co-creation

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Abstract

The role of users in service design is changing from one of passive research subjects to one of active co-designers and content creators. Users are the best experts in their everyday lives and therefore have great potential as sources of innovation. In this paper, we describe three different co-creation approaches that facilitate involving users in service innovations: the Owela (Open Web Lab) online co-creation platform, the Ihme innovation showroom and Living Labs. Owela is at its best in early ideation and concept design. Ihme is at its best when people can look at and experience physical demos or proofs of concepts. Living Labs enter the picture when the service already exists and is developed further during use. With all three co-creation approaches, direct designer-user interaction turns the designer's mindset from technical features to user experience. This facilitates the design of services that are better accepted by users and more successful on the market.

Introduction

Today, human-centred design is quite an established practice for designing products and services so that forthcoming users are represented in the design process. Human-centred design starts once the decision to design a certain kind of service has been made. To increase the users' role in design and innovation, we should increasingly involve them in deciding what is needed and what kinds of services should be designed for them and with them. Kanstrup and Christiansen [1] describe this change as changing the user's role in design from a victim who needs support to a valuable source of inspiration.

Co-creation stresses the collective creativity of all stakeholders including end-users [2, 3]. In user-driven innovation, users are not considered a reference group that sets the specifications for a system but a source of inspiration that can foster innovation [4]. User-driven design integrates user studies and idea generation [5]. A crucial factor for the success of service development is the performance in the early stages of the development process, that is, the 'fuzzy front-end' in which the targeted service has not yet been decided [6]. User involvement could be especially useful at this stage due to its high level of uncertainty and low formalization [7]. In addition to ideation, user participation 'at the moment of decision' is attracting greater interest [2]. A key challenge of user-driven innovation is to reach potential contributors and integrate them into the service innovation process. In traditional human-centred design, only small numbers of users have been involved in the design activities. New methods are needed to reach the masses of potential innovators. Computer-supported methods for co-creation with users are one solution [8,9]. New kinds of face-to-face collaboration methods are also needed. In the following, we will introduce three approaches to co-creation of services with users: Open Web Lab (Owela), the Ihme innovation showroom and Living Labs co-creation. VTT has successfully applied these approaches to several service development projects. We describe our usage experiences and conclude with suggestions on the suitability of each method to different user-driven innovation cases.

Co-creation approaches

The co-creation of services requires approaches that support collective creativity. Users, designers and other actors should have inspiring physical or virtual spaces where they can meet informally and as equals. In the following, we describe three different approaches to this: the web-based approach Owela, the physical space Ihme and Living Labs that combine both physical and web elements.

Open Web Lab (Owela, http://owela.vtt.fi/) is an online platform designed by VTT for co-creation between end-users, customers, developers and other stakeholders (Figure 1). Owela is built on social media-type interaction and thus enables user participation regardless of time and place. Owela provides tools and methods for understanding users' needs and experiences as well as innovating and designing new products and services together [10].

Figure 1. The Owela online co-creation platform.

VTT's Ihme innovation showroom (Figure 2) was launched to test and further develop the idea of an open public co-creation environment. Ihme aims to fulfil the existing gap between laboratory research and a living lab approach. Ihme is an open, low threshold environment that ordinary people can visit freely and in which they can experience and test new ubiquitous technology applications with guidance. Ihme emphasizes direct designer-user interaction.

VTT's first Ihme environment was located in the Ideapark shopping centre (Lempäälä, Finland) in a 61 square metre facility in summer 2010. People were able to visit it easily according to their own schedules. Co-creation was based on physical proofs of concepts and other tangible illustrations that people could see and try. Besides the Ideapark Ihme Innovation Showroom, more temporary Ihme

innovation showrooms have been set up in the contexts of fairs and exhibitions (e.g. Mindtrek 2010, Hyvä Ikä 2010 – Good Age and Myymälä 2011 – retail trade fair).

Figure 2. The Ihme innovation showroom.

Living Labs can provide reliable information about the market behaviour of users, further contributing to reduced risks for new business and technology [11]. A Living Lab community that has been successfully motivated is an efficient infrastructure to develop and test services as well as to gather user feedback on a long-term, thorough and systematic basis. As a development and innovation environment, a Living Lab is more participatory than traditional social pilot studies and ethnographic research, which focus on observing rather than interacting. Living Labs extend to more areas of human life than experimental laboratory studies.

At VTT we emphasize Living Labs as long-term 'design-in-use' activities in which users use the service and develop it further as part of their everyday lives. The Living Lab co-creation methods have been developed based on our experiences of different field pilots. Even if Owela can also be seen as a living lab, here, Living Lab refers to a long-term design-in-use user community with both online and face-to-face co-creation activities.

Usage experiences

Owela online co-creation

Over 40 different kinds of co-creation cases have been carried out in Owela. In most of the cases, ordinary consumers and citizens have had the chance to interact with companies and researchers in order to create new products and services. Most of the cases have been related to the early phases of the innovation process such as gathering information on needs, generating ideas and evaluating new

product and service concepts. There have also been encouraging experiments to involve end-users in the later stages of new product and service development, especially in the software context. Table 1 illustrates some of the studies that have been carried out in Owela.

Table 3. Selected cases of Owela co-creation.

Name of the Owela study	*Number of participants*	*Length*	*Topic*	*Phase of the innovation process*
Mobideas	33 users, 4 developers, 2 researchers	6 months	Co-creation of social media-based web service with end-users and a software development team	All phases of the innovation process (idea generation, concept design, development and testing phase)
Monimos	70 users, 5 researchers, 1 designer, 1 developer	1 year	Co-creation of a multicultural social media service with immigrants during one year	Idea generation, concept design, testing phase
Postal Lab	140 users, 1 company representative	Over 1 year (on-going)	Owela was used as a back-channel for a living lab in which new postal services were developed.	Concept evaluation and ideation
Home2030	110 users, 1 researcher	2 weeks	Young adults' opinions on uture living	Need capturing, concept evaluation
Events	4 users, 3 developers, 3 researchers	1 month	Co-development of a mobile event management service by users during a test period	Prototype testing

In our studies, using Owela for co-creation activities has had several advantages. Via Owela, companies have reached large numbers of users quickly and cost-efficiently. Owela has enabled companies to establish a long-term interaction relationship with the users. The flexibility of the online co-creation platform has enabled ad hoc changes in the implementation of intensive studies. For the users, participating in the Owela activities has been easy, regardless of the time and place. Owela encourages users to make micro-contributions, and people who would not have had the time to participate otherwise have thus been able to contribute through Owela. Users have been empowered to act as innovators, design partners and decision-makers as they have been continuously connected in the innovation process. An open and transparent design process has been achievable through Owela.

The Owela co-creation studies also had some special characteristics and challenges that need to be considered. First and foremost, the Owela tool itself does

not guarantee success; experienced facilitators are needed. The goals and tasks must be clearly communicated to the participants. Most participants will not read long and complicated instructions online, hence they should be as short and simple as possible yet contain all the necessary information. Assigned tasks should contain possibilities for micro-contributions. Tasks that require more intensive participation (e.g. idea chats) are also possible, but they have to be carefully planned beforehand. Most of the communication in Owela is text-based, and this has to be taken into account when analysing, e.g. end-users' ideas, as the text may lack some crucial information or be subject to misunderstanding for some other reason.

Ihme innovation showroom

In Ihme, the ideation theme has to be such that it will tempt passers-by to take a closer look. Each user should be able to devote as much (or little) time to the ideation as (s)he happens to have. In Ihme, we have studied, e.g. a virtual travel service, games, augmented reality applications, Internet of things and mobile consumer services. As data gathering methods, we have used interviews as well as posters on which users can put their ideas and comments as post-it notes. The interviews and ideation sessions lasted from twenty minutes to one hour.

It proved to be important to present the value proposals in such a way that ordinary, less technology-oriented users could quickly understand them. Flexibility in the schedule, according to each individual's available time, is also important. In a real-world setting, users are most interested in commenting on familiar topics such as future TV. The Ihme innovation showroom facilitates direct user-designer interaction in the actual usage context. Direct interaction with users has been fruitful and has produced concrete ideas. The dialogue not only foments ideas but also makes the designer understand the user's world.

The Ihme innovation showroom at the Ideapark shopping centre reached a large number of visitors during the first opening period, summer 2010 (approx. 2500 visitors). In a visitor survey, interactivity, entertainment factor, innovative visual representation, presence of sound feedback, possibilities for further development and broad applicability were mentioned as reasons that made some applications more appealing than others. Of the survey respondents, 69% showed a positive response towards participating in the design of new technologies and services. Participation was seen as useful and important but also fun and interesting. Convenient ways of participating listed by the users were short group inter-

views and conversations, online questionnaires, entering a publicly open showroom and participating as a test user. The main reasons for not taking part in the development process were insufficient time or interest and users not seeing themselves as tech-savvy enough.

The Ihme innovation showroom served well in the co-creation of services, with tangible experiences. Visiting the Ihme space was reported as a positive experience by all the survey respondents. The main positive aspects were the opportunity to participate, experiencing new technology trends, the public appearance of the research institute, the opportunity to meet experts, an easily approachable location and a low threshold to participate.

Living Labs

Living Lab co-creation is based on our experiences of applying and developing co-creation methods in different field pilots. These have focused mainly on media and mobile services. It is already an established practice to organize field tests in pilot services before they are launched on the market. Prototype services that are reliable enough for long-term use and include content valid for actual use are good candidates for field tests. Long-term field evaluations give user feedback beyond first impressions. Very often, user attitudes are only established after the first few weeks of a 'honeymoon' period. The Living Lab approach changes the setting of a traditional field test so that in addition to actively gathering user feedback, users are also encouraged to propose improvement ideas. The best ideas are put into practice right away and thus the users can see immediately how their feedback influences the service. This motivates additional comments and development ideas and gradually creates a positive spin of continuous improvements based on everyone's contributions.

Our most recent Living Lab case, Itella Living Lab, focuses on the development of postal services. In Itella Living Lab, we have carried out co-creation efforts in several phases using different methods from household and individual interviews and questionnaires to co-design sessions with group dialogical methods. Owela is also in use as a method for collecting feedback and ideas and for informing participants. The co-creation process has produced data that include plenty of user ideas and opinions on future postal services. At the same time, the community, part of a small village in southern Finland, has benefited from the living lab setting a social agenda and technical platforms for participants to meet each other and collaborate for common goals.

Comparison of the co-creation approaches

Figure 3 illustrates the three co-creation approaches in terms of participation space and participation role. Owela is an online approach and Ihme is a physical world approach whereas Living Labs can have both elements depending on the co-creation activity. Owela participation focuses on reflecting ideas and developing them further whereas Living Lab and Ihme focus on people experiencing themselves, and give feedback based on the actual experience.

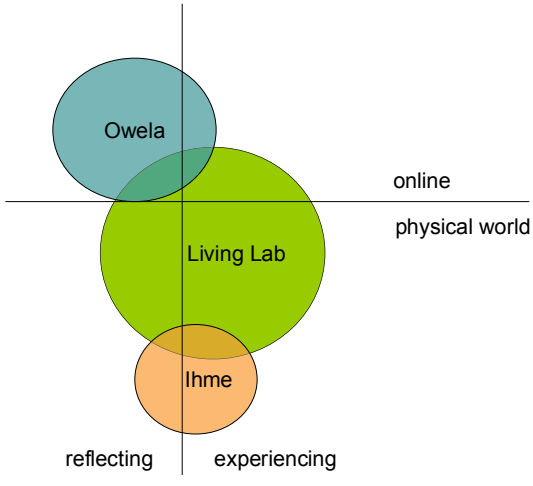

Figure 3. Comparison of the co-creation approaches.

Owela is at its best in early ideation and concept design. Ihme is at its best when people can look at and experience physical demonstrations or proofs of concepts. Living Labs are needed when the service already exists as a working pilot or when an existing service is further developed during use. These boundaries are not fixed however. For instance, Owela can be used as a Living Lab for online services. Living Labs can use both Owela and Ihme for long-term co-creation activities. Ihme can be used in early concept co-creation and Ihme can be used as the data gathering and communication tool throughout the Living Lab activities.

Table 4. Comparison of the three co-creation approaches.

	Owela	Ihme	Living Lab
Innovation phase	All (needs, ideas, concepts, prototypes)	All (needs, ideas, concepts, prototypes, even market research)	Piloting, ideating new services
Illustration material	Text, images, videos, slideshows	Scenarios, protos, demonstrators, products and services	Actual service
Data gathering	Online discussion, ideas, polls, surveys, votes, ratings	Interviews, observation, questionnaires	Owela, interviews
Form of user interaction	Mostly text-based commenting, rating, voting, chatting	Face to face	Online and face to face
Strengths	Easy to reach users, enables micro-contributions of masses, long-term collaboration	Open to all in public space – low threshold to participate	Feedback and ideas based on actual use
Challenges	No face-to-face contact, requires continuous facilitation, mainly text-based communication	Quite resource intensive	Obtaining sufficiently reliable pilot services, getting real content to the service

Discussion and Conclusions

Owela and Ihme both facilitate user involvement in service innovations in new ways. In Owela, users can participate in a web-based innovation community independent of time and space. Users can select their level of contribution, varying from short comments to long-term participation in development projects. In Ihme, designers can meet and interact with users in a physical environment that has been designed to encourage ideation. Living Lab environments enable long-term service development with users in parallel with using the service. Owela is at its best in early ideation, especially when the ideation theme is such that it tempts people to create ideas and comment on them based on their own experiences. Ihme is at its best when designing new interaction concepts or other tangible experiences. Living Labs enter the picture when co-creation extends to the actual use, and services are continuously improved in parallel with their use. With all three methods, direct designer-user interaction supports turning the

designer's mindset from technical features to user experience. This facilitates the design of services that are better accepted by users.

Exploitation Potential

VTT already has 25 references to using Owela in co-creating services with customers. The Owela method has proven its usefulness, especially in developing online and mobile services, but it is suitable for all kinds of services that can be visualized or simulated somehow online. Owela has also been used successfully as a feedback and ideas channel during real-life service testing. Ihme is a more novel approach, but the initial experiences are promising. The first Ihme setup was in a shopping centre. Future plans include company-specific Ihme innovation showrooms in service environments such as shopping centres, public transport, amusement parks and offices. Itella Living Lab is an encouraging example of the potential of Living Lab co-creation. At its best, a Living Lab enables firm and continuous connections to actual users and co-creation based on actual everyday experiences.

Acknowledgements

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Understanding corporate customers' service needs

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Abstract

Recognizing and understanding customers' needs and how they change provides important opportunities for innovation, sales growth, competitiveness and profits. We have carried out several research projects on service business and the value of service to customers. The purpose of this conceptual paper is to summarize our basic understanding of corporate customers' service needs, which has emerged during these research projects. We combine our experience of case studies with information collected from workshops and literature study. We discuss service needs and value from several viewpoints, such as risk, reference-dependence, financial and experiential value, systems and context specificity. We also describe the dynamic nature of customer needs. The results can be applied to companies as they develop their capabilities in customer understanding and service business development.

Introduction

We have carried out several research projects on corporate customers' service needs and the value of service to customers, focusing particularly on industrial services. For instance, the BeSeL project studied these topics from the standpoint of service business models and organizational change, the C-Understanding project from the standpoint of customer buying behaviour, and the TAPI project from the point of view of needs recognition and customer interaction. The purpose of this conceptual paper is to summarize our basic under-

standing of customers' service needs that has emerged in these and other projects and to reflect on possible future research.

The concept of *customer need* is often used yet vaguely understood. There are many different theories on what drives customer needs. With regard to human needs in general, one of the best-known theories is Maslow's hierarchy of needs. Maslow stated that unsatisfied needs motivate people to act, in addition, not all needs are equal, some must be satisfied before others [1]. These basic ideas have been applied by marketing researchers who study consumers' needs in order to provide ideas on how to design the right kind of products and marketing to motivate people to buy.

Within the study of corporate customers, it is more challenging to map the needs than in the case of individual consumers; it is even difficult to understand what a need means at organizational level. Some important streams of research related to this subject are research into customer value, value co-creation, customer experience, behavioural economics, organizational buying behaviour and organizational decision-making. We start the paper with a short description of our methodology. We then continue by describing the relationship between needs and value, and elaborate on these concepts through the themes of risk and reference-dependency, financial and experiential value, systems view and context specificity. Next, we proceed to how customer needs change within interaction. We end our paper with conclusions about the capability of customer understanding and possible directions for further research

Methods

This is a conceptual paper that merges ideas from our own research projects and literature, i.e. we reflect on our understanding with ongoing discussion of the scientific literature. Within the different research projects that form the empirical basis of this paper, our main research method has been the case study, in which data have been gathered by interviewing key personnel of service provider companies. In a large number of cases, we have also interviewed customers of these companies. In addition, we have collected material by arranging workshops in which service providers come together to discuss issues related to service development and customer understanding. In some cases we have been able to follow

the market as it has been formed within the co-creative interaction and negotiation between service providers and their potential customers.

Service needs and value

In a market context, a need can be defined as an unsatisfactory condition for the customer that motivates and leads the customer to an action that will make the condition better [2]. Needs can be described as tension between the actual and desired states in the customer's situation [3]. They are very subjective. The potential value corresponds to the amount of tension, and the experienced value emerges as the tension diminishes, i.e. value accrues as needs are satisfied [4]. This simple definition is presented in Figure 1.

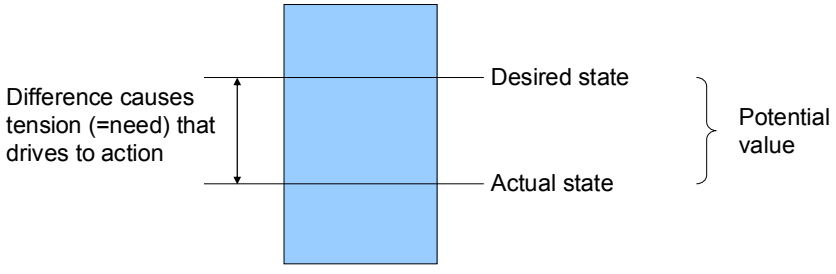

Figure 1. Needs as action driving tension between an actual state and a desired state in the customer's condition.

According to our case studies, the definition above works well in the case of corporate customers. In order for a customer to purchase a service, the customer has to have a genuine need that the service fulfils. We have noticed that even when a supplier offers some sort of service improvement, such as less effort by the customer or apparent financial benefits, the customer may not be very interested in this improvement [5]. The gap between the customer's desired state and the actual state related to the offered improvement is not big enough.

Risk and reference-fependency

The purchase of a new service always involves risk. Corporate customers' desire for a service is dependent on the risks attached to that service and the customers' tolerance regarding risks. It has been shown that risk has a great influence on

organizational purchasing [6]. Both people and human organizations avoid risks when things are going well and become more risk-seeking when they perceive their future and options as poor. This can be explained by prospect theory, which is based on the view of human perception as reference-dependent. The core idea of the theory is that humans perceive value as carried by changes relative to a reference point – not by final states – and that the value function is kinked at the reference point and loss-averse [7].

An aspiration level is a reference point that differentiates between perceived success and failure [8]. It is a specific desired state that decision-makers focus on reaching in both an organizational and individual context. They are reluctant to make decisions that may entail failure reaching their aspiration level. One consequence of this is that ensuring something is good enough is typically more important than pursuing the best possible. Organizations have different aspiration levels depending on their history, the attention patterns of their members, and the performance of others that are similar, for instance [8].

Our findings support the idea that perceived risk and aspiration levels affect the behaviour of customer companies when purchasing services. Adopting a service that is new to the customer typically requires changes to the customer organization. Big changes lead to significant risks for customers. Service outsourcing agreements, in particular, are often difficult or at least expensive to recall. Customers are therefore often conservative unless their situation (the difference between their actual performance level and their aspiration level) pushes them to seek new solutions.

Companies try to manage their risks. Risk affects not only what is bought but also how and from whom it is bought. Therefore, it is essential to understand how customers perceive the risks related to the service and to their business in general. Reducing the feeling of risk removes obstacles preventing a purchase decision.

It is common, also, for the value of an industrial service to be based on the way the service helps customers to manage the risks in their business. An example of this type of service is when the provider carries the risk of unexpected product failures and repairs or replaces broken products with a fixed monthly payment. The costs of such a service to the customer may actually be higher than the costs of in-house maintenance and repair. Yet, the service is of value as it helps the customer manage its risks.

Financial and experiential value

In the context of corporate customers' purchases, customer value is very often viewed from a monetary perspective – as financial benefits exceeding life cycle costs for the company [e.g., 9, 10]. Figure 2 illustrates this view. In long-term investments, interest rates are taken into account and service providers typically use calculations like net present value or payback time to prove the value of their service to their customers. These calculations are reasonable in the sense that they are also used by customer companies to justify their service decisions.

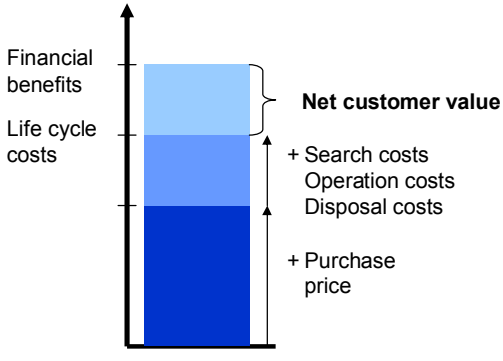

Figure 2. Customer value from a monetary perspective.

This rational and calculative approach to customer value is based on traditional economics, however, which typically views companies' decision-making as maximizing the subjective expected utility. The maximization assumption has been criticized for a long time [11, 12]. The rational choice is a socially accepted norm for making organizational decisions, though behavioural economics has shown that financial decisions are not purely rational. Reasoning, like calculating the financial benefits and costs, has an important role in decision-making but so does intuition [13]. Emotions guide attention and motivate rational thinking [14]. In our research, we have been interested in understanding these less familiar viewpoints on how corporate customers view the value of a service. We also aim to combine them with the more traditional view of value for corporate customers.

Literature on consumer value emphasizes experience and emotions much more than literature on value to corporate customers. The former literature has suggested, for instance, that new 'higher' sources of value beyond goods and services could be found in experiences that goods and services create and in

transformations that are guided by experiences [15]. It has also been suggested that individual decision-making is based on the anticipation of the resulting emotional experiences [13] and that value resides in the consumption experience, as the object (e.g. a product or a service) and the subject (e.g. a consumer) interact [16]. The meaning of value and value creation has been seen as shifting to personalized experiences [17].

Industrial services also create service experiences for customers. For corporate customers, an important part of the experience is the financial result of using the service. The significance of financial results can be seen as emerging from the human experience that it creates through mechanisms like rewards, acknowledgement and feelings of success. The social context of organizations and the community of people collaborating and competing also affect the formation of personal experience.

Like services in general, industrial services need to be considered as processes in time, not only through their end results. This means that customer companies and their employees experience services in time. As time passes, the customer experience may be positive or negative compared with the reference level of the customer's expectations. This is illustrated in Figure 3, in which time runs horizontally. The reference level of customer expectations is marked as a dotted line. The actual experience is marked with a solid curve. The red shadings mark points of customer disappointment.

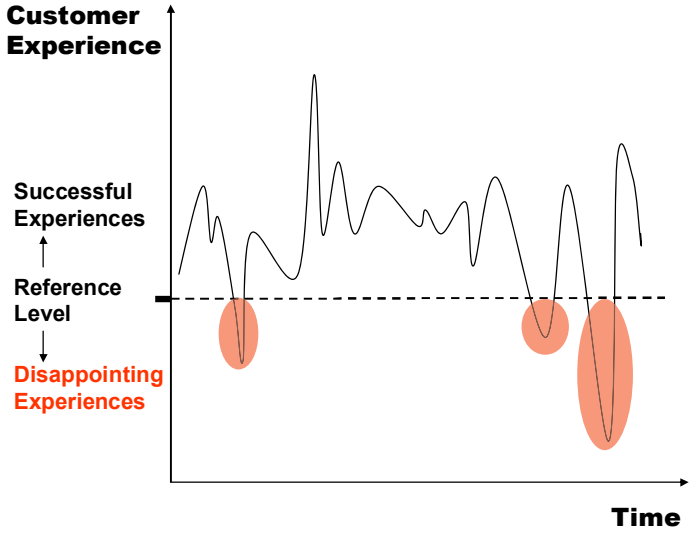

Figure 3. Customer experience of industrial service in time.

Customer disappointments could be due to, for instance, poor quality, communication problems or delays. When looking at the total customer experience in time, exceeding customer expectations in certain situations does not necessarily compensate for customer disappointments in other situations. On the basis of our research, it seems that many customers of industrial services are not primarily looking for extra high peaks for their service experience but reliable service without unanticipated disappointments. It is important to reach their aspiration level steadily.

Sometimes a service runs so smoothly that customers do not even notice the service. This may be reasonable in some cases, but it may also be a problem because the service experience does not play a role. It is often important that customers meet the service provider's personnel, see them doing things, receive reports on what actions have been taken and what the results have been. These are important issues that give customers the feeling that they are getting something concrete for their money. There is a thin line, however, separating this kind of situation from an experience that becomes disturbing for the customer.

The individual people who work in customer companies also experience industrial services on a personal level. These experiences are often attached to strong emotions. Many industrial services have an important influence on the way customers' employees succeed in their own profession and how they fare in the social arena of the organization.

A customer company as an organization does not constitute a single actor with one single will. Instead, it consists of multiple individuals who may experience the service in very different ways. Their wills and needs may contradict each other and the common good of the organization. Needs arise on multiple levels: individual, group, company and industry. Different parts and people in the customer organization may therefore have different views on the kind of service value for which the organization should aim.

Systems view and context specificity

Co-creation of value between service providers and customers has been emphasized in recent research [17, 18, 19, 20]. Figure 4, adapted from Prahalad and Ramaswamy, illustrates this view [17]. According to the so-called Service-Dominant Logic (SDL) perspective, all economic actors can be viewed as resource integrators that combine different resources by exchanging services for

services in order to generate value. The value of a resource or service is therefore dependent on the other resources and actors to which it is connected.

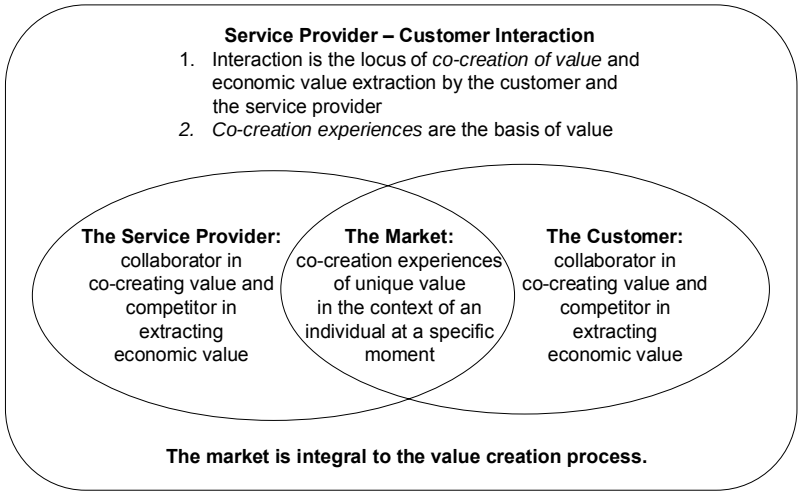

Figure 4. Economic actors as co-creators of value, adapted from Prahalad and Ramaswamy [17].

Value resides and accumulates in the complex web of relationships between suppliers and customers and it is realized throughout the consumption domain [21]. This easily leads to path dependency and lock-ins. It is necessary that the value offered through a service fits together with customers' existing value configurations. The value of a service is clearly dependent on each customer's own context and placement within the business ecosystem.

The fact that value resides in complex webs of interaction has the downside that it is very difficult to make systemic changes in the value constellations. Industrial service innovations often require changes in the value chain [22] and redefinition of the activities and functions between the customer and the service provider [23]. They change the mental models of what organizations do. Thus, industrial service innovations can be seen as systemic innovations.

Service value is created as the service is used within the customer's context. On the other hand, service value is based on service characteristics. Therefore, service providers need to adjust their service characteristics to the intended use situations. Service characteristics that are seen as highly valuable by one customer may be seen as totally irrelevant or even value-destroying by another customer.

In industrial services, service characteristics are usually linked to some product or investment good. Here, the value of the service or service experience is not based solely on the service or the product but on both. Service experiences are also based on the relationship between the service provider and the customer, and on the contextual environment and the value network within which the service is provided and consumed. The customer engages in value-creating interaction with the product, the service, the service providers and the environment. This interaction forms the service experience and the customer value within its use. Different customers emphasize different factors of value depending on their goals for service usage or the desired states. For example, some corporate customers think that they receive more value from the personal contacts linked to a service than from its financial benefits [24].

The different interlinked factors forming the service solution can be depicted by circles within each other as in Figure 5. The customer's needs or the tension between the customer's actual state and desired state stems from the customer context. Value is created through the customer's experience of needs being satisfied in the co-creation action.

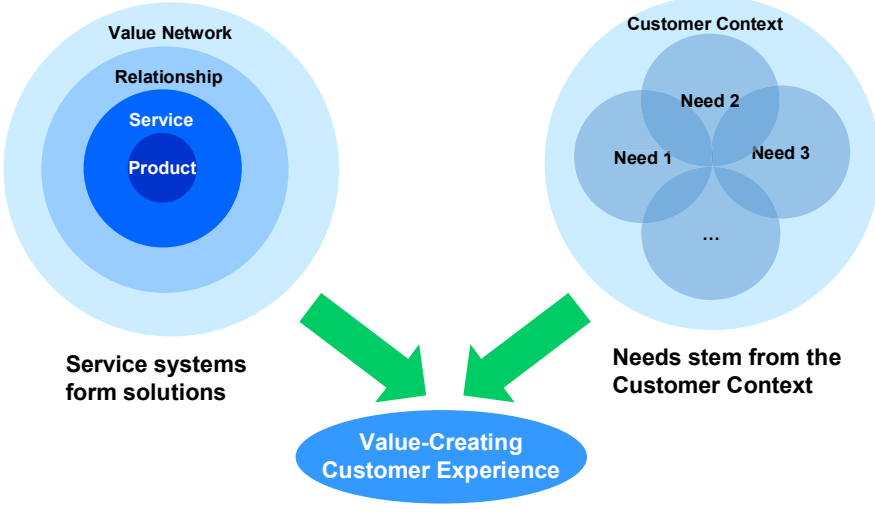

Figure 5. Value emergence through the experience of solutions satisfying needs.

In an industrial service, the core of the service solution could be, e.g., a machine tool and the quality processing produced with it. It could be linked to remote diagnostics and preventive maintenance that make the process very reliable. The

production personnel could also feel great pride in their machinery and appreciate their relationship with the machine tool manufacturer, helping them to improve their professional competence and gain new deals with their own customers. As value is connected to the whole ecosystem, the value of the service will easily disappear if, for example, the final customer stops purchasing products manufactured with this specific machine tool.

Dynamic customer needs

Customer service needs change over time. Sometimes the change is slow and sometimes fast. There are incremental as well as disruptive changes in customer needs. The change in the way customer needs are perceived is a driving force of innovation.

Flint and Woodruff [25] have introduced the concept of customer-desired value, which is substitutable with the concept of customer need. They have conducted grounded theory research within the US automobile industry in order to understand how customer need changes. Their theoretical model is presented in Figure 6. According to the model, the central phenomenon leading to a change in customer-desired value is customer tension. This tension has multiple dimensions, such as affective strength, perceived extensiveness and temporal dynamism. It is driven, on the one hand, by changes in customer environments and, on the other, by customer perceptions of their current knowledge levels, performance levels and control levels with respect to being able to succeed in a dynamic environment. As the affective tension grows, the customers seek to reduce the tension. Customers recognize their dependence on suppliers in reducing the tension they feel and, as a result, they alter the value they desire from suppliers.

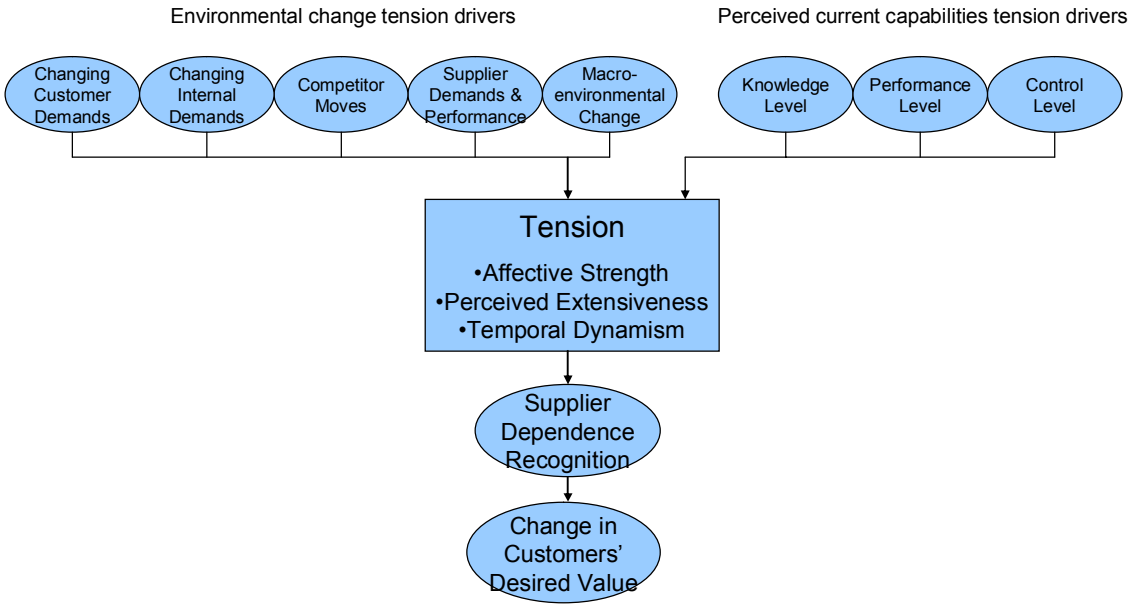

Figure 6. Flint and Woodruff's [25] model of customers' desired value change.

In our case studies, we have noticed very similar phenomena to those of Flint and Woodruff [25]. We have also noticed that sometimes a customer's new desire is no longer directed to the former supplier. The customer may seek to reduce the tension by replacing the service supplier with another one, or by getting rid of the supplier or a process step altogether.

In the studies by Flint and Woodruff, customers have described the affective tension with words like panic, pain and sense of urgency [25, 26], which have rather negative connotations. In our own case studies, we have also recognized customers' excitement or enthusiasm as a positive emotion connected to the motivational process and change in the customers' needs. It is typically combined with a relationship of a certain level of trust and mutual liking with the service provider with whom the new service is developed.

According to research carried out in the field of positive psychology, positive emotions – unlike negative emotions – do not usually produce a strong urge to act in a certain way. Instead, it has been suggested that positive emotions yield non-specific action tendencies, sparking changes, primarily in cognitive activity, broadening the scope of attention, cognition and action, and building physical, intellectual and social resources [27, 28, 29, 30]. People in customer organizations experience many different kinds of emotions, both positive and negative,

that have different effects on the change in the customer's needs. On the basis of literature, it seems that a change in needs resulting from positive emotional tension may potentially be more creative than a change in needs resulting from negative emotional tension.

As needs and customer experience differ between parts of an organization, the customer's prioritization of needs and choice of solutions is affected by intra- and inter-organizational interaction. Customer needs and the understanding of them are co-created as seen in Figure 7. Through the interaction in a positive relationship, both the service provider and the customer can learn about the customer's needs and develop. The needs are influenced within this co-creation.

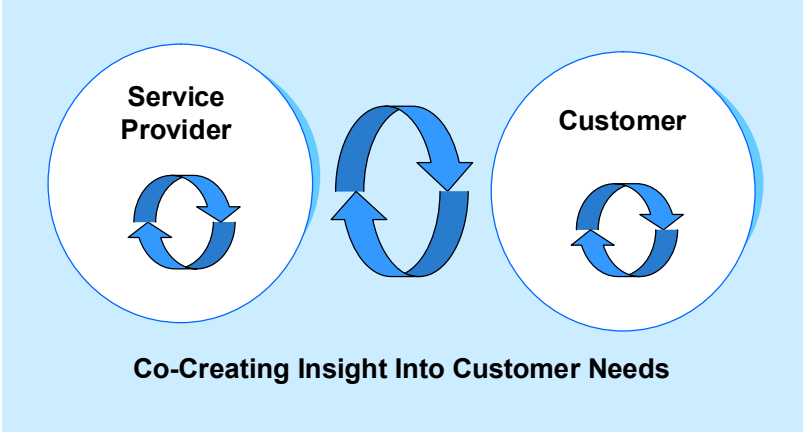

Figure 7. Customer needs formation within interaction.

Concluding remarks and future research directions

On the basis of this conceptual analysis, we argue that customer understanding is much more than gathering specifications about customer requirements or surveys on customer satisfaction. Customer understanding is a dynamic capability. It crosses organizational boundaries and includes interaction with customers and within its own organization, and even with partners, in order to co-create a deep insight into customer needs and their dynamics. It is based on human interaction and emotional intelligence. The knowledge flows of customer understanding do not run in one direction from the customer to the service provider. Instead they flow in multiple directions within the processes of interaction that change the

structures of value co-creation. Customer understanding is an ability to acquire customer knowledge, transform it into meaningful insight and use it for value co-creation with systemacy, speed and efficiency.

Our results can be applied to companies as they develop their capabilities in customer understanding and service business development. This applies to several functions such as sales and marketing, supply management, service and business development, innovation management and strategy work. The results are not limited to service development but can also be applied to product business and technology development.

In our basic research, we see several possible directions for further research. We find it especially interesting to continue this stream of research in the practice of service concept development and piloting; the service innovation process; creating and using customer insight; and shaping new markets, especially markets for sustainable consumption. In the theoretical sense, a more detailed analysis of phenomena at the individual level, on one hand, and at the organizational level, on the other, is an interesting challenge.

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Piloting as a platform in industrial service innovation and co-creation

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Abstract

Service design, configuration and customisation have proven demanding tasks for industrial companies that previously relied mostly on their technical superiority and technological R&D. In services, offerings and customer interaction largely deal with knowledge. The higher level of intangibility, abstraction and tailoring makes it more difficult to understand and communicate the content and value of the service compared with technology-based products. This paper aims to widen the understanding of the role of piloting in industrial service innovation and co-creation and present preliminary models to support the management of service development pilots in a manufacturing context. The research, conducted as an explorative case study, is still going on. Some early findings suggest that piloting is a viable method to deepen the understanding of the customer context and, especially, the non-core supporting processes, which need to be addressed to achieve smooth implementation of the new service.

Introduction and objectives

It has been widely identified that the development of services and new service business takes place in interaction between the provider and the customer and often includes other stakeholders (Chesbrough, 2011). This also holds true in the context of industrial services. As new service development does not take place in a laboratory, field-testing plays a central role. There should therefore be practices for rapid application and subsequent proof or improvement of the concept, or fail fast (Engvall et al., 2001). In practice, the application takes place through pilots when developing new services. These pilots should aim to prove and improve both the service concept and the implementation concept. The challenge is

to define principles and increase understanding of target-oriented piloting, linking piloting to shaping and improving the service itself, and to the systematic management of pilots. When managing pilots, the challenge comes from the systemic nature of services: the above-mentioned phenomenon in which the customer and various stakeholders are involved. How could companies set up and manage their service pilots efficiently in such settings?

This paper aims to widen the understanding of the role of piloting in industrial service innovation and co-creation, and present preliminary models to support the management of service development pilots. The research into the subject is going on as part of the Fimecc's FutIS research programme (Future Industrial Services).

Advancements in service innovation research

Manufacturing is becoming more service-like, and manufacturing firms are gaining an ever higher share of their turnover from selling services. This process has been characterised as the 'servicisation' of the manufacturing industry (e.g. Neely, 2008). As a result of this trend, value is primarily added by service activities in a number of manufacturing sectors. Part of the process of servicisation is the trend in manufacturing firms towards providing services that are related to the manufactured products they produce. This trend is evident in, for example, the vehicle and aerospace industry (Howells, 2004). This aspect of the servicisation phenomenon can be termed (ibid.) the 'service encapsulation' of goods and materials. Goods are not offered to consumers in their own right, but rather in terms of their wider service attributes.

According to Tether and Howells (2007), four perspectives on innovation in services can be identified between the 1980s and the present day. The first paradigm is 'Neglect', when very little attention is paid to innovation in services. Here the dominant view is that innovation is about technical advances in machinery, equipment and other goods, and the processes involved in their development and commercialisation. Services and other 'low technology' sectors, which are predominantly users rather than producers of new technologies, are seen as uninteresting, adopters of technology, rather than as 'real innovators'.

By the early 1980s, the continued growth in services in advanced economies meant that services were increasingly hard to ignore, and a number of innovation researchers set out to explore this part of the economy. This 'Assimilation phase'

of research was characterised by the attempt to study innovation in services using the conceptual tools developed to understand technological innovation in manufacturing. For example, the role of R&D was seen as central. This phase can be seen as an attempt to assimilate or subordinate services into the wider fold of innovation research.

The third 'Distinction phase', which emerged in the 1990s, was more radical in its approach and sought to reject the centrality of the technological innovation that had been the focus of most innovation studies. Instead, it focused on organisational innovation and innovation in knowledge-based services (e.g. den Hertog, 2000; Hauknes, 1999) in which the role of R&D and hard technologies is less prominent than in the technology-producing manufacturing sectors. This approach therefore drew on and highlighted the peculiarities of services and the way services and their innovation activities differ from archetypal manufacturing.

The last 'Synthesis approach' began with an agreement that the study of innovation should combine an analysis of both technological and non-technological forms of change (see, e.g. Gallouj and Weinstein, 1997). Researchers adopting this approach recognise the importance of both technological and non-technological innovation, and the interactions and complementarities between them.

The synthesis approach highlights the increasingly complex and multidimensional character of innovation, not only in the service sector but also in manufacturing. This includes the increasing bundling of services and manufactured goods into 'solutions' (Howells, 2004). The driving force in this line of research is less about understanding the peculiarities of innovation in services and more about the use of the broader conceptualisation of innovation as a set of processes that does not privilege technological change. This kind of research is interested in organisational change, the role of intermediaries in innovation (Howells, 2006), social networks, the development of integrated solutions, and a range of other mechanisms to support innovation in services and manufacturing. This shift in emphasis requires incorporation of many tools and theories from outside traditional innovation studies, including organisational behaviour, social networks, marketing, strategy and communication studies (Tether and Howells, 2007).

Managing service innovation

Although services represent a wide and heterogeneous phenomenon, it is meaningful to assume that the underlying innovation drivers and mechanisms are, in principle, similar to those of manufacturing (Bessant and Davies, 2007). In accordance with Bessant and Davies (ibid.), we highlight two aspects that have particular relevance to service innovation: servicisation of manufacturing and customisation. Customisation requires increasing emphasis on user involvement, i.e. co-creation as a route to sustaining defensible competitive advantage through innovation.

Service design, configuration and customisation have proven to be demanding tasks for industrial companies that previously relied mostly on their technical superiority and technological R&D. For technology-based products, defining physical measures and references to the products is part of the everyday management of the offering and customer communication. In services, however, offerings and customer interaction largely deal with knowledge. The higher level of intangibility, abstraction and tailoring makes it more difficult to understand and communicate the content and value of the service compared with technology-based products.

There are significant differences across different parts of the service sector that have an impact on the dominant drivers and the management of innovation. For example, banking and insurance deal with high-volume markets, and they are often cost-driven, whereas knowledge-intensive business services have more of a one-off project orientation for which service quality and competence may be more significant drivers (Bessant and Davies, 2007).

In the context of service innovation, it is important to pay attention to the definition of innovation. Innovation means the successful exploitation of new ideas. Central to this is the idea of different kinds of knowledge streams woven together (Bessant and Davies, 2007). Countless studies of innovation highlight its nature as an interactive, recursive and communicative coupling process (e.g. Lundvall, 1992) – yet much thinking in management practice defaults to earlier linear views of the process and, especially, to a knowledge-push model. In the context of service innovation, the search for and the use of demand-side knowledge is critical. Many services are produced and consumed simultaneously, and end-user understanding and empathy are essential to success (e.g. Heiskanen and Repo, 2007). This is not to say that new knowledge – for exam-

ple, of technological possibilities – is unimportant, but the balance in service innovation may be more in the direction of demand-side knowledge.

One consequence of this user-based orientation in services is that much of the language that surrounds the discussion of innovation may differ between the manufacturing and service contexts. The underlying principles and issues may be the same but the labels may differ (Bessant and Davies, 2007). For example, the term R&D used in manufacturing contexts conjures images associated with organised research and development (search, experimenting, prototyping, productisation). In the context of service innovation, we see a similar process taking place: searching (albeit with much stronger demand-side emphasis), experimenting and prototyping (which may extend the 'laboratory' concept to pilots and trials with potential end-users) and a gradual scaling up of commitment and activity leading to launch. Service business may not have a formal R&D department, but it does undertake this kind of activity in order to deliver a stream of innovations. Importantly, the knowledge sets with which it works involve a much higher level of user insight and experience.

Table 5. Language differences between manufacturing and service innovation (Bessant and Davies, 2007).

Core innovation concept	*Manufacturing*	*Services*
Search for new possibilities	R&D, laboratories, prototyping, test-beds, pilot plants, simulation, etc.	User-context and user-needs analysis, empathic design, concept testing, piloting and pilot studies, ethnographical studies
Strategic selection and resource allocation to projects	Portfolio tools, bubble charts, risk/reward matrices	Business case development
Implementation of innovation projects	Stage gate models, NPD systems, heavyweight project management, concurrent engineering, design for manufacture and assembly, CAD/CAM, etc.	New service development systems, test marketing, beta testing, market development teams
Process innovation tools	Lean production and supply, kaizen, total quality management, Six sigma, etc.	Business development, process excellence

Methodology

Our study within the FutIS research programme aims to increase understanding of the role of piloting in the context of industrial service innovations. Research into service piloting has been relatively scarce, and we therefore decided to apply an explorative case study approach in our research. Explorative case studies are often used in organisational processes with a high level of complexity in a real-life context (Yin, 1994). They are preferred in the study of social processes, such as the phenomenon at hand, as they allow for context-dependence (Hartley, 1994) as well as particularity and complexity in each case (Stake, 1995). Our research will be carried out as a participatory and observational case study. The researchers will join the companies, in particular in the service innovation cases in which the customer company and the service provider test the features, feasibility and validity of the service value proposition.

A variety of large Finnish industrial companies is involved in the project. The companies come from different industries and vary in size. Representatives of these companies and their customers are interviewed and observed in negotiations and discussions in order to study on-going service innovation piloting processes in depth. A wide variety of company cases and contacts within each case make the collected data more valid and the selected cases more multi-faceted and vivid.

Preliminary framework

In the research project, we aim to create a framework for systematic service piloting that shortens the time from concept to service product. We consider piloting a continuous process instead of a clearly defined single time activity. According to our view, developing a systematic service piloting process includes a set of pilots required to prove and refine the service in collaboration with the customer instead of just one successful pilot.

Our overall goal is to enhance the concept and context of piloting in service innovation and to view piloting:

1. as an experimentation phase in an internal development and learning cycle
2. as a method for reducing risk and uncertainty of R&D projects (uncertain technological context; see, e.g., Editorial 2005)

3. as a platform and forum in a process of co-development and co-creation (value proposition and value capturing process).

At a more detailed level, we study and define the goals for different pilots in the piloting process. The roles of different partners during piloting, including those of customers, are of great interest to us. We aim to develop management practices for systematic service application and piloting in which different partners collaborate in different roles. We also aim to create practices for integrating customers and other interest groups of the service value network into the piloting framework. Clearing out the included issues will allow for rapid application of service innovations, thus increasing the efficiency and accelerating the speed of the service innovation process.

In the proposed framework (Fig. 1), we illustrate co-creation as a form of service innovation strategy that emphasises the generation and on-going realisation of mutual firm-customer value. This implies that pilots and projects are forums for firms and active customers to share, combine and renew each other's resources and capabilities to create value through new forms of interaction, service and learning mechanisms.

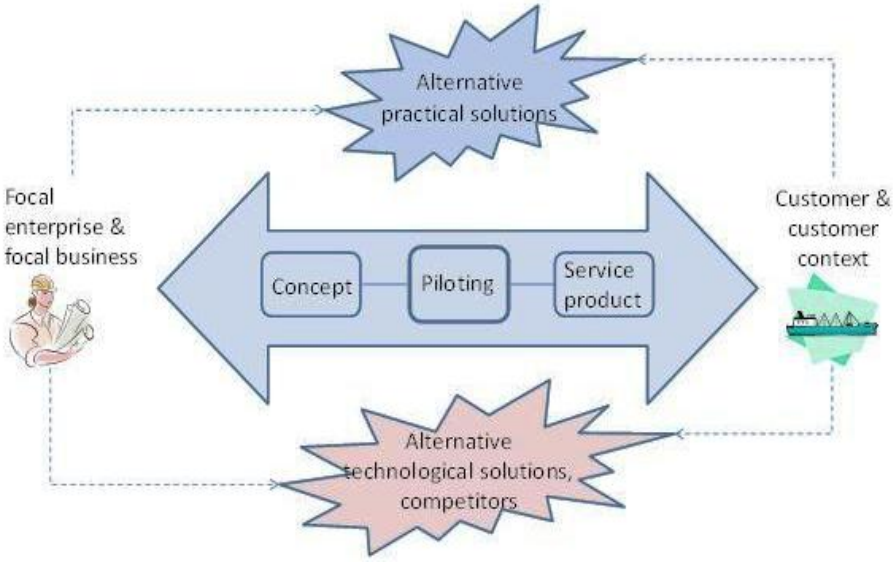

Figure 1. Piloting as a platform in service co-creation.

Some early findings and conclusions

The empirical study is at the data gathering stage, but some preliminary findings and conclusions can already be presented.

Applying the concept of piloting in practice has to be considered carefully in real life supplier-customer service development. Service providers have a clear interest in developing the piloting process. Customers are seldom interested in pure piloting of new solutions, but they actively look for the promised benefits even in the first application (i.e. pilot).

Piloting is a practical method to reveal the customers' critical business processes, which are crucial to take into account as service solution elements in order to facilitate the smooth implementation of the service. Business-to-business services often require close integration of supplier and customer processes. In addition to core processes there are many other processes and systems (e.g. IT services, accounting, project management), which also need to be understood and specified carefully as part of the service offering. The challenge for service developers is to observe and take notice of the impacts of these supporting processes while piloting the core service offering.

In product development, piloting of the concept is often used to finalise the specifications for a relatively standard product that can be manufactured in volumes to different customers. In the service development context, the relevant business processes may vary significantly between different supplier-customer relationships. This may blur the idea of piloting, as more tailoring is required in every customer relationship than with physical products. Hence, the result and focus of piloting in a service development context is more inclined towards understanding and defining the main elements of the service offering and their relations instead of finalising the detailed service specifications.

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Servitization and non-technological innovation in Finnish manufacturing establishments

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Abstract

Several researchers have recently argued that manufacturing companies can stave off price competition, increase margins and retain customers by combining services to their product offerings, and that their users and clients are important sources of this type of non-technological renewal. To date, however, there exists very scarce systematic evidence for these claims. In our explorative survey study, we investigate firstly the generality of such non-technological forms of innovation and renewal in Finnish manufacturing establishments across various industries, including both product- and process-oriented industries. Secondly, we contribute by examining potential enablers of service innovation. The findings show that 20 to 30 % of manufacturers are actively engaged in the process of servitization.

Introduction

The creation, production and provision of services has taken a dominant economic position for many decades now. Today services are of increasing importance as value propositions in business models and in service-based competitive strategies of Finnish companies, including the manufacturing industries. Thus, services have an increasing importance at both the level of companies and the level of the economy as a whole[1]. Some scholars have even gone as far as to argue that goods are no longer the most important unit of

exchange, and suggest an alternative logic of economic value creation, which they refer to as the 'service-dominant logic'[2, 3]. Also those scholars who do not push the argument that far claim that servitization in the manufacturing industries can afford a variety of competitive advantages for companies. For example, adding services to product offerings may increase profit margins, facilitate more stable and predictable streams of revenues, or answer better to customers' needs than market transactions of product-offerings alone [4–6]. The term 'servitization' refers to "…the innovation of an organisation's capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use"[6].

In Finland, as well as in many other countries, this shift in thinking about the potential of services has not remained unnoticed by policy-makers, and has had an impact on the outlining of new public innovation strategies in support of industrial policy. It is therefore important to gain insight in the servitization phenomenon through systematic approaches that include a variety of companies and industries. However, to date such systematic approaches have been scarce, and most existing evidence is based on case-studies and qualitative data. While these efforts have produced important information and paved the way for this important research area, more systematic and larger scale studies, both explorative and deductive, are still needed. This paper falls in the explorative category, and tries to verify the extent of servitization in Finnish manufacturing establishments. A second objective is to shed light on the extent to which customers play a role in new service development - a prominent issue in the literature on service innovation and servitization because customers have been considered to be an important source of competitive advantage and innovation [7–9].

Methods

The analysis is based on data from the Finnish Manufacturing Survey, which is a national part of the larger European Manufacturing Survey (EMS). This survey probes product, process, service and organizational innovation in the manufacturing industries (NACE Rev. 1.1 class codes 15–37), among other topics. The Finnish survey was conducted electronically via the web by VTT Technical Research Centre of Finland during winter 2009 and early spring 2010.

The target population for the EMS consists of manufacturing establishments with at least 20 employees within the above-mentioned NACE classes. The survey is a single-informant questionnaire which targets general management, plant managers or manufacturing managers as informants. In total, 1741 managers were contacted, of which 131 submitted a utilizable questionnaire, i.e. with a minimum completion of 50 percent or more. Thus, the survey had only a modest response rate of 7 percent, which is, however, the average rate for EMS. The industry distributions of the target population and the sample resemble each other proportionally (Figure 1). An advantage of the survey is that it covers various perspectives on innovation in manufacturing companies, including non-technological aspects, such as service innovation [10].

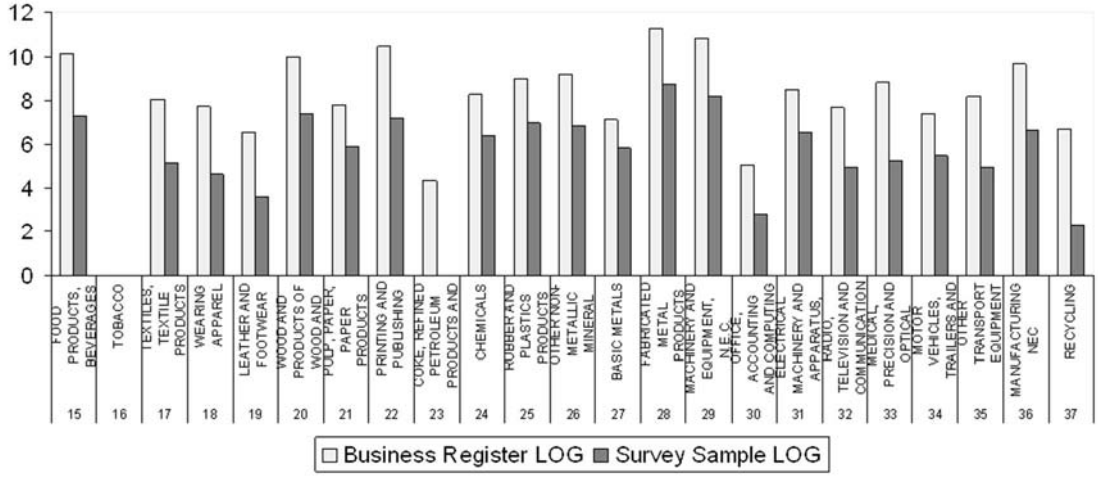

Figure 1. Comparison of industry distributions by 2-digit classes of NACE Rev. 1.1: target population vs. survey sample.

Research results

Services as a competitive factor and services turnover

How do manufacturers compete on the markets? There are a number of basic strategic aspects which managers have to give precedence when competing in ever-changing markets. One can divide competitive factors

in two basic classes: 1) traditional factors, such as price, quality and delivery time, and 2) contemporary factors which have emerged more recently during the last two decades or so. The latter factors lie within the realm of what Vargo and Lusch have called the service-dominant logic [2, 3], and which most prominently involve customization and service. Within the perspective of globalization, and resulting dynamic shifts in the global division of labor on the basis of costs and competences, the answer to the above question is of great interest. As Finnish manufacturers are generally considered to be highly advanced, and their high technology has diffused globally, one would perhaps expect them to have embraced a more contemporary competitive orientation as well. However, Figure 2 shows quite clearly that the traditional competitive factors - like fast and timely delivery, quality, and costs - are dominant among the Finnish manufacturers we surveyed. One could argue that these are 'baseline' competitive factors which form a minimum requirement for customer satisfaction. The major competitive concern of just under one-fifth lies within the realm of the 'service dominant logic': service and customization were regarded as the major factor by 18.6% of respondents. Product innovation is the main concern for a small but noticeable group (8.1%).

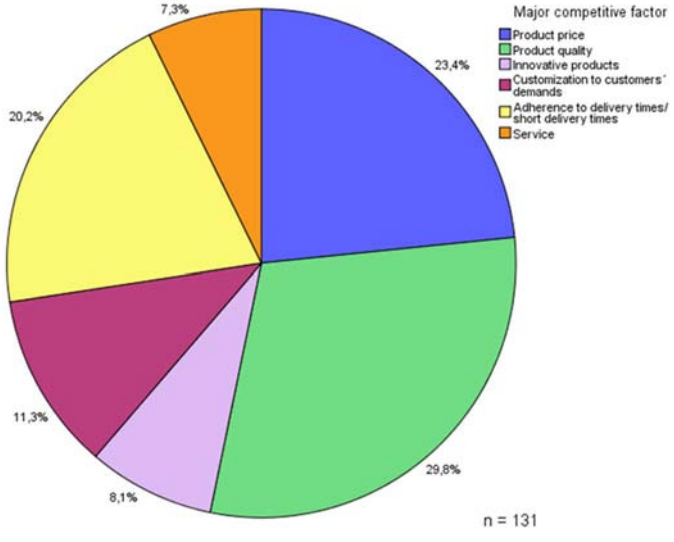

Figure 2. The competitive factors of highest significance for Finnish manufacturers.

Another important indicator of servitization is the share of turnover generated by services. Figure 3 displays the mean share of turnover generated by services for both product and process industries. This is interesting, because generally servitization in manufacturing seems more obvious in the context of installed-base manufacturing (manufacturing focused on equipments).

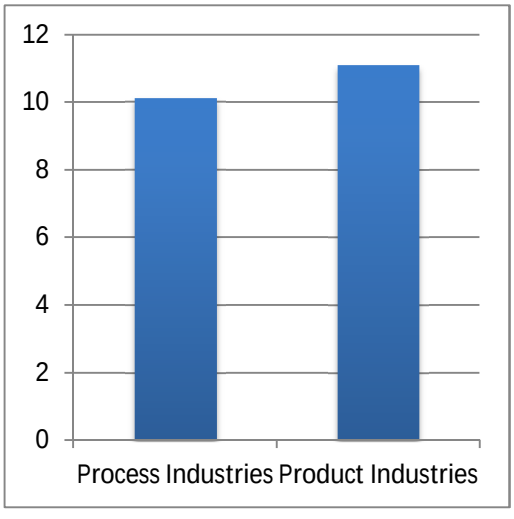

Figure 3. Mean share of turnover from services (N=74).

Interestingly, the shares appear to be almost identical, with only about one per cent difference. In terms of the ability to generate revenue streams from services, process industries do not seem to lag behind.

Service Innovation

Even when a manufacturer doesn't consider services as its most important competitive factor, it may experiment with new business models or new service development as a complementary activity. It is therefore important to assess the extent to which companies have made service innovation efforts. Because the development of new services in manufacturing is likely tied to manufactured products, we distinguish low-, medium-, and high-tech organizations. Due to the modest sample-size, we chose to apply the recent 3-class taxonomy and accompanying tresholds proposed by Legler & Frietsch [11], instead of the more fine-grained taxonomy used by the OECD [12]. Figure 4 shows the share of service innovators in each of these three categories.

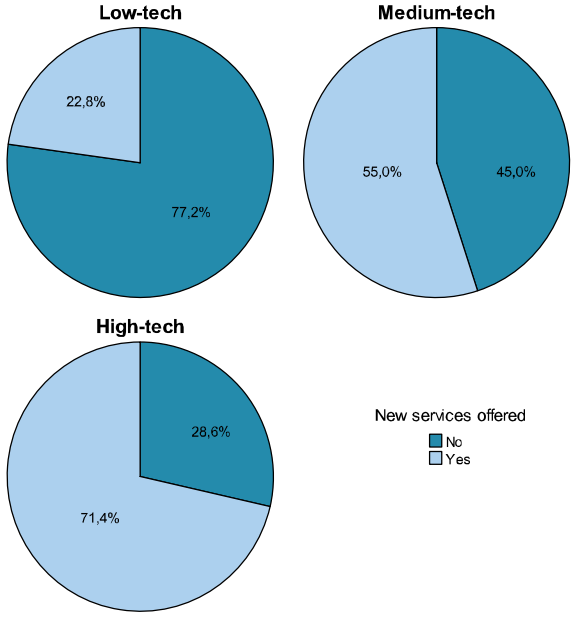

Figure 4. Share of manufacturers offering new services since 2006.

We firstly observed that roughly one quarter to one-third of manufactures has introduced a new or significantly renewed service which complements their product(s). Secondly, low-tech manufacturers are 'servitizing' on an average level, but medium- and high-tech manufacturers appear to innovate in services relatively more frequently. This suggests that the transfer from low-tech to high-tech is positively related with service innovation – measured by new services.

Enablers of servitization in manufacturing

Having highlighted that servitization is not as wide-spread as one would expect on the basis of literature, an important question is: what may enable the development of new services in manufacturing companies? Two important issues have been raised in the new service development literature: 1) organizational renewal and adjustment [13, 14], and 2) involving customers in the service innovation process [15]. Furthermore, the previous section suggested that other forms of renewal can be associated with higher levels of service innovation in companies.

In order to get further insight in these other forms of renewal in the context of servitization, we first examine what kind of actions of modernization are carried out in manufacturing establishments with differing competitive orientations, including the ones that were described above. Figure 5 shows the major measures of modernization by the major competitive factor.

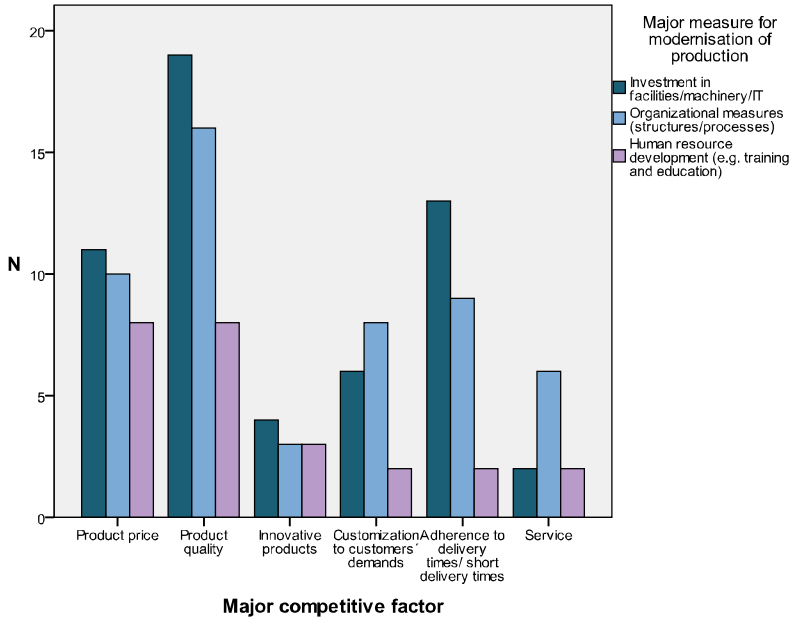

Figure 5. Major competitive factors and major measures of modernization.

We perceive that technological and organizational forms of modernization are the most important ways of renewal for the most sub-groups formed on the basis of the major competitive factor. However, we can identify some marked relative difference in the sub-group of establishments that assess service to be their most important competitive factor. (To some extent this also holds true for the group emphasizing customization). Here, organizational measures clearly stand out as the most important factor. Perhaps surprising, human resources are not as highly rated as a means of modernization in these groups. Our results suggest that competing on service requires organizational adjustments rather than technological options. We also see that in the group of 'traditional' price competitors, almost one third lists human resources as their most important means of modernization. Thus, it appears that organizational renewal may be

associated with service-dominant competition, while there is a stronger focus on human resource development in the traditional competition. This, in turn, suggests that human resource development is being deployed in technological competence areas. It should, however, be kept in mind that the group of service-based competitors is small in our sample.

We turn next to the issue of customer involvement in new service development. To the extent that the value of services stems from their ability to serve customer needs, customer integration has the potential to ensure well-fitted and profitable services. Figure 6 shows both the frequency of involvement of various partners for different innovation areas and the importance given to different sources of innovation.

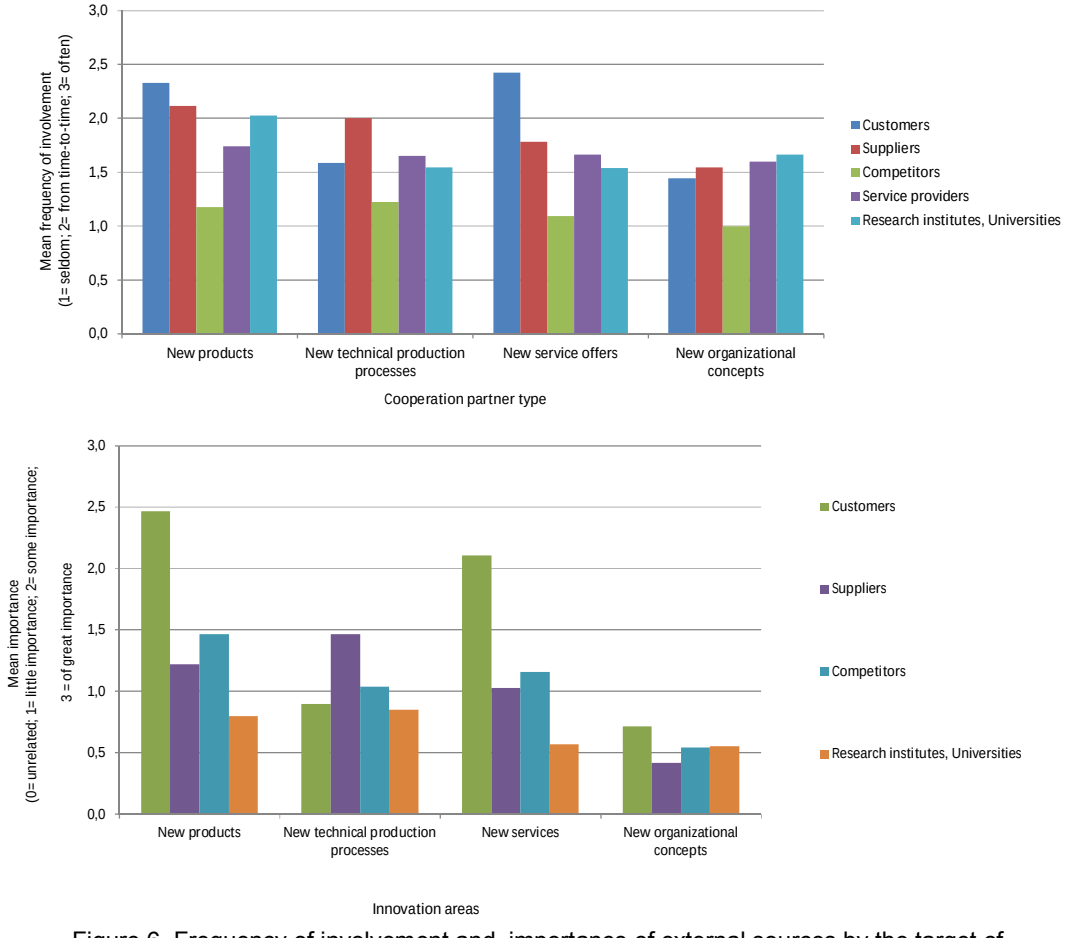

Figure 6. Frequency of involvement and importance of external sources by the target of innovation.

Both panels in Figure 5 show clearly that customers are indeed important to innovation and renewal. If we consider the implementation of new organizational concepts as a non-technological form of process innovation, then we can say that customers play a more important role in developing technological and non-technological product innovation than (not surprisingly) in developing technological and non-technological process innovation. Interesting is that customers have been given a somewhat higher importance in tangible product innovation than in service innovation, but they are involved slightly more frequently in new service development than in new product development.

Concluding remarks

This empirical and explorative study has investigated firstly the generality of non-technological forms of innovation and renewal – in particular servitization – in Finnish manufacturing establishments across various industries, including both product- and process-oriented industries. A minority (20 - 30%) of surveyed manufacturing establishments have developed and introduced new product-related services. In terms of the generated share of turnover from services, product-based industries are not more servitized than process-based industries. About one-fifth of surveyed manufacturers believe that their most important competitive factor exists within service business and customization - in line with with the service dominant logic of Vargo and Lusch [2, 3]. However, price and quality still seem to be the most important competitive factors for the lion's share of surveyed manufacturers. Yet, the difference from low- to high-tech of manufacturers appeared to be positively associated with higher levels of new service development, which suggests that the two types of innovation activity are mutually interlinked in manufacturing. We also observed that modernization through non-technological renewal of both organizational structures and processes (i.e. organizational renewal) appears to be relatively salient among manufacturers who compete on service. In line with prior research, we found that customers are among the most important drivers for service innovations.

Acknowledgement:

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Social media-supported indicators for user-driven service innovation

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Abstract

Our goal is to develop and validate indicators for measuring the process and impact of user-driven service innovation. We concentrate on using the increasingly vast, diverse, open and available data that are created and shared by individuals in social media. The new analytical tools, such as social network analysis, and the powerful visualizations give us opportunities to see innovation, its entities, relationships and forces in a new way. These new insights can be used to create new services and improve innovation activities, as well as for policy development. The Sindi (Social media supported indicators for monitoring and evaluating user driven innovation) project is a collaboration project between VTT Technical Research Centre of Finland, TUT Hypermedia Lab and Stanford's Media X, Innovation Ecosystems Network Initiative.

Introduction

Although there are many definitions, the word 'innovation' has generally been used in literature to describe both the process that uses new knowledge, technologies and processes to generate material and service products and the new or improved products themselves [1, 2]. Innovation is widely regarded as the critical source of competitive advantage and growth in the global economy. Its out-

come is therefore seen as a quest for many, as are the ways, methods and approaches of the process towards it.

Need for innovation indicators

The current STI (science, technology and innovation) indicators were developed in the early 1960s to answer the needs of policy-makers, private businesses, financial investors and researchers for available quantitative statistical tools to control the scale of commitment and learn more about the relationship and interdependencies between the science, technology and innovation activities [3]. The core belief then was that most efforts to generate discoveries and inventions were central in relatively specialized private and public institutions and therefore addressed R&D. However, as 'innovation' started receiving more attention in the 1970s, the measures started talking about input-output indicators. Overall, 'STI indicators have today become an essential ingredient in research on the modes of operation of the science-technology-innovation subs-system itself and its relationship with the wider social and economic system' [3: 583] and are based on the production and use of codified scientific and technical knowledge (see Table 1). For example, measures of input (such as expenditure on R&D as a share of total revenue), output (patents) and process (cooperation with researchers) are included [4].

Since the 1990s, it has been understood that innovation evolves beyond traditional production, and models have emerged that look more at the tacit components of knowledge (sometimes referred to as know-how and know-who), learning by doing and using interactions. The people involved in innovation were no longer considered to be only R&D personnel. Therefore, an innovation mode based on doing, using and interacting (DUI) was added, for example, approaches associated with 'learning organizations' and 'high performance organizations' and questions like 'does the firm have interdisciplinary workgroups' or 'is there integration of functions' [4]. Similar aspects of 'team working', 'multifunctionality' and 'diversity of innovation' have also been presented [5]. In addition, different kinds of innovation surveys and indexes have emerged as new types of innovation indicators [6]. More recently, emerging indicators have also emphasized the intangible nature of innovation, demands and outputs, the aspect of clusters and networks and looked at risks and returns as well as system dynamics.

Table 1. Summary of some current innovation indicators [4], [6].

STI indicators	DUI Indicators	Emerging Indicators
• R&D expenditures • Patenting • The share of population with tertiary education • The weight of S&E graduates in the workforce • ICT expenditures • Importance of venture capital	• Interdisciplinary workgroups • Quality circles • Systems for collecting proposals • Autonomous groups • Intergration of functions • Softened demarcations • Cooperation with customers	• Knowledge Intangibles • Demands and outputs • Clusters and networks • Management practices • Risk/Return • System Dynamics • ?

In addition to these more general indicators, there are numerous company-specific innovation indicators. For instance, Intel looks at the percentage of the budget dedicated to innovation, research and exploration of emerging technologies, the number of white papers published and the number of ideas generated in specific innovation-harvesting campaigns [7]. Despite this, innovation remains under-measured at all levels, perhaps due to the complexities and interactions of the processes as well as the fact that innovation processes are strongly linked to the factors of time and context [8]. Hence, the need for further innovation metrics remains acknowledged.

Innovation in the context of user-driven ICT-supported services

The landscape of innovation has continued to change since the 2000s. The following main trends have been recognized in the analysis of the questions and challenges that players involved in innovation processes and their management have to face [8]: (i) structural changes in the economy – new sectors and the transfer of focus from industry to services, with ICT providing new opportunities, (ii) growing knowledge intensity – with network management of interfaces between organizations and their networks, and the broadening of decision-

making in innovation processes (including users), and (iii) changes in the knowledge infrastructure, contributing to the fact that more than ever, organizations have to choose in which knowledge development they want to invest. These trends provide the context for our research.

For the purposes of the research, we acknowledge that strong integration of the user is one specific characteristic of service innovation, implying subsequent benefits and necessity of user involvement [9]. The user-driven innovation approach recognizes that users can foster innovation in its own right and participate in the process of co-creation [10]. In our preliminary framework of indicators for user-driven service innovation, we use the concepts of technology push and market pull to analyse the user-driven nature of innovation. According to Brem and Voigt [11], in technology push, the stimulus for new products and processes comes from research and is driven by technical capability. Hence, the goal is to make commercial use of new know-how, and it does not matter whether a certain demand exists. On the contrary, in the market pull (demand pull, need pull) approach, the source of innovation is currently an inadequately satisfied customer need, which results in new demand for problem solving. Therefore, the impulse for the innovation comes from individuals or groups who articulate their subjective needs [11].

Users have many opportunities for creating, communicating and collecting information and knowledge related to the result as well as the process of innovation. For example, user experiences are easily shared in social media. Harnessing this information is seen as beneficial to innovation. The open innovation approach, in particular, acknowledges that most of the information resides outside the innovating company [12]. The availability, timeliness and volume of this data are unparallel right now and growing rapidly.

In addition, we agree with the view that the growing importance of innovation in services and the growing insight into innovation processes in general stimulate the need for indicators that not only measure the (hard) input variables like investments in R&D and the number of scientists but also the far more intangible throughput and output variables [8]. Therefore, we propose that looking at the phases of innovation from inputs through processes to output and impacts can provide us with innovation indicators.

Furthermore, we see that innovation is a complex process that takes place at different levels [8]. The traditional indicators have looked at certain issues, mainly at national, regional or firm levels. We consider it important to supplement these indicators with indicators that characterize the inclusion of users

(individuals) and the global nature of innovation activities. In our preliminary framework of indicators for user-driven ICT-supported service innovation (Figure 1), we combine this supplemented unit of analysis with user-drivenness and phases of the innovation process. The framework can therefore address the specific context of this study as well as guide the development process of innovation indicators.

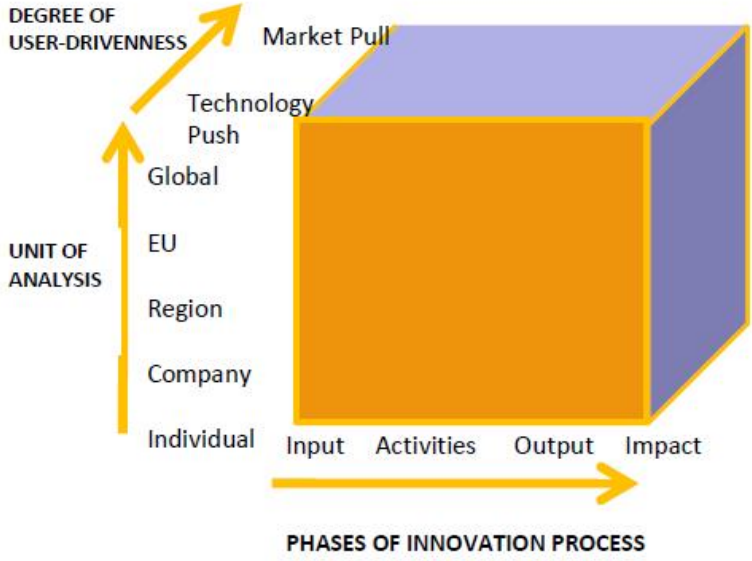

Figure 1. Preliminary framework of indicators for user-driven ICT-supported service innovation.

Methodology

We acknowledge the need for timely data as well as quantitative and qualitative ways of explaining the complexities of innovation, and we believe that there are possibilities for measuring and monitoring user-driven service innovation. We highlight the power of visualizations. Visualizations can describe the innovation processes and impacts through novel network perspectives addressing interactions, costs, timelines, trends and geo-spatial characteristics.

Our approach to innovation research is data-driven, taking advantage of the more traditional sources of data – organizational (and governmental) data, which have increasingly been converted into open data and private data – and combining them with newer sources of data, including news in new media as well as

social media, socially constructed databases and web analytics that can be derived from them [13]. Social media has made social networks ubiquitous and given researchers access to massive quantities of data for empirical analysis [14].

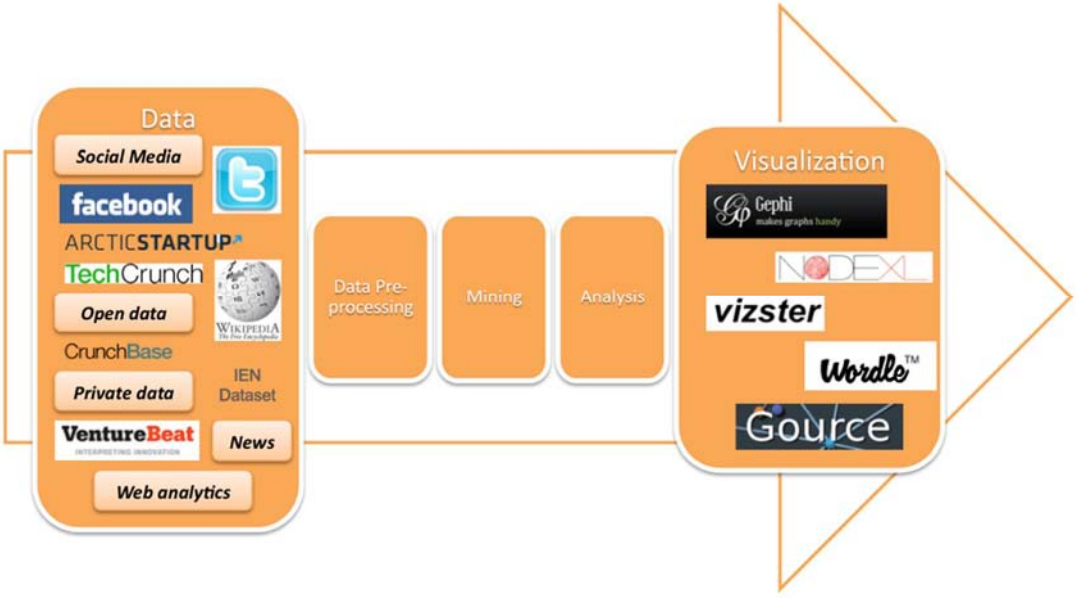

Figure 2. Research methodology and tools for data-driven visualization.

We consider information visualization and, in particular, visual network analysis a powerful method that allows the investigator to gain insight into the structure of the social networks under study and to communicate the findings to others [15]. The visualization of the overall network structure, the different characteristics of the network, the roles of the network actors and the nuances of their interaction are of interest in many fields of research including that of innovation ecosystems.

Due to the availability of state-of-the-art network analysis tools and platforms such as NodeXL and Gephi, social media data can be presented with graphical images and even animations or movies that represent various phenomena. Social network analysis (SNA) is a particularly suitable method for investigating phenomena that are essentially networks [16]. Furthermore, it has been shown that basic SNA metrics such as connectedness and centrality may be complemented with measures of specific phenomena such as homophily, reciprocity and transitivity between corporations [17].

Initial findings and visualizations

During the first phase of the project, the research concentrated on ICT-supported service innovation in the contexts of schools, well-being and Finnish innovation ecosystems. We have gathered data from traditional sources as well as from social media. The data includes, e.g., tweets about innovation (#innovaatio), Facebook connections, publicly released financial data (e.g. Tekes funding), socially constructed data about technology-based companies, executives and investments (e.g. IEN dataset) and documents (e.g. about the goals and benefits of ICT and services).

The following two visualization examples present the possibilities of visualization as well as its interpretations. The first one (Figure 3) illustrates linkages between the Facebook pages of Finnish education technology companies and individuals 'liking' them. It can be interpreted as demonstrating the way companies are linked through individuals and show the pattern of smaller companies being connected to each other.

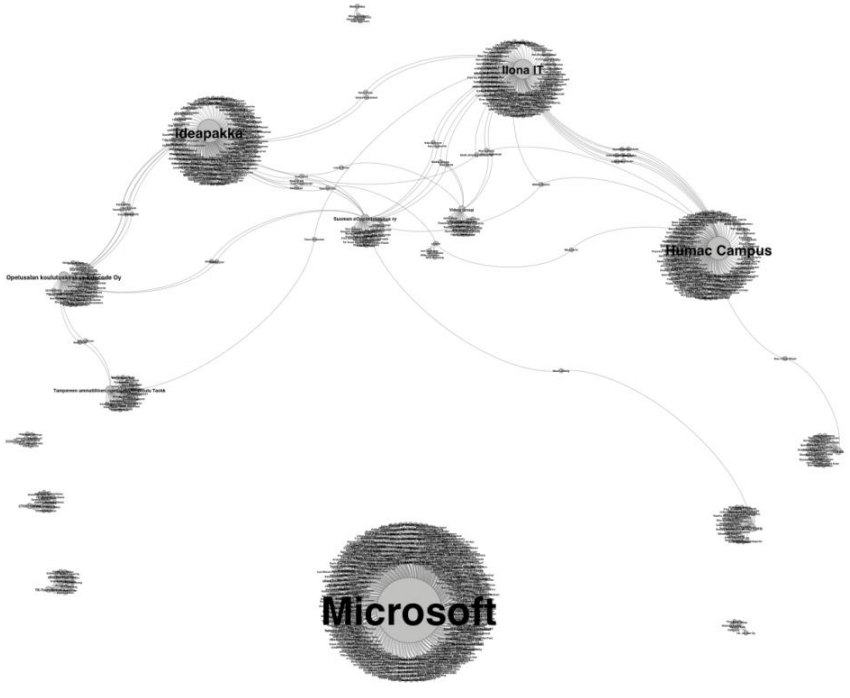

Figure 3. Facebook fan pages of companies presented at the ITK 2011 exhibition and a sample of people liking the pages.

The second example (Figure 4) shows investment flows within the Finnish innovation ecosystem [18]. The actors are colour-coded: companies are grey, unless they were sold or issued an initial public offering, in which case they are red. Investors with their home office in Finland are blue and investors whose whereabouts are international or unknown in the dataset are orange. The nodes (referring to entities) are inflated according to the number of connections that they have to other nodes. Hence, the bigger the node, the more connections it has. The resulting visualization emphasizes the role of Finnish Industry Investment in the landscape of the Finnish Innovation Ecosystem.

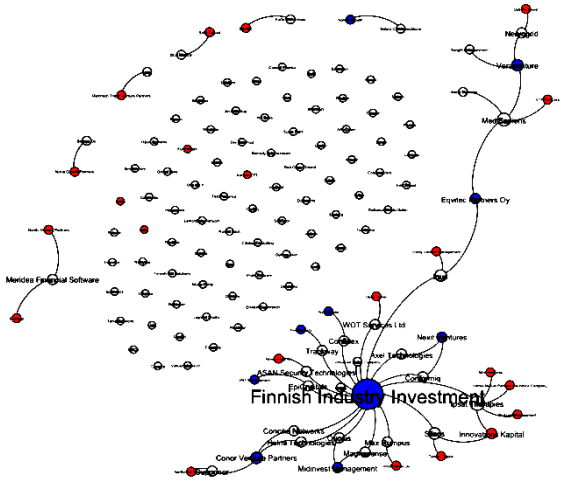

Figure 4. Network of Finnish Technology Companies and their Investment Organizations.

Conclusions

Communication and knowledge sharing about ICT-supported service innovation processes and impacts are increasingly performed by individuals and groups, and organizations at local, national and global level. The use of multiple data formats and sources, especially social media, brings valuable information that can be analysed and visualized towards understanding the complexities of innovation. Hence, measurement and monitoring of innovation can be explored with indicators based on, for example, social network analysis.

We propose that our framework (with dimensions of level of measurement, phase of innovation and level of user-driven innovation) provide the basis for

further analysis, discussions and interpretations. The results may be used for innovation activity improvements as well as for policy development.

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MEL: Mobile media enhanced learning application

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Abstract

The recent development in mobile and web technologies has led to a growing amount of personal digital content. This technological advancement opens up possibilities for special application domains, such as e-learning. In this paper we present MEL, a web application that seamlessly combines user-created multimedia with the student's learning process in a school environment. With MEL, the teacher can easily create assignments for students who can then execute these assignments with mobile phones, capturing multimedia content, such as videos or pictures. We report on field trial results with real users showing that MEL is quite easy to learn and use, even for inexperienced users, and present insights from user comments on using mobile devices and user-created multimedia to aid the learning process.

Introduction

Our mobile devices are becoming more embedded, ubiquitous and networked, with enhanced capabilities for rich social interactions, context awareness and connectivity. Such technologies can have a great impact on learning. For the current school generation, the use of mobile phones and social media is becoming a normal part of everyday life. This technical advancement in mobile and web technologies has contributed to the potential to support learners studying a variety of subjects in compulsory [1] as well as higher education [2].

As both [1] and [3] state, the important feature of mobile learning is that it is the learner who is on the move. The technology gives us the opportunity to move

the learner outside the traditional schoolroom. Although much research has been done into using the mobile phone as a content/material viewing tool [4] and [6], relatively few use the mobile phone's unique content creation capabilities. The use of mobile videos to promote the learning process is presented in article 0, which argues that learning can be deepened using mobile video material when it is done properly. However, the article concludes that much remains to be done in the field of mobile learning in order to overcome technical difficulties and to make it more functional for different types of learners.

In school there is also a need to foster a feeling of community and to teach co-operation between students, for example, using scripts that provide a set of instructions prescribing how students should perform in groups, how they should interact and collaborate and how they should solve the problem 0.

Our research aims to create solutions that will help to bring social user-created media into practical use in the school environment and to use the opportunities created by mobile technologies. In this paper we will present our solution, the Media Enhanced Learning (MEL) application, for enhancing the learning process with the help of user-created mobile multimedia. We aim to facilitate technology-based learning and help students to express their needs, thoughts and experiences by capturing multimedia content, such as pictures and videos during learning activities.

MEL is built on top of the existing Mobile Multimedia Content Creation Platform (MMCCP), which provides a platform for mobile and web services using user-created mobile multimedia 0. With MEL, the teacher can give various media assignments to students. MEL uses the unique capabilities offered by the MMCCP platform to enrich the learning process with the user-created social media enhanced with rich context data.

The core idea of the application is that it should be very easy to use, as the technical experience of the intended users can vary greatly, yet flexible enough to be used for different purposes in different school subjects. For example, in biology 'Out in nature', the teacher could give media assignments such as taking a picture of a daisy and sharing it with the class or keeping a video blog as a form of learning diary. There are dozens of other potential ways to use the application in the learning process, but defining them all at the implementation phase is impossible.

As well as being a learning aid, the application could offer additional value for students and their families. Collections of images, videos, situations and learning activities captured on a school trip would stay in the repository. This would ena-

ble a new kind of school history for the students and their families and leave a history of the person for generations to come.

We validate our approach by presenting a real user field trial. In the field trial we test and verify our mobile enhanced e-learning approach in a real school environment. Based on the pilot results we present strong and weak points of our approach and also discuss issues related to using mobile devices/applications to aid the learning process in a school environment.

Application scenario

Alice, a sixth grade teacher, wants to make her biology lesson more interesting and decides to use the MEL application to create an outdoor biology assignment for her students. Alice does not have an assignment ready so she creates a new one. She selects from a selection of possible biology assignment types and chooses the 'Monitor nature' template. Before she can activate the new assignment, she needs to give some parameters and definitions for the assignment.

Alice selects her own class as the target group and defines the assignment as active for three days. She divides her pupils into groups of three, as she wants to give each group a separate assignment. Each group should find and monitor different autumn plants. Alice also adds to the assignment that each group should identify the monitored plants, describe their habitats and write a short summary about the plant. When the students arrive in the classroom Alice gives a mobile phone to each student and instructs the students to check their new biology assignment, divide into the given groups and go to the nearby forest to carry out the assignment. Alice decides to stay in the class and observe in real-time what kind of plants each group monitors.

At the beginning of the lesson, Bob is given a mobile phone containing a pre-installed software application. When Bob opens the application he sees that there is a new biology assignment. He is assigned to Group 1 and sees that the other group members are Lisa and Jake. They go to the nearby meadow in the hope of finding autumn flowers. Lisa takes pictures of flowers with her mobile phone. After half an hour the groups return to the classroom and give back the phones. Alice reminds them that the rest of the assignment, the identification of the plants and the description of the plant's habitats, should be done as homework before the next biology lesson.

At home, the group logs in to the MEL application on the Web and selects the biology assignment from the list of open assignments. There they can see all the pictures taken as well as context information (location, weather, altitude…) of said pictures. Next to each image there are assignment-specific fields specified by the teacher. In this case there are two fields: 'Plant name' and 'Description of plants' habitat'. In addition, each picture/video contains a 'comment' button through which everyone can give his/her comments.

The next day in the biology lesson, Alice goes through the results of the biology assignment with the class. Using the MEL web service, Alice selects the previous day's biology assignment. This contains the results for all the groups and Alice discusses the results with the class. When the assignment is no longer active, it is filed in the student's portfolio and moved to the 'Past activities list', where it can be accessed later.

Implementation objectives

Mobile e-learning is a relatively new research area, so we are only beginning to see the full potential of using mobile phones and user-captured content to enhance the learning process. Mobile phones are small, portable and compact. They can easily be carried with the user, unlike laptops, which are much heavier and power-hungry

When designing mobile services, the mobility of the user device should be taken into account. The devices move with the users, encountering various contexts. The mobile context is retrievable from the device and its features include location, ambient conditions, user activities, social context, informational context and other factors. As the camera phones are also on line, publishing or sharing of multimedia content can take place on the spot right after capture.

Any mobile learning aid application, such as MEL, should be robust and rich in functionality yet easy to use and engaging, despite the restrictions imposed by the small display size and minimal keyboard. Moreover, application developers must pay attention to the way resources are used: network traffic should be minimized, battery power should be conserved when possible and CPU and memory should be used frugally. These restrictions come on top of the classic mobile phone application development nightmares (device incompatibilities, network application debugging, immature SDKs and different operating system versions

with undocumented bugs), making the development of an application like MEL challenging.

In addition to technical problems, the school environment inflicts challenges on the application developer. The application should help support both independent and collaborative learning, motivate the students and encourage a sense of responsibility. These goals are hard to achieve because the user's age may vary from a first year to a secondary school student, so there is a wide distribution of technical abilities and preferences.

A mobile learning aid application, such as that presented in the previous scenario, has four main functions: assignment creation by the teacher, assignment execution by the student, assignment management by the student and assignment review by the teacher. Not all of the teachers are necessarily technically competent and probably do not want to use applications that are too complicated, so a main requirement of the application is that it is simple and easy to use even for inexperienced users. Nevertheless, the application should allow the teacher to create versatile assignments for different school subjects.

Assignment creation, the first function, is a process in which the teacher creates scripts that provide a set of instructions prescribing how students should perform in groups, how they should interact and collaborate and how they should solve the problem.

The second, and probably most important, function of the application is the execution of the assignment by the student. The assignments given by the teacher should guide the execution process in which the student completes the assignment using captured videos or pictures, possibly annotated with extra information. The assignment can be a simple textual instruction (e.g. capture pictures of flowers from the forest) or a complex set of subtasks and extra questions. The captured multimedia content can be combined with any additional information that can be provided on location (where), social context (with whom) and in what circumstances (event, weather conditions, etc.).

The third functionality, assignment management by the student, means that the student should be able to manage and complete the assignment using a web-based user interface with a normal computer. The after-management, containing editing, augmentation and reiteration of the results created using mobile phones, is as important as the actual execution of the assignment in the field of the learning process.

The last function, assignment review, contains the exploitation of the created multimedia results by the teacher in teaching activities, e.g. simply going

through selected results with the whole class or organizing competitions. More advanced features, such as sharing the assignments and their results with other teachers/schools could also be envisaged.

The rest of the paper focuses on presenting the MEL application, its architecture and user interfaces, and the results of a field trial evaluation.

MEL application

The core idea of our service architecture is twofold. It was designed to provide the teacher with an easy and efficient way to create mobile media-based assignments and offer the students an easy-to-use tool to execute these assignments on mobile phones.

The MEL application offers two separate user interfaces (Figure 1):

- The *Web UI* provides a connection point to the application for the teacher who can create assignment templates, share and edit assignment templates with other teachers, create assignments for students, monitor, instruct and comment on the execution of assignments, review the results with the class, share the results with other teachers, etc. Similarly, with the *Web UI* students can also connect to the MEL service and manage the results of the assignment in co-operation with other students.
- The *Mobile UI* provides a mobile application user interface for the students to view and select assignments given by the teacher and, of course, execute the selected assignment with supervision from the teacher.

The MEL architecture can be roughly divided into three different entities: the *MEL Server*, which provides the application logic, authentication and integration with other components; the *Web MEL*, which provides assignment creation and management functionalities for both teachers and students; and the *Mobile MEL*, which provides tools for assignment execution with mobile phones. The architectural and implementation concept is driven by AJAX (Asynchronous JavaScript and XML), which provides better usability, speed and interaction with the web service when only the required data are transferred between the client and the server. Figure 2 presents screen captures of a mobile user interface for a typical assignment.

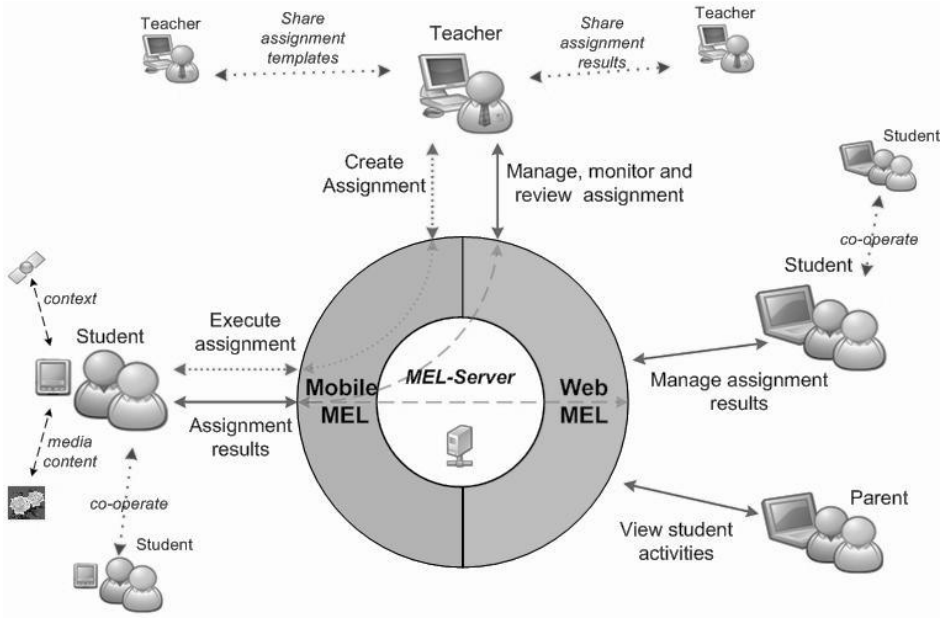

Figure 1: MEL User Interfaces

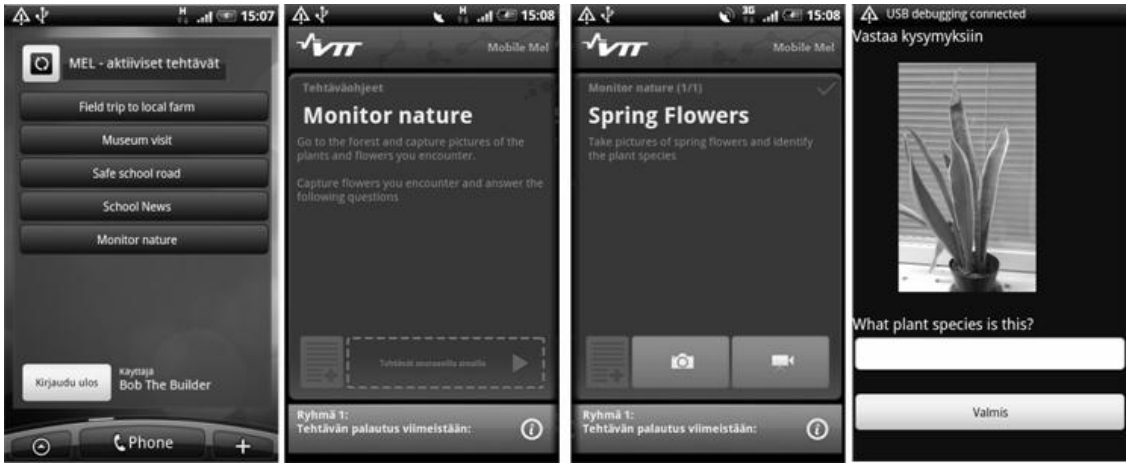

Figure 2. UI Screen shots of Mobile MELj.

Field trial and evaluation methodology

The main aim of the MEL field trial was twofold: to quantify application usability and assess the overall appeal of this kind of novel mobile learning aid application. We wanted to see how our overall concept worked in a real school environment and what students and teachers liked about the MEL application. A secondary aim was to discover usability problems and application.

The field trial was implemented in the Metsokangas comprehensive school in Oulu. We conducted a field trial with two classes (50 students and 1 teacher) that tested the MEL application in their lessons. Pilot testing started with a small group of students who tested the application for one week. After that, we collected their experiences of the application and made the necessary changes to it; the other classes and students then tried out the application. The response rate in the user survey was 100% (n=47; boys=28, girls=19) among the students. User experience data were collected in two phases: during and after use. We used a questionnaire, interview, observation, diary and log to gather information from the users.

The first method of collecting data was a questionnaire. We used a structured questionnaire consisting of System Usability Scale questions. It comprised eight multiple choice questions and used a scale of 1-5 in increasing affirmative order. We also used one free-text question to gather additional information. The aim of the questionnaire was to collect experiences about the MEL application and gain ideas for improvements to the application. At the end of the field trial, we interviewed the teacher and asked about his feelings and experiences of the MEL application.

Observations were also made during the field trial. The main advantage of observation was that we obtained immediate and direct information from the user's activities and behaviour through it. Observation is an excellent method of, among other things, interaction study, and for situations that are unpredictable and rapidly variable. It is much used when dealing with children because they are often not able to express in words what they mean.

Field trial results

During the three-week field trial, students completed seven different assignments created by their teachers. The students recorded and successfully uploaded 440 media objects (videos or pictures) during the field trial. The maximum number of media objects by a single user was 38 (35 images and 3 videos), the minimum was 3 (3 images, 0 videos). There is no clear correlation between the students' previous experience and the number of captured clips, but we observed that older students took more pictures and videos than younger students, and boys were more active than girls.

One important requirement of the MEL application was that it should be versatile yet easy to use. During our field trial, we observed that students were capable of completing given assignments and generally enthusiastic about using the MEL application. We also observed that quite a large number of students had difficulties using the mobile phone, especially younger students, who had problems writing on the touch screen keypad. For this reason, students were uninterested in answering text-based question and preferred multiple-choice and web questions.

Regardless of the technical problems with the mobile phones, students generally liked using the MEL application. After the initial problems and once the use of the mobile phone was familiar, the technical problems decreased and the students were able to concentrate on the MEL application. Based on the questionnaire, 41 out of 47 students thought they would be interested in using the MEL application at school in the future, while only two students did not want to use the service in the future. The students thought that the MEL application made learning more pleasant, with 36 out of 47 students giving it a rating of 'agree' or 'strongly agree'. None of the students rated it 'disagree' or 'strongly disagree'.

Somewhat surprisingly, only 15 out of 47 students thought (rated 'agree' or 'strongly agree') that the MEL application helped them to learn new things and 13 out of 47 students even rated it 'disagree' or 'strongly disagree'. Remaining 19 students were uncertain about this question. This indicates that students were unsure of how the MEL application could help them with the learning process. The results showed no clear difference between girls and boys, or age groups. At the beginning of the trial, the assignments concentrated on the capabilities of the MEL application and less on its pedagogical use. We believe that after the students and teacher become more familiar with the MEL application, it will move into the background and be used as a tool to enable its actual pedagogical use in

the learning process. Nevertheless, students felt that they were highly motivated to do their assignments using the MEL application: 34 out of 47 thought that the MEL application motivated them to do tasks and only 3 out of 47 students thought that it did not motivate them to do tasks.

Finally, 41 out of 47 users found this type of service 'useful' and stated that they would be interested in using these services in the future. Teachers were also positive about the possibilities offered by the MEL application. They felt that it could make teaching broader and more meaningful. One teacher also commented that he thought that one of the biggest advantages of the MEL application was that it was suitable for students of different ages.

Conclusions and future work

We developed a novel mobile learning application that allowed for web-based assignment creation by teachers, assignment execution by students with mobile phones, assignment results management by student and assignment results review by the teacher. The application, called MEL, successfully integrates the pedagogical scripts created by the teacher with user-created mobile multimedia and mobile phone context information.

We evaluated MEL in a real-world school environment and found that the majority of users though that the service was useful, the application was not too complex and was easy to learn and use. The field trial was successful: it verified the potential of the application, identified problems and provided excellent ideas for improvements.

Based on user comments, we improved the usability of the mobile user interface by developing a new, graphically enhanced user interface for the mobile client. This improvement was well received by the students. Another improvement will be made to the usability of the web user interface, which also received some comments in the field trial. Teachers, in particular, complained that the web user interface for creating assignments was too complicated to use, at least for the first few times. In order to improve usability and steepen the learning curve, we are also planning to streamline the web user interface.

Finally, we note that explaining the use of the application and clarifying its benefits and possibilities to teachers should play an essential role in any future field trials.

Acknowledgement

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New approaches in service research

Simulation of effects of alternative strategies in health care services – the dynamics of lung cancer

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Abstract

People are living longer, there are new medical breakthroughs and, as a result, the cost of health care is rising. These trends are fuelling an increase in the need to understand health care services and the effects of different strategies and uncertainties, and to develop tools to support the political decision-making process. The lung cancer model presented in this paper is a proof-of-concept for the approach to modelling and simulating diseases and health care services using a system dynamics approach. Model- and simulation-based tools for decision-making are becoming increasingly commonplace in the industry. For health care, the widespread use of and definite positive impact of these methods require a common platform and forum spanning the whole range from ground-level computational methods to interactive tools for collaboration and decision-making. The long-term goal is to create a dynamic simulation model library for the state of the health of the Finnish population in which the effects of alternative strategies, scenarios and uncertainties in the health care sector can be analysed and new and better practices developed.

Introduction

Health care in Finland, as well as in many other Western countries, will face serious challenges within the next few years. Increasing demand for health care services due to an aging population and novel medical treatment possibilities, combined with a scarcity of resources, challenge the decision-makers to match the demands of the health care services to the available resources. In order to

tackle these challenges, the health care system needs to find the best ways of focusing, adapting and prioritising its resources while trying to anticipate future needs with greater accuracy and confidence. This is challenging because decisions on health care made today may result in changes to the public health status and resource demand after significant time delays: typically 5-20 years or more. New types of tools and practices are therefore urgently needed to guide political decision-making in health care towards effective solutions that are coherent in the short and long term.

When it comes to political decision-making, trends in other disciplines indicate that there is an increasing desire to use modern computer simulation methods for testing the effects of policy proposals. Several road maps indicate that in the near future, modelling and simulation methods will be widely introduced into and employed in all political and governmental decision-making, and no major political decision will be made without prior simulation of the effects in 2020 [1, 2, 3, 4]. Despite the recognised need, no such tools are currently available for the health care sector. Some simulation studies exist (e.g., [5]), but they are few and far between.

The aim of this proof-of-concept study was to test the applicability of detailed simulations that are widely used in other areas in the health sector. A lung cancer model capable of simulating disease incidence, prevalence, need of health care services, costs and soft values, such as the rough number of lost life years, subject to the selection of simulation parameters, was developed. Changes in the risk factors (smoking) and the introduction of future diagnostics were chosen as key parameters to be evaluated in this paper.

Trends in health care services and policymaking

The future demand for health care services will challenge what can be provided with limited resources. This will force decision-makers to prioritise and seek the most cost-effective options. This partially contrasts with the ongoing trends in drug and technology development and the markets for health care, where

- new therapies are typically more complicated and expensive than old ones
- novel therapies are more specific than conventional ones, and tailored companion diagnostics are needed in order to identify the patients suitable for each therapy
- the average development costs for a new drug have increased.

Overall, the health care system becomes more complex as conventional methods of predicting the future health care service demand and costs may not be flexible enough with increasingly individualised therapies. These trends in health care are in line with the claim that decision-makers could benefit from a digital decision-making environment allowing them to find the best alternatives.

Our aim is to build a model capable of evaluating the simulated effects of varying the desired parameters. Even though the methods applied are quite novel in this application area, the idea itself is not. In the past, there have been attempts to build e-health and policymaking applications based on simulation and disease modelling [6–15]. The approach of using modern methods of model optimisation and simulation (traditionally used in technical and industrial applications) in the field of disease modelling has recently been tested successfully by others [16]. To the best of our knowledge, however, there have been no attempts to build a comprehensive simulation environment for decision-making in the health care sector.

Lung cancer

Lung cancer is a significant killer, especially among persons with a history of smoking. It is clearly the most common death-causing cancer among males and in second place after breast cancer among women. When measured in number of lost life years due to death caused by a cancer, lung cancer is by far the most significant killer.

The prognosis after diagnosis is poor. The only curative therapy is an operation in which the part of the lungs containing the tumour is resected. In cases applicable for surgery, the prognosis is at best approximately 50% chance of living for more than 5 years. This option, however, is only available in rare cases when the disease is locally limited at the time of diagnosis. In most cases, the tumour will have spread beyond the reach of tissue resection possibilities, and

chemotherapy and/or radiation therapy remain the only treatment options, being only palliative in nature. In advanced cases, the prognosis is very poor.

As the prognosis of lung cancer is strongly dependent on the advance status (tumour stage) at diagnosis, attempts are being made to find tumours at the stage when curative therapy can be used, i.e. an early stage. Estimating the effectiveness and costs of such future diagnostics is essential when considering the investments in screening. Lung cancer is also a disease for which there is a clear risk factor (smoking), and the effects of changes in that risk factor can be weighted by simulating various scenarios in population smoking habits.

Lung cancer model

Model structure

The model consists of a segmented multidimensional aging chain model of disease progress and a linked population model. In the aging chain, the population is divided into sub-populations according to the stage of the disease, diagnostic status and subsequent therapy. The dynamics then specify the transition of people between sub-populations. There are three main subsections of the chains:

- those who are healthy at the beginning of the chain
- people who have undiagnosed cancer (cancer will spread and tumour grows in size as no treatment is administered)
- people who have diagnosed cancer and are consequently undergoing cancer treatment.

Each of these subsections has its own aging chain with parallel structures for different treatments and cancer types (three distinct lung cancer types are included: small cell lung cancer, non-small cell lung cancer and non-smoker-type lung cancer). The model is segmented with respect to sex, age and risk factors. The model is tuned using existing real epidemiological as well as clinical data and the structure is based on expert judgements on the most relevant phenomenon to include in the model. The model is depicted in Figure 1.

The subsection of the healthy population is the simplest: it is just one subpopulation divided into age and sex groups. The risk data, i.e. smoking habits, are drawn from separate prediction data with annual smoker percentages. The transition to the next subsection introduces a further division into the three can-

cer types included in the model: small cell, non-small cell and non-smoker-type lung cancer. The subsection of undiagnosed progressing cancer consists of a division into sub-populations based on the clinical diagnosis stage categories (IA, IB, IIA, IIB, IIIA, IIIB and IV) and additional very early stages in which the tumour is, in practice, undetectable by currently available methods. The transitions between clinical stages are either an 'increase in tumour size' or 'spread'.

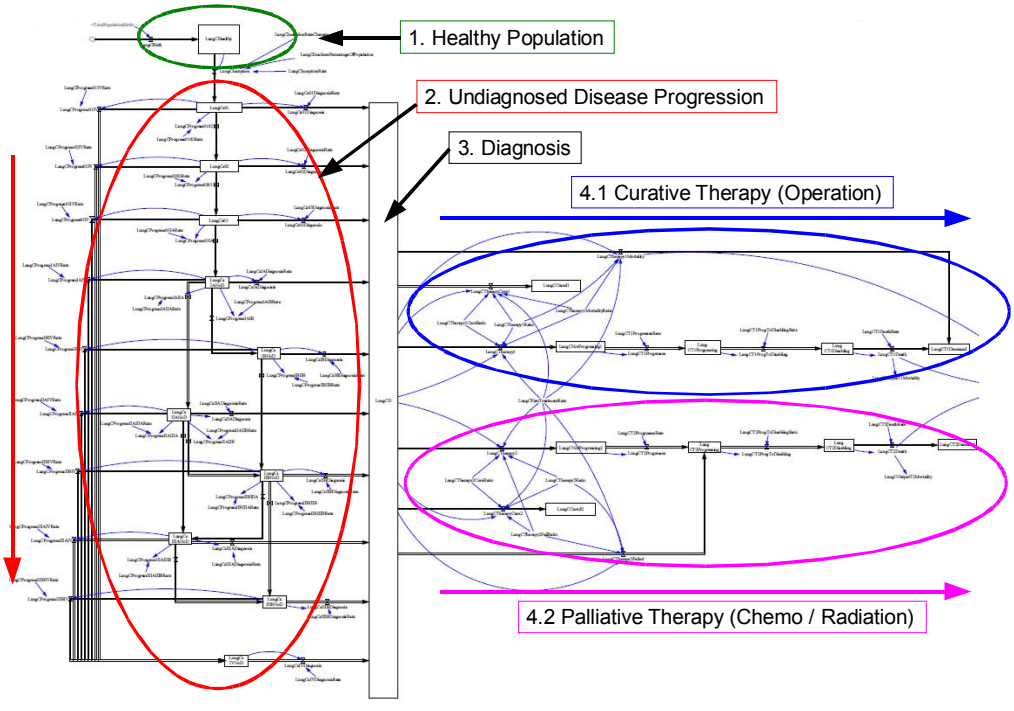

Figure 2: The structure of the lung cancer model.

The last subsection is the treatment phase after diagnosis. The stage at which the cancer is diagnosed acts as one more division within the sub-populations. The treatment consists of two alternative pathways: palliative therapy (chemo- and radiation therapy) and curative therapy (surgical operation). The distribution between the therapies depends on the patient and the disease characteristics, and the *stage* at which the cancer is diagnosed and the *type of cancer* are particularly significant. Both therapy pathways have a rather similar structure consisting of successful treatment resulting in complete removal of the disease, partial success with the disease recurring after a time, and failure to remove the tumour or halt its growth and spread. Unless the therapy is successful, the final transition in the

model is mortality due to lung cancer. Mortality for other reasons is implemented through the population model.

Population model

The model uses a forecast of the Finnish population until the year 2060, provided by Statistics Finland in numerical tabular format. The data consist of annual figures for population size divided according to sex and age in full years from 0 to 100 or older. The lung cancer model uses the same sex and age division.

In addition to births and deaths, the population data incorporate immigration. The change in a population age group, e.g. difference between the number of 50-year-old men in 2020 and 51-year-old men in 2021, is fed into the sub-populations of the aging chain. For 0-year-olds, this gives the birth rate into the healthy group. For other age groups, to avoid overlapping, the mortality predicted by the cancer model is removed from the changes and the remainder is applied to the sub-populations so that the distribution is not affected, i.e. immigration and death in a car accident are not dependent on an individual's current state of health with regard to having lung cancer.

Model parameters and user interface

The cancer risk and inception parameters are primarily based on epidemiological incidence data [17]. The inception risk is age and sex specific. Once a tumour is discovered, it is treated and the direct data on tumour growth progress are therefore scarce. However, the distribution of diagnoses of different cancer types at different stages is known. This distribution alone is not sufficient to determine the parameters, but it can be used to refine values based on indicative data and expert judgement.

The main parameters of the treatment phase are the distribution between administering palliative or curative therapy, the success rates of therapies and the duration of the treatments and final stages of disease progression. Survival data are included for a particular therapy for a specific cancer type and stage at the time of diagnosis. These data incorporate the initial success ratio and the rate at which the cancer proves fatal through failure of the initial therapy or relapse of the disease.

The end-user can access the model parameters through an Excel user interface, which has several sheets for different aspects of the model, such as smok-

ing habits (as seen in Figure 2), biomarker screening and population, to name a few.

Scenarios and simulation results

The current model includes two primary simulation variables for scenarios: the smoking habits of the Finnish population and the introduction of a novel diagnostic method that detects the cancer earlier than the currently available methods. Both simulation variables are freely adjustable qualitatively and quantitatively.

The smoking scenario control has two predesigned scenarios and the option to adjust them freely as functions of time (table functions). The data are given as percentages of smokers for sex and age groups. The two scenarios are a projection of current trends and the goal of the *Smoke Free Finland 2040* project [18], which is aimed at an annual decrease of 10% in smoking. The projection of current trends is a much more pessimistic estimate.

The novel diagnostic method included in the model allows diagnosis at an early stage. Effectively, this means stages at which there are not yet any cancer symptoms. Population screening can be applied to selected age groups, sex and smoking habits. In addition, the cost, accuracy (specificity and sensitivity) and coverage of the screening can be adjusted. As well as the effects of earlier diagnosis of the disease and treatment dynamics, the screening activity incurs costs of its own that are added to the calculated overall costs.

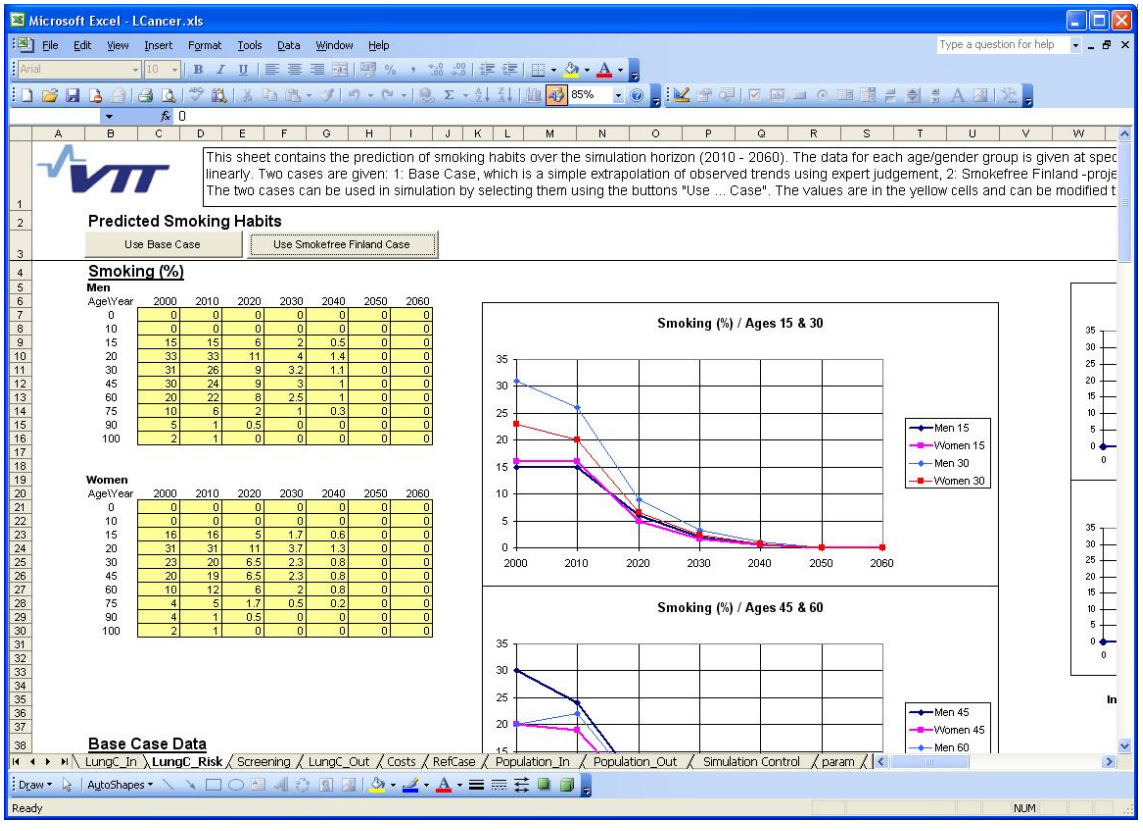

Figure 3: 'Smoking' worksheet on the Excel interface.

The basic outputs of the model include the number of undiagnosed cases, incidence and prevalence data (new diagnosed cases and number of patients in treatment), and mortality figures. All outputs are categorised according to the type and stage of the disease, the therapy, and patient sex and age. The figures in the user interface group and total these data for various sub-populations annually over the simulation time horizon. An economic aspect is included by roughly calculating the total cost effects of the simulated strategy based on the primary outputs. In addition, a softer aspect of outcome is included as 'lost life years', i.e. lost (or saved) years of life due to premature death from the disease (assuming a certain fixed life expectancy). The outputs are suitable for further refinement to estimate, e.g., the effects on quality of life aspects. The tool allows a quick comparison of alternative future scenarios, for example, different diagnostic screening protocols and various scenarios of changing exposure to risk factors.

Conclusions

The traditional areas of system dynamics lie in the analysis of processes, operations and organisations. This proof-of-concept model of lung cancer has shown the applicability of the system dynamics modelling approach also to this type of detailed disease model. The combination of phenomenal and organisational modelling can provide powerful tools for decision-makers to analyse and compare different strategies for health care, not just individual actions in specific situations. The high level of automation of the computations also provides the possibility of analysing sensitivities, e.g., model parameter accuracy as well as the effect of hypothetical future options or poorly measurable biological or social factors. On the other hand, automated optimisation and fine-tuning of strategies also become an option for solving the inverse problem: the aim is known but the measures to achieve it are unknown.

The accuracy and limitations of the model need to be taken into account when devising and implementing strategies. All the models always represent only an approximation of the underlying reality, and they are limited by the currently available information. Therefore, the decision-maker cannot blindly trust the model but must have an understanding of the model and the context. In particular, large deviations from the current state of affairs and the data on which the model is built lead to increased uncertainty. The judicious use of decision tools must therefore take into account the risks of an incorrect model and incorrect interpretation of the results.

Based on the experience gathered in this proof-of-concept project, a call for a comprehensive simulation-based toolset in the area of decision-making in health care is apparent. A unified open platform supporting various modelling approaches and tools with analysis and decision support would enable better preparation for future challenges. In addition to simulation models for the most important diseases, from the public health point of view (a model library), the toolset should also include models for evaluating alternative socio-economic strategies in the health care system. The openness and modularity would allow reuse of the model components and data. The development of integrated toolset options to facilitate a wider interest group and citizen participation in political decision-making would also enable greater understanding and acceptance of public policies.

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Dynamic simulation of real estate repair and comfort services

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Abstract

This article presents a system dynamics simulation model built to study the effects of office building renovations, energy class upgrades, and comfort services. These effects are important to the real estate owner and have an essential impact on the satisfaction of the customer organization renting the office space. Decision-making in real life is often short-sighted, either because of the wrong incentives or because of faulty mental models people have. The proof of concept simulation model shows the value of the system dynamics modelling approach in facilitating communication between different stakeholders and evaluating different policies.

Introduction

The highly capital-intensive construction industry involves decisions that have long-lasting effects on many people and organizations. Buildings in poor condition can be repaired in different ways. This article makes the distinction between energy class upgrades and smaller renovations. In energy class upgrades, the energy class of an old building is improved when the building is repaired, while in smaller renovations it stays the same. As new building construction is only a small proportion of all buildings, energy class upgrades of old buildings are important for improving the energy efficiency of the whole building stock.

The focus of this article is on office real estate that the owner can either rent to another organization or, alternatively, make renovations and sacrifice the short-term rental income. The real estate utilization rate also drops if buildings are not

repaired and they degrade into bad condition. While in real life the rental prices depend on the real estate condition, in the model, rental prices are assumed constant.

Comfort services such as heating and ventilation also play a key role in determining the value of real estate to organizations renting office space. Poor quality comfort services have a negative effect on customer satisfaction, which is known to lower employee productivity [1][2]. However, real estate owners and users have different goals regarding facility management. Users naturally emphasize usability but, for the owners, cost minimization and economy are often more important.

System dynamics

System dynamics [3] is based on the idea that the structure of the system (i.e. feedbacks, accumulations, and time delays) causes its behaviour. There are two types of feedback loops: positive (reinforcing) feedback, which amplifies change, and negative (balancing) feedback, which counteracts change.

Simulation helps to improve understanding in situations involving dynamic complexity, i.e. complexity arising from the interactions of different components in a system, which often leads to unanticipated side effects of policies. System dynamic model scopes are often broad, encompassing the physical and institutional structures of systems as well as people's behavioural decision-making rules. System dynamics is based on the mathematical theories of non-linear dynamics and feedback control, and ordinary differential equations are used to model the systems. The model building process is typically iterative.

Simulation model

A proof of concept system dynamics simulation model and a user interface were developed. The model focuses on office buildings and includes renovation and comfort service decisions made by the owner of the buildings that affect the organizations renting the buildings for office use.

The buildings in the model are grouped into buildings under construction, buildings in good condition, buildings in bad condition, and buildings under repair (Figure 1). Buildings in good condition degrade over time and must even-

tually be repaired or demolished. The energy classes of buildings can be upgraded when buildings are repaired. The model also includes the customer organization's satisfaction with the real estate.

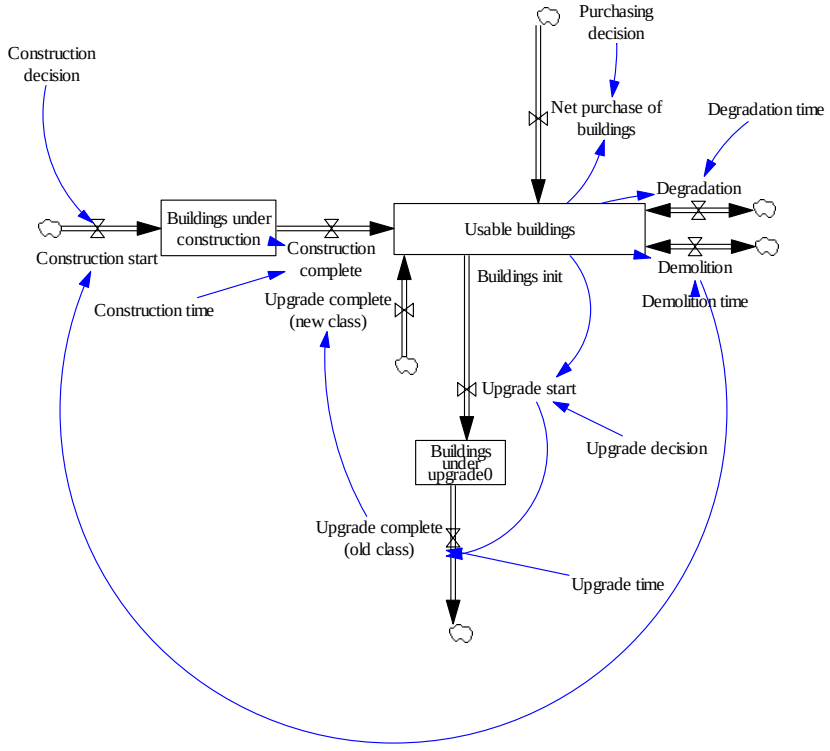

Figure 1. Part of the simulation model.

Buildings are grouped into the following six energy classes: Class A1 – modern low energy building; Class A2 – typical year 2010 building; Class B1 – typical year 2000 building; Class B2 – typical year 1990 building; Class C1 – typical year 1980 building; Class C2 – worse than typical year 1980 building. The buildings differ in their levels of energy consumption (kW/m^2/year), maintenance costs, and comfort service costs. All new buildings are assumed to belong to, at least, energy class B1. The construction times for the buildings, including the planning phase, are assumed not to depend on the energy class. However, the construction cost (€/m^2) is higher for better energy class buildings. Model parameters are shown in Table 1.

Table 1. Model parameters.

	Energy class					
	A1	A2	B1	B2	C1	C2
Initial amount of real estate space in good condition (m^2)	0	0	100	100	100	100
Initial amount of real estate space in poor condition (m^2)	0	0	100	100	100	100
Construction time from planning phase to moving in (years)	3	3	3			
Percentage of new buildings	5 %	90 %	5 %			
Construction cost (€/m^2)	3500	3000	2000			
Comfort service cost factor	1	1	3	3	5	5
Energy consumption (kW/m^2/month)	8	10	12	16	20	25
Maintenance cost (€/m^2/month)	3	3.5	4	4.5	5	5.5
Degradation time (years)	20	20	20	20	20	20
Demolition time (years)	10	10	10	10	10	10
Demolition unit cost (€/m^2)	100	100	100	100	100	100
Energy cost (€/kWh)	0.06	0.06	0.06	0.06	0.06	0.06

In all the renovations, the condition of the building is changed from poor to good. Buildings in good condition are not upgraded to a better energy class. Table 2 and Table 3 show the renovation times and costs that are used in the model. The renovation time is assumed to be shorter and the cost lower for smaller renovations in which the energy class stays constant. Buildings in energy classes C1 and C2 that are upgraded are upgraded to at least energy class B1.

Table 2. Repair and energy class upgrade times of buildings in bad condition to good condition (from planning to moving in).

Renovation time (months)	To A1	To A2	To B1	To B2	To C1	To C2
From A1	8					
From A2	12	8				
From B1	30	24	8			
From B2	30	24	24	8		
From C1	48	36	36		8	
From C2	48	36	36			8

Table 3. Repair and upgrade costs of buildings in bad condition to good condition.

Renovation cost (€/m^2)	To A1	To A2	To B1	To B2	To C1	To C2
From A1	80					
From A2	500	80				
From B1	1500	1000	80			
From B2	1500	1000	500	80		
From C1	2500	2000	1700		80	
From C2	2500	2000	1700			80

The number of different types of renovations to be started each year as well as the level of comfort services can be changed from the user interface (Figure 2).

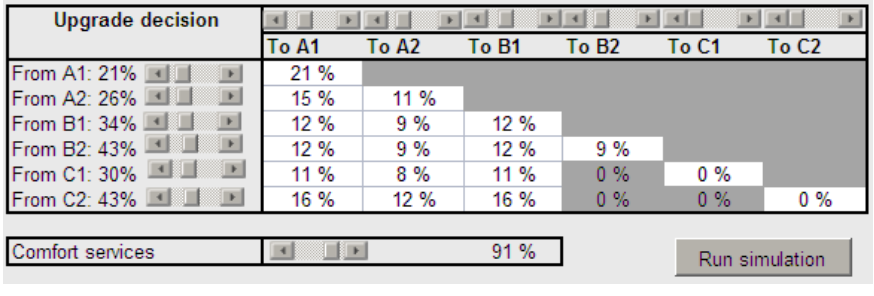

Figure 4. User inputs.

Simulation results

Four different scenarios were simulated using the model:

- **Scenario 1:** No renovations are made and poor quality buildings are eventually demolished.
- **Scenario 2:** Renovations are made (30% of each energy class), but the energy classes of buildings are not improved.
- **Scenario 3:** Renovations are made (30% of each energy class), and the energy classes are improved to A1.
- **Scenario 4:** Renovations are made but there are no energy class upgrades. In addition, there is a lack of comfort services.

Figures 3–5 show how the building stock behaves in different scenarios. The amount of real estate is kept constant in the different scenarios. In scenario 1, in which no renovations are made and the buildings in poor condition are demolished, more new buildings are constructed than in the other scenarios. As new buildings are more energy efficient than old ones, the amount of real estate in better energy classes also rises more rapidly than in scenarios 2 and 4. In scenario 3, the amount of energy-efficient real estate rises because of the energy upgrades that are implemented.

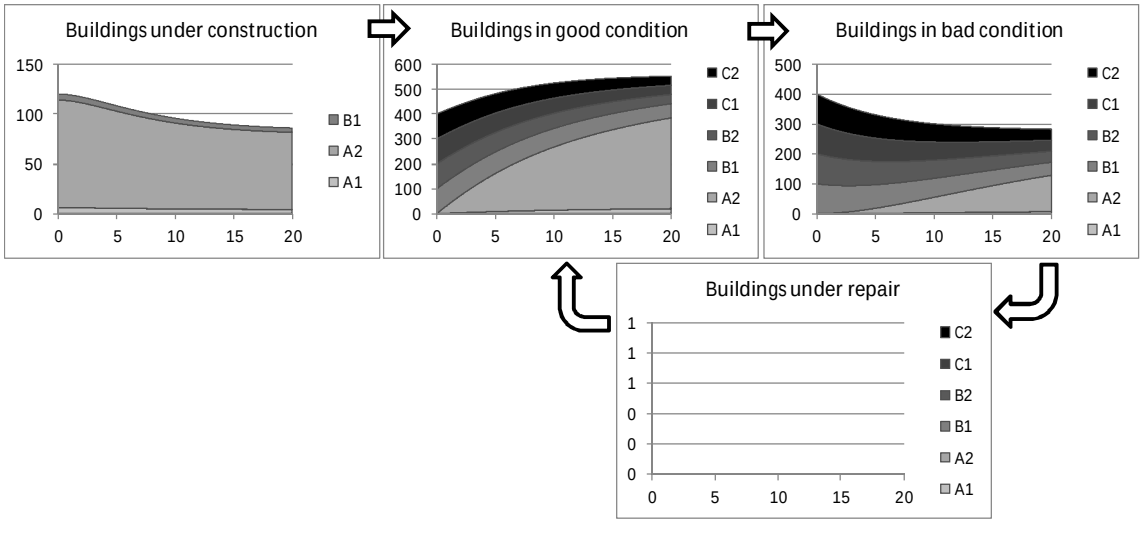

Figure 3. Scenario 1.

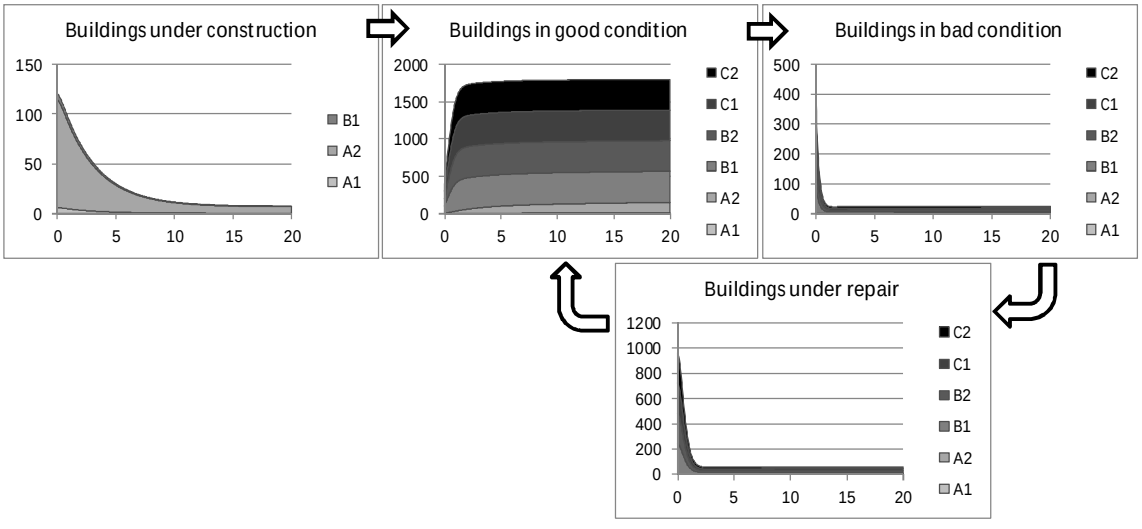

Figure 5. Scenarios 2 and 4.

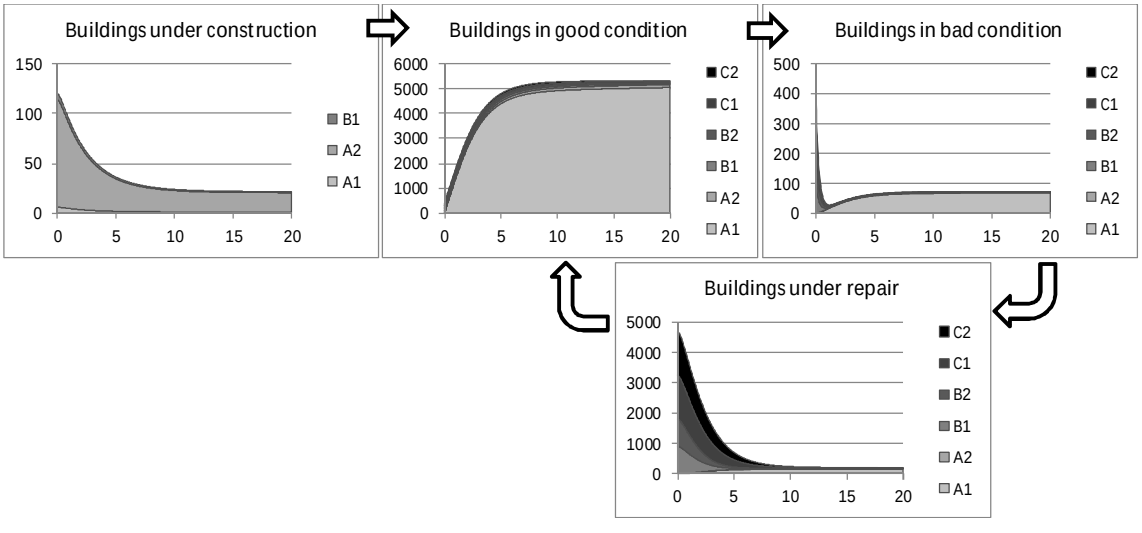

Figure 5. Scenario 3.

Figure 6 shows the utilization rates in the different scenarios. In scenarios 1 and 4, the utilization rate stays low throughout the simulation. In scenarios 2 and 3, the utilization rate is low in the beginning of the simulation because of on-going renovations but gradually rises.

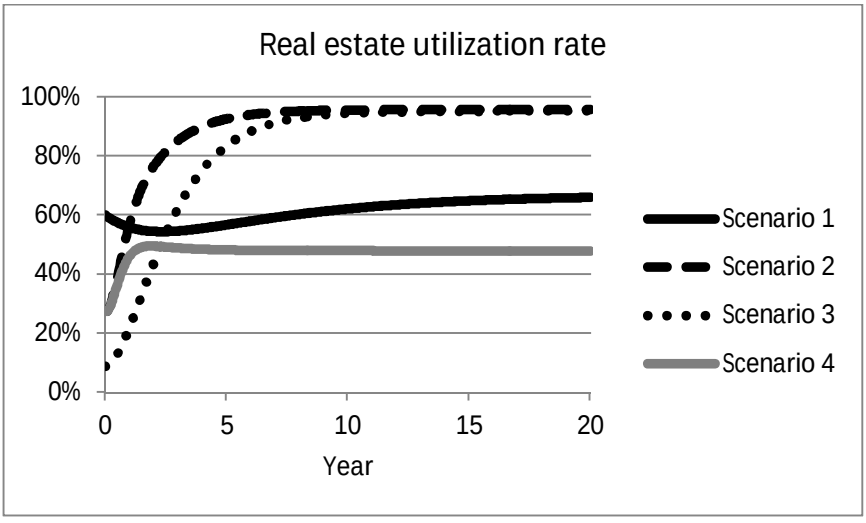

Figure 6. Real estate utilization rates.

Discussion, conclusions, and exploitation potential

System dynamic simulations have great potential in shaping political decision-making as well as decision-making in privately held companies. Alternative scenarios, such as the effect of rising energy prices on the profitability of energy class upgrades, can be explored with simulations. Collaborative model building facilitates communication between different people, and causal diagrams and simulation models can be used to uncover false mental models and to develop better policies for all stakeholders.

One problem with real life decision-making is that it is often short-sighted. People often focus on the investment costs of renovations and new buildings but neglect the life cycle costs. Efficient use of energy is more economical in the long term. As many investment decisions generate additional costs in the short term, it is useful to be able to show the long-term positive implications of policies using simulations in order to change decision-making towards a more sustainable direction.

This article presents a proof of concept simulation model for the purpose of showing the value of real estate repair and comfort services. The model uses data about construction, repair, and upgrade times and costs, as well as energy

consumptions and prices. To use the model in real life decision-making, further research would be needed to validate it. More data would also be needed, especially in assessing how customer satisfaction is affected by the level of comfort services and the condition of the buildings. There is an ongoing EU-funded research project in which simulation is used to evaluate different types of energy class upgrades.

There are many additional aspects that could be taken into account in the simulation model. These will be addressed by future research:

- Quality of the renovations: Bad quality is common practice in the construction industry. Impeccable quality is perceived to be costly but, in reality, poor quality causes additional rework. The manufacturing industry has long acknowledged the importance of quality management, which strives to improve the quality of the manufacturing process.
- Trends in energy prices: The level of energy prices influences the profitability of renovations. If energy prices increase, decision-makers will have more incentives to invest in energy class upgrades. Typically, less than 5% of the energy is consumed during the building phase and 85% during its use.
- Brand image of the real estate: In addition to energy savings in the long term, energy class upgrades can also have a positive influence on brand image and attract more customers. This can be important if people's values emphasize environmental protection in the future.
- The dynamic effect (over time: short vs long term) of comfort services to employee satisfaction and productivity as well as the combined effects of various factors such as noise and poor ventilation.

Acknowledgement

The research was funded by VTT. I wish to thank my VTT colleagues in the Advice FM project in model development and data collection as well as colleagues in the OneStopShop project for ideas on future work to expand the scope of the model.

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Dynamic model of electronic invoicing adoption

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Abstract

Traditional paper invoicing is in the process of being replaced for the major part by electronic invoicing, as it is comparatively outdated. Considering the advantages of electronic invoicing the adoption rate of the service has been surprisingly slow among billers and their customers in Finland. Nevertheless, as more and more companies and consumers adopt electronic invoicing, service providers compete for market shares. The service provider that comprehends and makes the best use of the features of the market's dynamics has an advantage over its competitors. We used system dynamics modelling to understand the dynamics of electronic invoicing adoption in Finland.

Introduction

The electronic invoice (e-invoice) is a typical service in the modern information society as it makes good use of information technology. Compared with traditional posting of sheets of paper, the e-invoice has several advantages: it costs less; it is faster; and its environmental impact is lower. Depending on the readiness of the client, the e-invoice is also easier to pay and archive than the paper invoice. The advantages for the billers come from the cost-efficiency of billing a myriad of invoices to numerous clients. Despite the significant benefits that e-

invoicing offers, the adoption rate of the service has not developed as fast as it could have. However, adoption of the service among companies and consumers has been increasing.

In Finland, there are several e-invoice service providers selling business-to-business (B2B) and business-to-consumer (B2C) invoicing services. As a result, the competition for market shares is tough. One of the key factors of this competition is to understand the dynamics of the markets. Understanding market dynamics is especially important as it explains the differences in e-invoice adoption rates in the B2B and B2C sectors. It may also explain why, for example, Denmark is so much further ahead in e-invoice adoption than Finland. The share of e-invoices in the Finnish B2C sector is only 25% while in the B2B sector the share is approximately 50%. In Denmark, the share of e-invoices in the B2C sector is more than 50% [1]. The substitution of paper communication tells us that over the past ten years, the letter volumes in Denmark have also fallen by over 40% and in Finland by 10%. Nevertheless, the service provider that best understands and exploits the characteristics of the market's dynamics has a clear advantage over its competitors.

In the literature, comparable problems have typically been examined by mathematical modelling and simulation. The most famous model is the Bass model [2] (see Figure 1). It is a simple model in which the potential adopters of the product become adopters as innovators or imitators. Maier [3] elaborated the problem by extending the model to incorporate competition and substitute successive product generations. Milling [4] studied the strategies for new products, especially concerning pricing, product development and research while considering the actions of competitors.

Purpose of System Dynamic Modelling

In order to understand the dynamics of the e-invoicing market we used system dynamic modelling and simulation. We wanted to understand which factors have the most significant influence on the e-invoice adoption rate in the B2B and B2C sectors, how these factors could be exploited and what can be expected to happen to the markets of traditional paper letters and invoices.

In order to gain a more profound understanding of the system's behaviour, we wanted to simulate alternative scenarios for the adoption of e-invoicing under

different kinds of circumstances and assumptions. The idea was not to give pure predictions – because they are unreliable – but to raise questions and challenge conventional thinking. Furthermore, scenarios are good at conveying fundamental assumptions and considerations of a system's behaviour.

Modelling Process

None of the papers [2, 3, and 4] studied a system in which the attractiveness of the product was dependent on different stakeholders in the system. To be more precise, the benefit to the biller is a function of the number of consumers who have adopted the service, whereas the benefits to the consumer are dependent on the number of billers that offer the possibility of e-invoicing. We used the Bass [2] innovation diffusion model structure as a starting point (see Figure 1). However, the relatively simple structure of Bass's model proved inadequate to explain the dynamics of e-invoicing adoption rates.

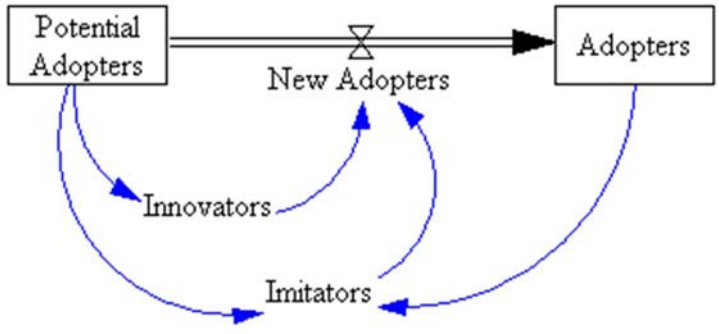

Figure 1. The Bass model structure.

We modified the model structure to suit our needs and added necessary variables to it. The model became quite complex, and it is beyond the scope of this paper to explain the whole structure. A much-simplified structure of the B2C model can be seen in Figure 2. Only the most salient variables are shown in the figure.

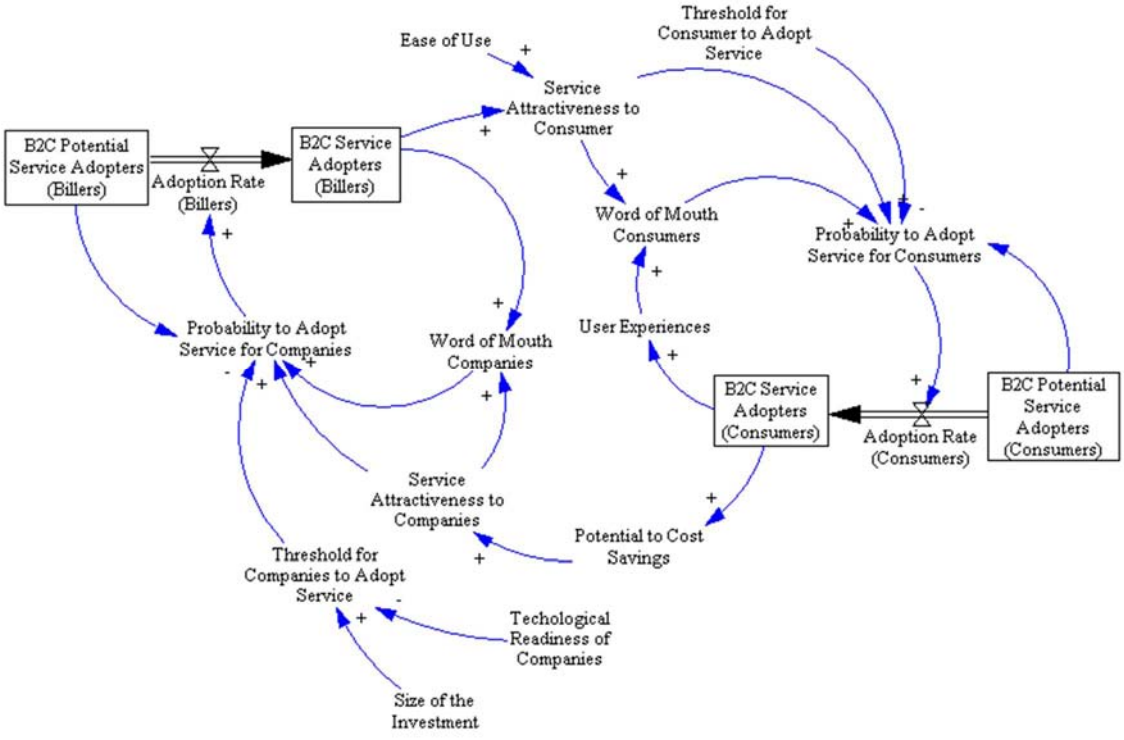

Figure 2. A simplified model structure.

There are adopters and potential adopters among both billers and consumers. The potential adopters become adopters at the adoption rate. The adoption rate is determined by the number of potential adopters and the probability of adopting the service. The probability of adopting the service depends on how well known the service is among the potential adopters, which in turn is determined by word of mouth and the effort invested in marketing. Word of mouth can have both negative and positive effects on the adoption probability, depending on the users' prior experiences. It depends on the attractiveness of the service and the number of users. There is also a threshold for adopting a service, determined by the readiness (e.g. technological readiness) of the billers and consumers and the size of the initial investment for the billers. It has a direct effect on the probability of adoption of the service. One of the most important factors influencing the adoption probability is the attractiveness of the service. The attractiveness is mainly determined by the potential benefits of the service. For the billers, the benefits are for the most part cost savings while for the consumers they are ease of paying and archiving of the invoices and, in some cases cost savings. Moreo-

ver, the benefits for the billers are dependent on the number of consumers who have adopted the service (i.e. potential cost savings) whereas the advantages for the consumers depends on the number of billers offering the service.

The consumers in the model are divided into several segments according to their preferences and attitudes towards e-services. The segmentation follows Rogers' categorization of consumers [5]: innovators, early adopters, majority of consumers and laggards. Likewise, the companies are divided into segments. The segmentation is performed according to the size of the company and the volume of invoicing.

Moreover, we built an Excel user interface for the end-user (see Figures 3, 4, and 5). With the user interface, it is possible to simulate different scenarios with various parameter settings and inputs (see Figure 4). For the scenario generation we used the following model inputs:

- scenarios of economic development (e.g. the growth of GDP)
- scenarios of costs (e.g. increasing transportation costs due to increasing oil prices)
- significant events (e.g. biller with large invoicing volume adopts e-invoicing)
- pricing policies (e.g. prices of paper letters increase while prices of e-invoices decrease)
- payment policies (e.g. consumer pays for paper invoices vs biller pays for paper invoices)
- scenarios of technological development (e.g. development of ease of use and/or data security).

We were also interested in the influence of hybrid services on e-invoicing adoption. By hybrid service, we mean electronic letters sent by the biller in electronic format and printed in paper format by a hybrid service provider near the bill payer. The printed paper letter is then sent to the payer from a short distance. Hybrid services are commonly adopted by the billers in Finland. They cost less than traditional paper letters but more than e-invoices. That is to say, the adoption of e-invoicing offers comparatively less cost savings when hybrid services are already in use. This may have an effect on the adoption rate of e-invoicing.

Considerable time in the modelling project was spent on model testing and validation as well as fitting the curves of the simulations to history data. The model was tuned to match the current situation of e-invoicing in Finland (see Figure 3). The idea was to fit the model to different countries with a roughly

similar model structure but different parameter values. The sensitivity of the model to different assumptions was also tested.

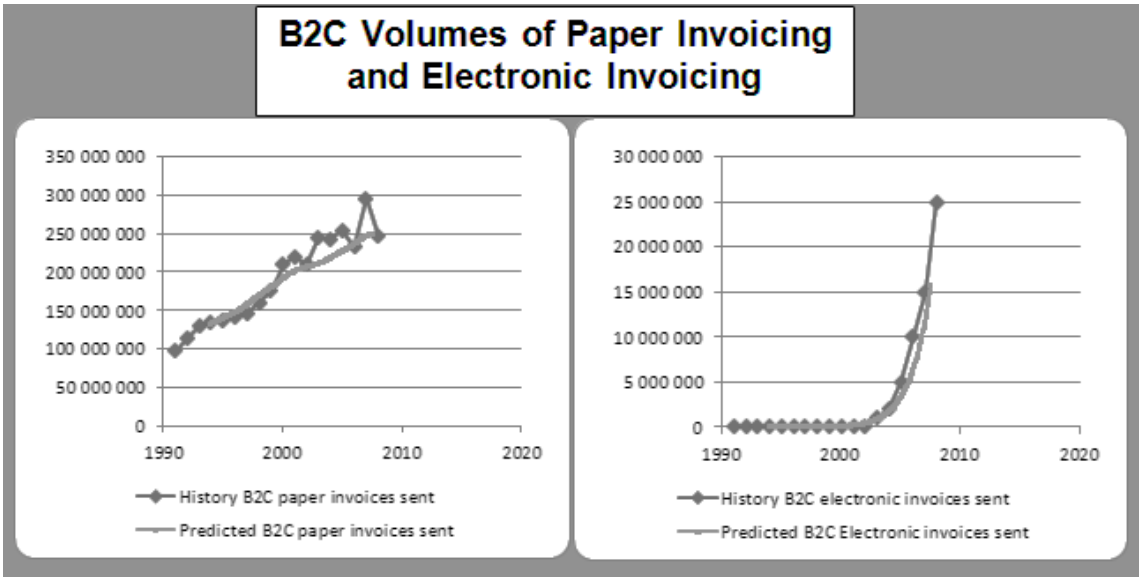

Figure 3. Curve fitting.

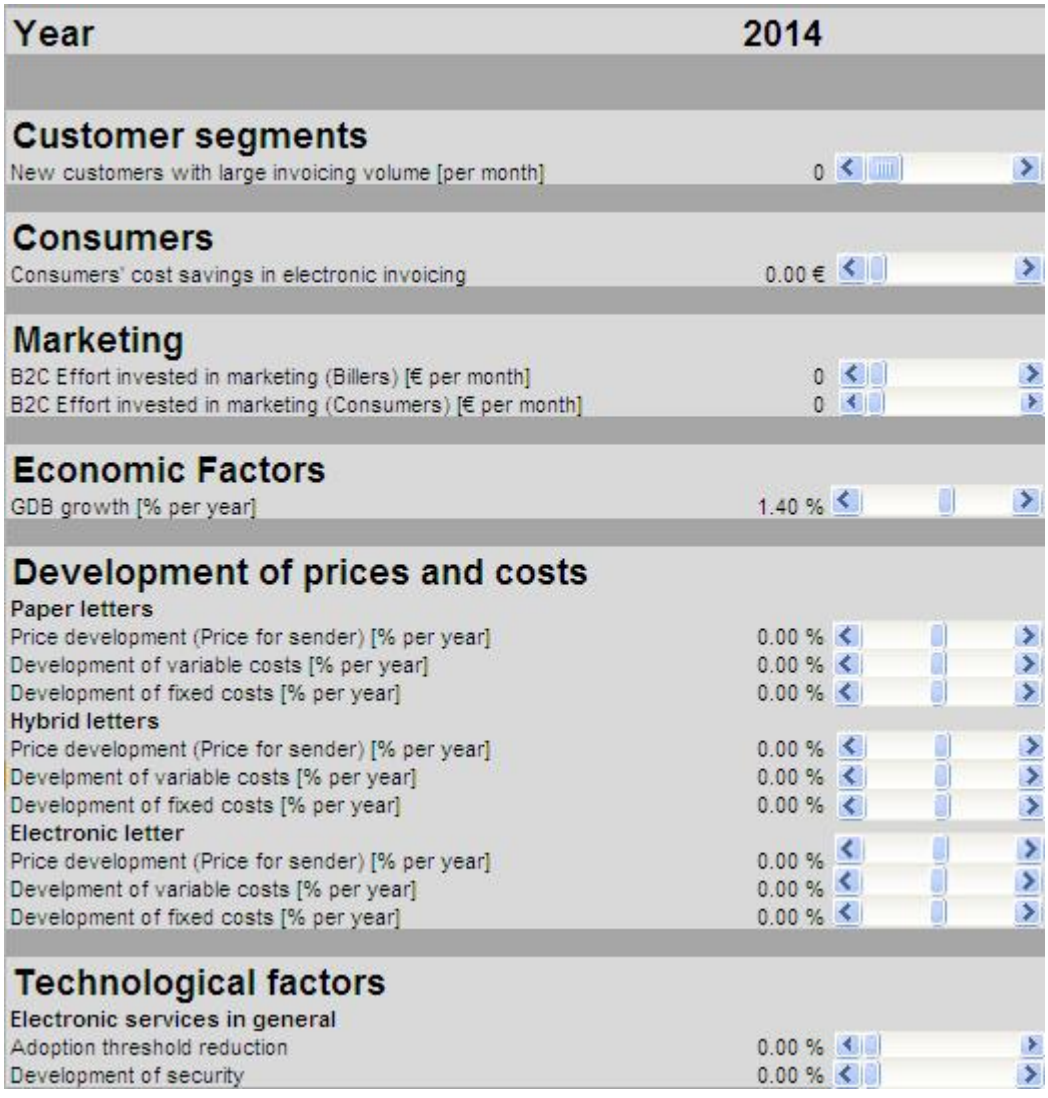

Figure 4. Input parameters for the scenario generation.

Results

An example scenario in the B2C sector can be seen in Figure 5. The left graph shows the volume of traditional paper letters, which declines soon after 2008. The reason for the decline in traditional letters is the rapid development of e-invoicing and letters. The development of the e-invoicing volume can be seen on

the right graph. It is an exponentially increasing curve and it shows no sign of ceasing. Eventually, as traditional letters are replaced for the major part by electronic ones, the growth slows down.

The model was found to be sensitive to the word-of-mouth effect as it is an essential part of a positive feedback loop. The sensitivity can be a feature of a model or of an actual system. This requires further elaboration.

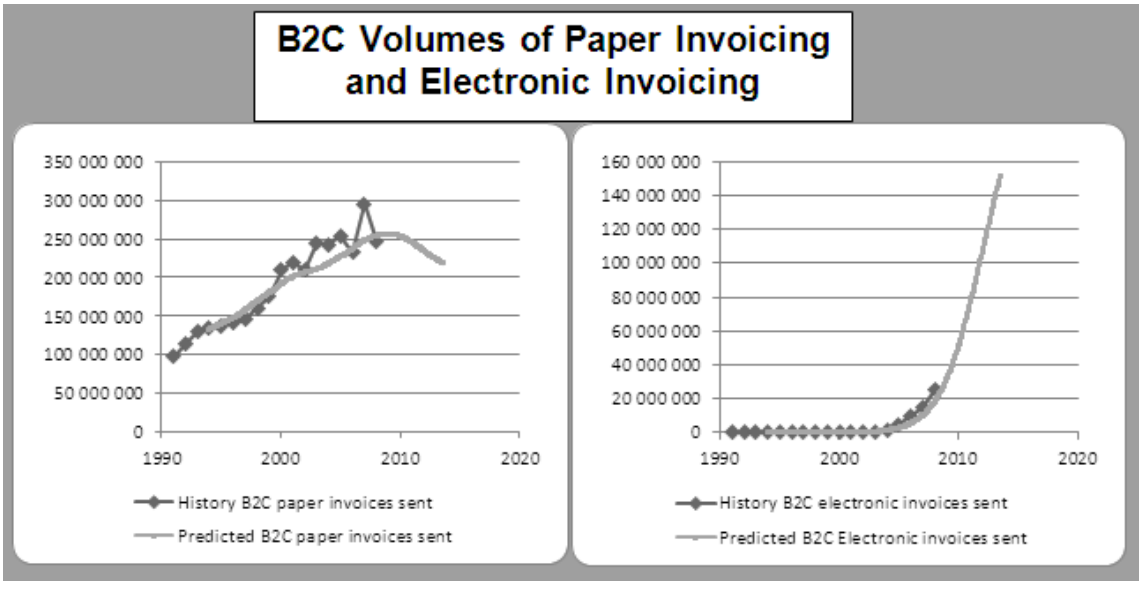

Figure 5. Example scenario.

Discussion and Conclusions

The research described in this paper has served as a proof of concept for a systemdynamic approach to understanding the dynamics of the e-invoicing markets. The model was used to simulate various scenarios under different circumstances. The generic model structure makes it possible to use the same model with different parameters when studying the situation in different countries.

The dynamic model presented in this paper facilitates systemic understanding of the phenomenon of e-invoicing adoption. It outlines the further elaboration and prediction of the system. Moreover, it produces a synthesis of the whole electrification process.

Acknowledgement

The research was funded by Itella.

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Structural modelling of maintenance services

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Abstract

Maintenance services are complex systems that require a wide perspective in order to comprehend the real value and achieve the optimal level of service performance. Computer-aided models enhance understanding of the dynamic complexities arising from feedback, time delays and non-linearities. A System Dynamics approach is used to capture the complex structures as well as to explicitly incorporate mental models into policy analysis and design. Due to the difficulties of creating and maintaining extensive models, it is imperative to encapsulate structure into logical entities. In this paper, a hierarchical model comprised of reusable modules is presented.

Introduction

Maintenance services comprise technical, economical and managerial aspects that form an intricate network of supportive functions. System behaviour derives from the interaction of these functions – monitoring, finance, human resources, etc. – and not from separately planned actions. In fact, even maintenance services as a whole should be viewed as part of a larger interrelated system involving several stakeholders. Productivity, reliability, product and service quality, and total operating costs are all ultimately affected by maintenance activities. Simplifying a complex system into isolated components often leads to lower overall performance, as the optimization of individual components only defers problems in other parts of the system.

The complexity of maintenance services is not limited to the number of components and stakeholders within the systems. Feedback, time delays and non-linearities in, for instance, staff training, cause dynamic complexity where actions and their effects are far apart in time as well as space. Human limitations to comprehend the perplexity of maintenance management and the trade-offs between different maintenance policies make achieving the optimal level of system performance extremely challenging.

Computer-aided model formulation and simulation enhance learning and understanding of the underlying dynamic complexity. The use of formulated maintenance models serves as a playing field to test and develop different policies and study the benefits of maintenance services. However, creating a reliable and accurate model of a complex maintenance system is highly time-consuming and costly. Although they have potential [1], fully generic parameterized models lack the customizability and accuracy needed for most challenges faced by maintenance service providers. New models are usually constructed from scratch – partly due to the lack of a mechanized way of making use of previous work – to answer the problems of a specific client. Exploitation of reoccurring patterns, however, makes it possible to formulate modules – building blocks – that can be reused and modified to correspond to different needs. This article aims to illustrate the use and development of these generic patterns and show how they can be used for service process analysis and design.

Encapsulation

A System Dynamics approach is used to capture the feedback and dynamic structures as well as to elicit and represent the mental models [2] of maintenance services. The purpose is to understand complex behaviour of organizational processes and practices over time. The easy-to-understand characteristics of system thinking – emphasizing the relationships and interactions between components instead of the actual mathematical implementation – make it a natural tool for formulating encapsulated modules.

Traditional System Dynamics models do not aim to generate a highly accurate quantitative result but rather try to support decision-making by facilitating learning, in which case the accuracy gained by adding more variables or elements is insignificant compared with the increased complexity. Nevertheless, there is

demand – as in the case of maintenance services – for more comprehensive dynamic modelling of operational business processes. Detailed models combine many of the various structures presented in other, more simplistic models [3] and hence gain most from reusable building blocks.

Due to the difficulties of creating, comprehending and maintaining extensive models, it is necessary to encapsulate structure into logical entities. In addition to merely combining and encapsulating elements into modules, a structural approach is necessary to reflect the high-level structure. The structural notion can be viewed as a way of seeing and implementing models based on the idea that every model is a composition of distinct elements, which are either rudimentary or defined by other elements, giving rise to a hierarchy.

Object-Oriented Programming and software engineering concepts, such as objects, classes and inheritance, are applied to maintenance modules to improve maintainability, flexibility and reusability. The interdisciplinary approach between Object-Orientation and System Dynamics has attracted interest [4, 5], but it has yet to achieve its full potential. With only a few models implementing the interdisciplinary approach, practical ways of using object-orientation in the System Dynamics field have not been fully developed: they are still evolving.

Model construction is carried out using Simantics System Dynamics [6], an open source simulation and modelling platform. Simantics supports hierarchical modelling and module libraries [7] – both of which are essential to structural modelling of complex systems.

Maintenance management

As companies try to gain competitive advantages and focus more on their core businesses, the demand for maintenance services and expertise is growing in many industrial sectors. Outsourcing of maintenance activities to the equipment manufacturer or a specialized industrial maintenance provider often achieves mutually beneficial outcomes. The manufacturer has the most comprehensive knowledge of the performance and requirements of the equipment and can design a maintenance strategy accordingly, whereas a general service provider is an expert on maintenance management.

A proactive maintenance strategy will reduce the need for unexpected repairs and downtime by anticipating malfunctions to extend the operating life of equipment. Direct condition monitoring, analysis of maintenance records and

equipment lifetime expectancy assessment should be considered in order to develop an efficient and effective long-term maintenance plan for each equipment type. In most instances, efficiency is measured and rewarded based on the performance of individual departments, resulting in quick solutions (e.g. hiring uncommitted workers from leasing companies or low-cost labour markets) that neither last nor deal with the underlying problems (e.g. job satisfaction).

The equipment condition, total operating costs, resource allocation, system performance, human resources, market demand, and other key performance indicators are all main components of maintenance services. These modules capture the key aspects needed for maintenance policy analysis and design. Although, they are not all necessary to address specific problems, these subsystems form a basis that allows domain-specific details to be added. The level of depth is encapsulated in hierarchical layers of nested sub-modules (as shown in Figure 1) implemented in the Simantics model library. Many of the modules are based on subsystems described in [2, 8, 9] with the exception of dividing structures into more logical segments and several hierarchical levels.

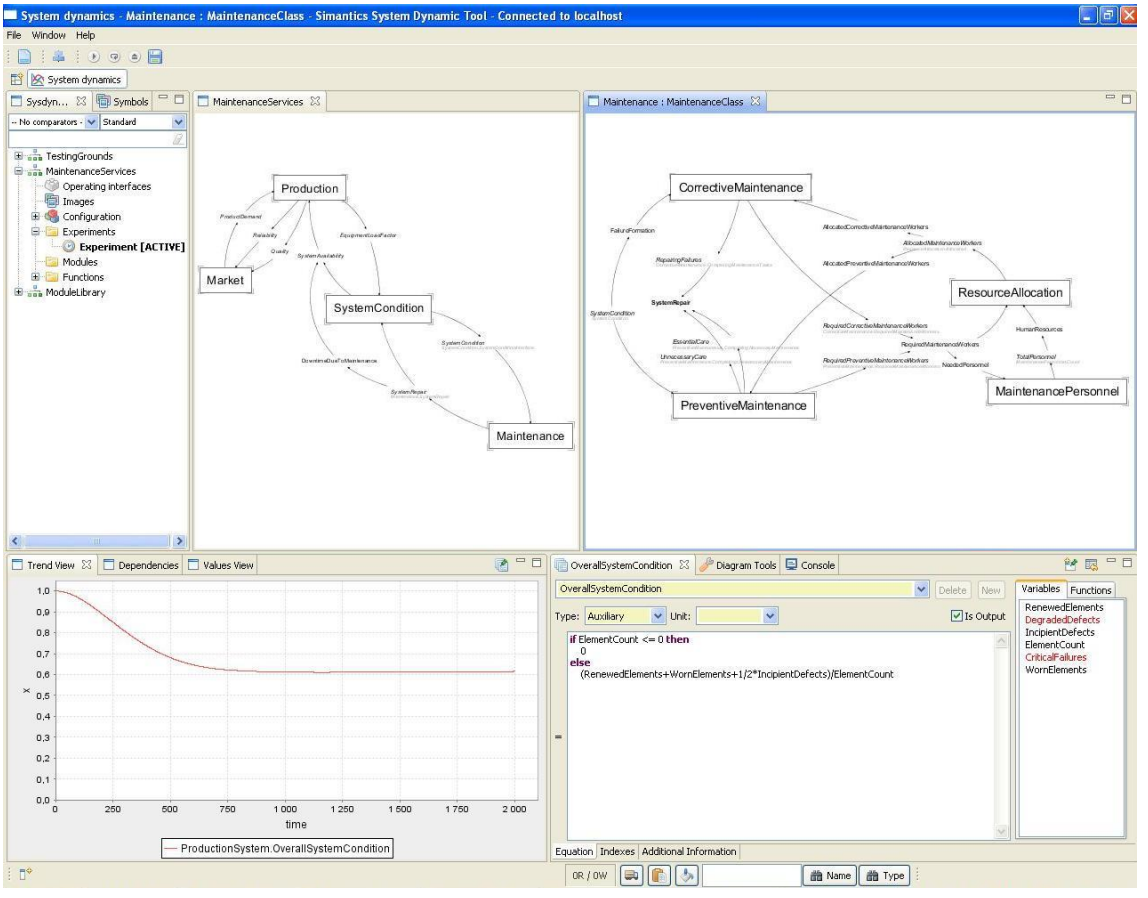

Figure 1. High-level structure as seen in Simantics.

The duration and quality of a maintenance task depends heavily on the workers – their knowledge, experience and productivity – who are assigned to it. Human resources are one of the most important assets of maintenance services but also the most complex to manage. For example, always assigning the most skilled or qualified workers available to difficult and critical tasks may be cost-effective in the short run but unfavourable in the long run as less skilled workers do not acquire the necessary expertise while performing routine tasks. The formulated modules give managers a way to incorporate soft variables, such as worker experience and commitment, explicitly and openly into decision-making.

During the recession of the late 2000s, many organizations were forced to downsize and cut costs of uncritical operations. Now, as the demand for services grows, maintenance providers are struggling to acquire and hold on to experi-

enced personnel. Uncommitted employees, although not necessarily looking for more satisfying employment contracts, are likely to seize new opportunities if they present themselves. In the short term, it may be adequate to handle human recourses on a fixed spreadsheet, though a dynamic approach is needed to ensure the supply of the right personnel and the accumulation of the required skills.

Figure 2 shows a detailed sub-model for addressing and exploring human resource management challenges. The higher level module (on the left) is a modification of a basic promotion and learning curve chain [2, p. 491]. Every personnel group in the promotion chain has a more detailed model, however, describing the dynamic behaviour of experiences and skills that affect the maintenance quality and duration.

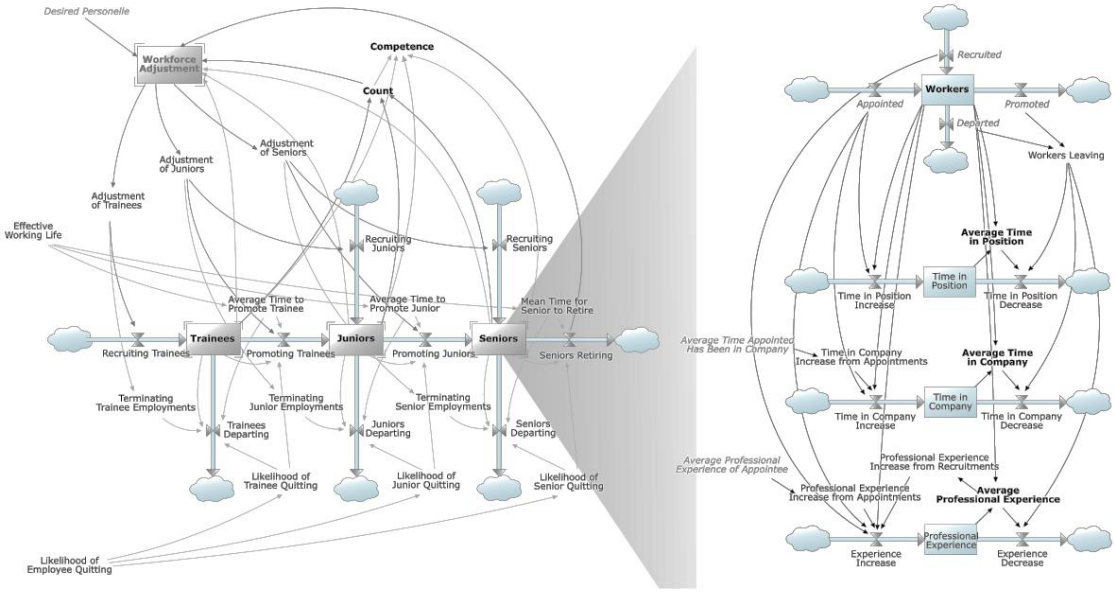

Figure 2. Detailed workforce structure.

Discussion and conclusions

The modules and object-oriented concepts used preserve the fundamental features – simplicity and transparency of model construction – of System Dynamics modelling. Nonetheless, modularization slightly shifts the focus from modelling a problem [2, p. 89] towards modelling a system. In order for the module users

to limit the factors taken into account to those that were relevant to the problem at hand, the building blocks needed to be lightweight and have high cohesion. That is to say, a module should only include elements that are part of the entity it tries to encapsulate.

Formulating the required level of genericity – neither too generic to address any real problems nor too specific to be applicable in only a few specific cases – into the building block is quite challenging. The development of premade components is an iterative, never-ending process in which modules in a model library are updated as errors and new requirements emerge. Hence, the ideal level of depth becomes clearer as the modules are applied to a wider variety of problems. These partly over-ridable modules of repairable systems ensure appropriate and easy use of the encapsulated structure. However, the new way of structuring large models does not force anything but rather offers the possibility of gradually adapting more advanced features.

Exploitation potential

Establishing a library of pretested and pre-validated modules will greatly improve the maintainability and reusability not just of maintenance service models but also of all complex models in general. It will also help the manager and other business professionals, who are not trained modellers, to build models and participate more closely in the modelling process. This will give practitioners who want to improve their maintenance processes or share knowledge between stakeholders a better understanding of the dynamic complexities they face. The transfer of experience and knowledge gained while constructing a model is often as important as the simulated results.

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Procurement of ICT services for schools – towards a decentralised process for the benefit of stakeholders and the environment

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Abstract

The aim of this research was to evaluate modern ICT procurement practices and ICT deployment in Finnish-speaking schools in the Municipality of Kauniainen. The main idea was to procure ICT services rather than hardware. The school administration defines the needs of schools and procures the services through competitive tendering. The first phase of the research was to review the previous problems associated with the old practices. The second phase was to assess how the new practice has affected the service level, costs and environmental aspects of ICT in schools. The results show that the procurement of services rather than hardware has proved to be the right decision: service levels have been improved, costs have been reduced by about 40% and, due to a longer life cycle for workstations and reduced electricity consumption, the environmental load has been cut by about 50%. The model adopted in Kauniainen requires the schools and school administration to have the skills and expertise to define their needs and the competencies to prepare and execute the procurement process. The most important prerequisite seems to be political will at local level to grant the school administration the freedom to choose the right kind of ICT service system to fit its needs.

Introduction

Schools are taking big steps towards adopting ICT in learning, teaching and various education processes. ICT is part of everyday life for today's young pu-

pils, and teachers face a challenge introducing new technology in the classroom and as educational tools. Municipalities govern the schools as well as the procurement processes of ICT, which are then implemented in schools.

The national plan for ICT in education [1], published in late 2010, defines the strategic policies and proposed measures for the educational use of ICT. There is still much room for improvement in the deployment and use of ICT. In this respect, Finland could learn from the experiences of other countries, such as Singapore, where ICT has determinately been taken inside the schoolrooms as a tool for both pupils and teachers [2].

According to the national plan, ICT procurement should be carried out as a comprehensive process involving both users and service providers (see also [3] and [4]). The ultimate goal is a systemic change resulting in a brand new way of procuring and using ICT. An example of such a non-mainstream, new approach comes from the City of Kauniainen, where service procurement in Finnish-speaking basic education has been decentralised and cooperation partners now work more closely with the school as providers of various services through competitive bidding processes.

This paper tells the story of Kasavuori School and shows the impacts of the decentralised approach, in which the school defines the ICT services and their quality level independently. Different aspects of the impacts on working time efficiency, level of service of ICT, economy and user satisfaction are analysed with different methods and then summarised. The paper is based on a VTT report published earlier in 2011 [5]. It was written in connection with a national project (OPTEK) carried out in 2009-2011, which focused on the everyday use of learning technology in schools. A multidisciplinary cooperation project involving 13 research units, OPTEK, was carried out in close collaboration with 28 companies and schools from 12 municipalities. The project results included operating models and solutions for innovative application of ICT in Finnish schools.

Objective and implementation of study

The goal was to provide an overall description of the current state and development needs of IT in basic education, as well as to assess the impacts and generalisability of the new procurement and deployment model that Finnish-speaking

schools in Kauniainen have used for their IT services since autumn 2007. This report focuses on assessing the impacts of the service procurement and deployment model. The assessment emphasises the quality and cost-effectiveness of workstation services used in basic education, as well as the life cycle of equipment. Pedagogical impacts were not included in the scope of this study.

Research methods differed depending on the research stage. The first stage – a general survey of issues and the overall situation – was carried out through interviews with 28 experts and decision-makers (including staff from the municipal education sector, national educational administration officials and business representatives). Material collected through thematic interviews was used to create a picture of the general current state of using ICT and the problems and challenges related to it. This was used as a starting point for the study, as the same problems were also present in Kauniainen.

In the second stage, the new procurement model (giving schools greater autonomy in ICT purchases) and deployment approach that were adopted in the Finnish-speaking schools in Kauniainen in autumn 2007 were compared with the previous traditional approach, in which the implementation of basic ICT services was handled and provided by a municipal ICT unit. The procurement models were compared both in terms of the service level achieved and the operating costs incurred. The cost analysis was based on accounting records of Kauniainen's educational administration and ICT unit. In addition, savings in external costs achieved using the Kauniainen procurement model were evaluated using literature references. These externalities were mainly considered to comprise environmental expenses.

The impact of the services was evaluated indirectly by measuring the service level achieved in different procurement models, as well as by applying a preliminary assessment system for educational IT services. This system, interactively produced in the OPTEK project [6], includes criteria, indicators, key figures and methods supporting service assessment.

In addition to thematic interviews, the study involved several discussions, with the staff of Kasavuori School in Kauniainen serving as case example. Discussions were also conducted with service providers (Opinsys Ltd., IBM) as well as with representatives from the Kauniainen ICT unit. Figure 1 depicts the stages of the research process, along with the methods and materials used.

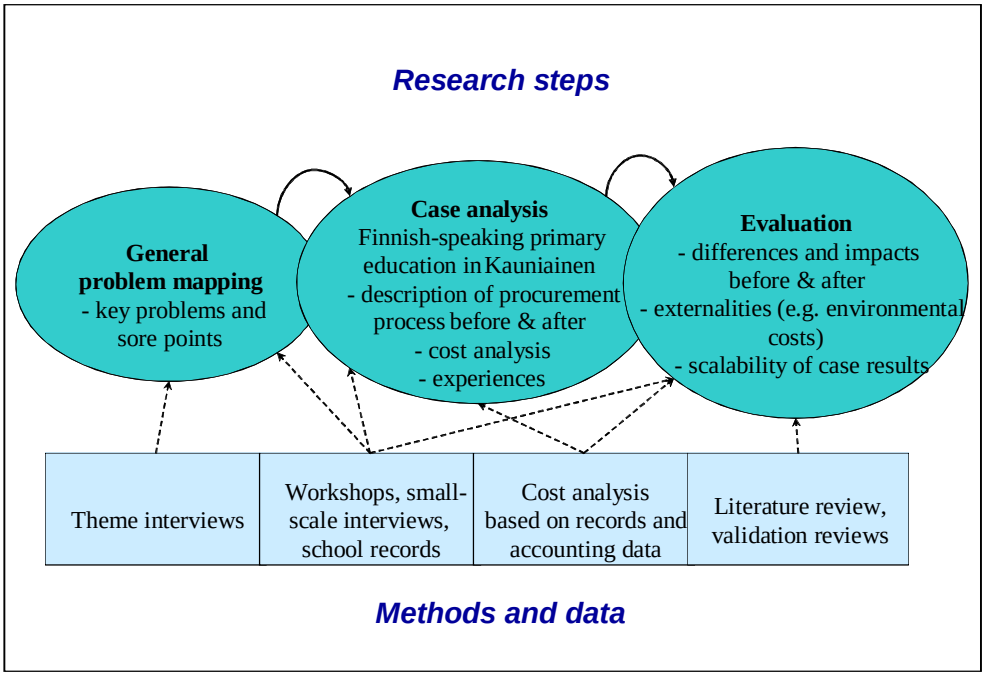

Figure 1. Stages, methods and materials of the research process [5].

Description of procurement models

Traditional procurement model

Prior to 2007, the ICT services used in schools were supplied by the City of Kauniainen's own information management unit. The unit was in charge of workstation procurement, installation and disposal; maintenance of workstations and applications installed on them; maintenance and development of internal school networks and the fibre network connecting city offices; and maintenance of the server environment for school networks. The city's budget included the costs of annual computer and IT appropriations for individual schools, and it was used to pay for, among other things, new servers, workstations and network equipment, as well as for spare parts for existing equipment. The budget for the schools' computer and IT appropriations was also used to pay for operating system and software package expenses as part of the price of workstations with which the systems and packages had been ordered. The traditional operating model is illustrated in Figure 2.

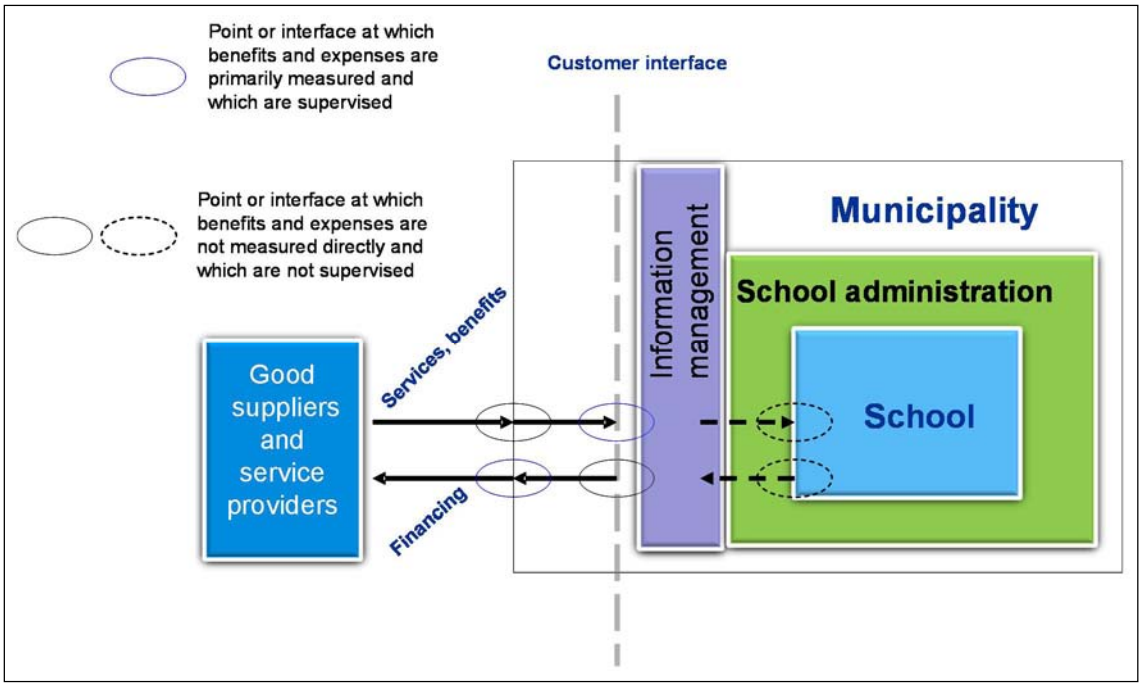

Figure 2. Traditional ICT procurement model in schools [5].

In the traditional model, the municipality's own information management unit supplies IT services to schools. The unit makes the required purchases from private companies and puts together the service it offers the school. The content of services offered by the information management unit is often decided in negotiations conducted between the school and the unit. The services that the information management unit produces itself or outsources to other companies are often selected on the basis of decisions made in the unit or in line with the municipality's ICT strategy. In this model, the school may not be able to affect the features or prices of services offered by the information management unit. If IT service expenses are not fully visible at the level of individual schools, it is difficult for those making decisions in the schools to formulate a reliable assessment of the cost-effectiveness of services and the cost of operations in relation to the benefits achieved.

New procurement model and deployment

In 2007, basic education provided in Kasavuori School in Kauniainen underwent a process change in which the procurement of ICT equipment and services was transferred from the information management unit to the schools. The main difference compared with the traditional model is the schools' strong role in defining their own needs and planning procurement. A school-specific ICT team presents its proposals concerning the school to the steering group of the Finnish-speaking school administration, which decides on procurement and development (coordination and harmonisation of needs). The school administration procures the services and equipment needed by schools from companies following a competitive bidding procedure and negotiates the agreements concerning the purchases. The municipal information management unit was also relieved of its budgetary responsibility for purchases. Service and equipment expenses are now paid directly from the schools' own assets instead of being managed by the information management unit. This has resulted in more active cooperation with private companies as concerns the organisation and management of ICT in schools. The ICT service procurement model adopted in autumn 2007 is illustrated in Figure 3.

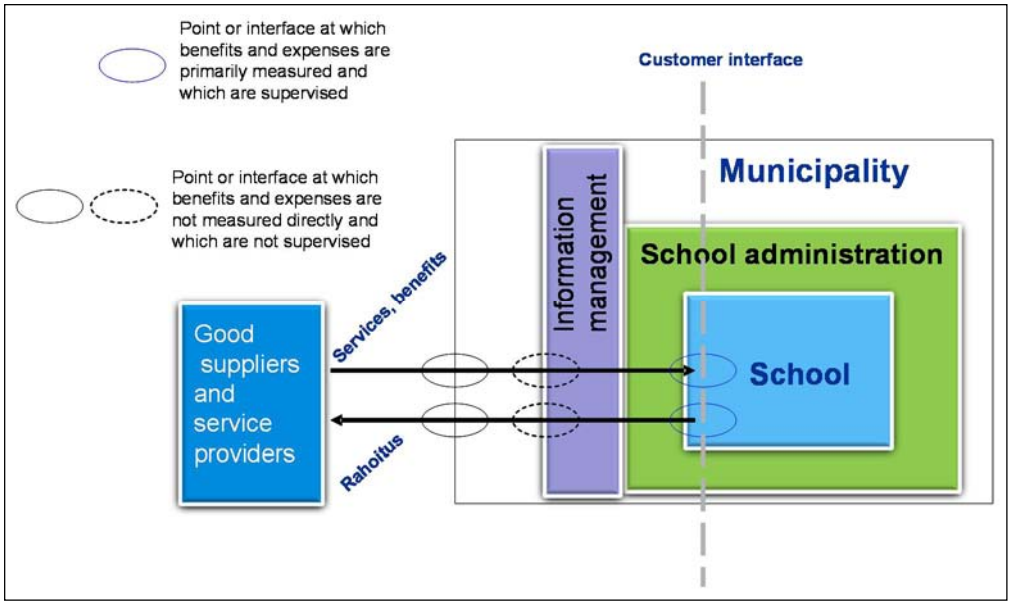

Figure 3. The IT service procurement model adopted by Finnish-speaking schools in Kauniainen in autumn 2007 [5].

The server and network-oriented deployment approach adopted in autumn 2007 also differs considerably from the previous solution in which applications launched by users were run on Windows-based workstations. In the current system, most of the workstations start up online via servers. Open-source desktop software and applications are centrally located on servers. Essentially, the new deployment approach makes efficient use of old equipment, which has doubled the useful life of workstations used for teaching purposes.

Results

Experiences at schools

According to school teachers and the educational administration, the new procurement model led to a server-oriented architecture and a clear improvement in ICT services. The services offer a better match with user needs, the devices work more reliably, the proportion of devices out of use due to malfunction has decreased, delays in the installation of new equipment have shortened and workstations are quicker to start up.

Prior to the adoption of the new operating model, teachers found the biggest problem to be the large proportion of faulty or defective workstations, which led to a considerable amount of wasted time in teaching. The long time (up to 15 minutes) required to start up a workstation or log onto it at the beginning of each lesson would sometimes affect the same teacher and students several times a day. Following the adoption of the new server- and network-based deployment, the cold start-up (first start-up in the morning) of workstations takes a maximum of two minutes and all subsequent start-ups are performed in a matter of seconds. That is to say, the amount of wasted time has been reduced considerably: by as much as 13 minutes for cold start-up.

Financial impacts

The financial impacts of the schools' ICT services were examined by analysing the development in expenses and number of services in the current procurement model from 2007 to 2009 in Finnish-speaking schools in Kauniainen, as well as by comparing these figures with the IT service expenses and the number of services produced in Swedish-speaking schools, which kept to the traditional mod-

el, in 2009. The expense calculations focused on the proportion of expenses generated by workstations in the pupil network. The basic data used in the expense comparison and the calculation proper are presented in greater detail in a separate VTT research report [5].

Despite the rise in overall ICT expenses, the number of workstations in relation to the number of pupils has increased and the unit expenses calculated per workstation have decreased in Finnish-speaking schools (Figure 4). The survey of ICT expenses and service level indicators showed a clear difference in cost-effectiveness in favour of Finnish-speaking basic education compared with Swedish-speaking basic education, which kept to the traditional model.

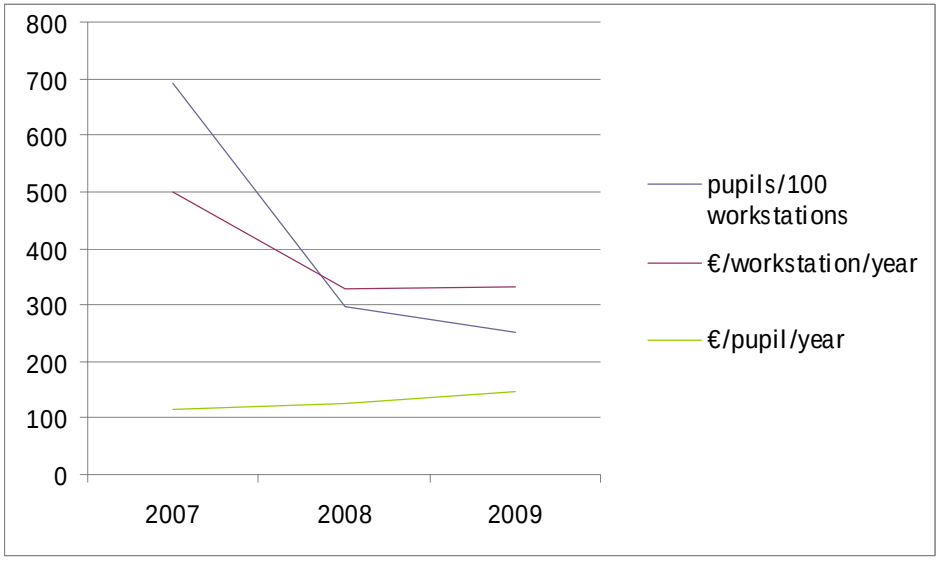

Figure 4. Development in the number and unit expenses of workstations from 2007 to 2009 in Finnish-speaking schools in Kauniainen [5].

A procurement model based on the purchase of entire service packages combined with a server and network-based deployment model have generated clearly measurable benefits. The expenses per workstation in Finnish-speaking schools are about 37% lower than those of Swedish-speaking schools, which still follow the old procurement model. This translates to annual savings of €100,000 in the productivity of workstation services (in 2009). The savings are likely to be even bigger, as the cost calculation for the new model also includes the expenses for

system set-up but does not take the achieved reduction in wasted time and environmental load into consideration.

After basic investments, the server-based architecture offers even greater savings potential in the long term. In the past year, for example, Finnish-speaking basic education has received workstations from health centres free of charge and also used workstations from Opinsys Ltd at €80 per workstation. The two sources have each provided approximately the same number of workstations. The estimated useful life of these workstations is around four years, which means that future equipment expenses could drop to as little as €10 a year (average acquisition price of €40 and useful life of four years).

Ecological impacts

The increased average life cycle of workstations has also reduced the environmental load. To give an example, the manufacture of a single laptop is estimated to result in 500 kg of net waste without recycling and 93 kg when recycled [7]. According to another example [8], the carbon footprint (CO_2 equivalent) of a single laptop is 150 kg for manufacture, around 20 kg for transportation and some 65 kg/year for use. If the Finnish-speaking basic education in Kauniainen (with 529 workstations in 2009) were to follow its previous operating model, it would purchase an average of 176 new computers a year, which would result in an annual minimum of 16 tonnes of recycled waste and a 30-tonne carbon footprint (CO_2 equivalent) in terms of the manufacture and transportation of workstations. The current deployment model doubles the life cycle of workstations and thus halves the environmental load described above. The environmental load caused by workstation use is more or less the same in both models.

The above-mentioned source discussing the carbon footprint does not indicate how far back in the manufacturing chain the calculations extend. Another interesting question is where equipment leased on a three-year contract ends up after the contract terminates. Workstations that have served Finnish-speaking basic education in Kauniainen for six years are delivered to an environmental waste management company for disposal/recycling.

Environmental expenses can be calculated using different kinds of unit prices per tonne of CO_2. The Nord Pool spot price ranged from €10 to €15 in 2009 emissions trading [9]. The unit price used for estimation purposes in traffic projects is €37/tonne of $C0_2$ [10]. Using the latter unit price for calculations, the deployment solution currently used in Finnish-speaking basic education in

Kauniainen has resulted in annual savings of some €1,100 in emission costs. Even though external expenses only account for a minor share of the overall benefits, they should still be emphasised, since their pricing is largely related to valuations and affected by, among other things, climate change issues.

The server and network-based deployment model has also reduced the use of electricity: the consumption per workstation (when running) has dropped, the automatically scheduled, centralised workstation shutdown system saves power (and relieves the school staff from checking classrooms and turning off workstations), in addition to which the need for air conditioning in teaching facilities has reduced. The power consumption of servers has increased slightly, but the impact of this is small on the whole. Moreover, only half of the servers are kept running during holidays.

Conclusions

The procurement of services rather than hardware has proved to be the right decision in Kauniainen. Due to the new architecture solution and service-level definitions, service quality has been improved, costs have been reduced by about 40% and, due to the longer life cycle of workstations and reduced electricity consumption, the environmental load has been cut by about 50%. The traditional procurement model did not facilitate the above-mentioned solution and benefits. The model adopted in Kauniainen, however, requires the schools and school administration to have the skills and expertise to define their needs for the service providers and the competencies to prepare and execute the procurement process, which still has to follow public procurement rules. The most important prerequisite seems to be the political will at local level to grant the school administration the freedom to choose the right kind of ICT service system to fit their needs.

Therefore, clever use of ICT does not necessarily mean more ICT or the most advanced ICT. This depends, of course, greatly on the procurement skills. There needs to be a shift in not only responsibility but also skills. In the long run, this will increase innovative individual solutions in different schools. It is the role of the national educational authorities to make sure that such innovations are spread across the country, rather than to try to exert too much control over the models of how ICT is deployed in different schools and parts of the country. Decentral-

ised procurement also has strategic consequences if adopted widely. Small service-providing companies are in a good position to find a new market in the educational field. On the downside, a lack of transparency presents a risk when schools make their own decisions on ICT equipment and service procurement.

A decentralised approach could be ideal for small markets and in, e.g., a developing country environment. It creates a small market of its own and relies on small service providers and retailers. Economies of scale are largely lost, but quality control and level of service are enhanced.

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Risk management and service business development

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Abstract

Designing attractive and efficient service concepts is a prerequisite of business success. The development of business through service excellence is one way of surviving the competition while increasing service quality and the related customer loyalty. Managing risks is an essential part of service business management. Risks related to, e.g., quality of services, service cost-effectiveness, available resources for service development, and service contracts, need to be taken into account. The traditional emphasis in risk management has focused on protecting the system and its users from the failures in the system. When considering the performance of a system in its larger commercial and political environment, uncertainty may provide opportunities as well as threats. Therefore, it is important that risk management take into consideration both of these aspects of uncertainty. The key research question of this paper is how to develop new service business and at the same time take into account both threats and opportunities related to the new services.

Introduction

Moving towards service-oriented business models introduces new risks that must be taken into account in the development of new services. There is a need to consider risks in customer collaboration, information exchange between service value network partners and capabilities related to collaboration and communication. Moreover, there are internal risks related to capabilities required by the high-intensity customer relationships of the new services as well as to external

risks that include, e.g. how customers are willing to share critical information needed for the successful delivery of new services [1].

Service value is created in a network context, and the structure and dynamics of the value network and customer expectations influence the complexity of service delivery. This needs to be taken into account when considering the management of risks. Value for customers is created at the network level, at which each network partner contributes incremental value to the overall offering. Network actors contribute to the value creation process by focusing on their core competencies and by cooperating with other network actors, such as suppliers, partners, allies and customers, through various value constellations [2].

ISO/EIC Guide 73 defines risk as the 'effect of uncertainty on objectives'. Effect is a deviation from the expected and can be positive or negative [3]. Risk management is about improving business performance via systematic identification, appraisal and management of business-related risk. In addition to downside risks, improving performance also covers exploiting opportunities or favourable possibilities – upside risks. In service business management it is important to take risks into careful consideration, e.g. during the transition process of an organisation from a manufacturer to a service provider [4]. Furthermore, as competition is increasingly happening at network level, it is challenging to identify threats and opportunities that may arise and to act on them.

The aim and structure of this paper

The aim of this paper is to present an approach for developing new service business and, at the same time, take into account threats as well as opportunities related to the development of new services. First, the paper discusses risks and success factors in new service business development based on existing literature. Next, a case study presents an approach for managing risks in new service development. Finally, the benefits and challenges of the approach are discussed.

Risks and success factors in new service business development

In order to manage risks systematically, organisations typically apply formal risk management methods and procedures. In addition to formal practices, organisations need to increase flexibility to absorb the unexpected and to be prepared for

the uncertainties that cannot be assessed beforehand [5,6]. The understanding of risk and uncertainty management has been based mainly on linear models that describe how various risk events are present in considered business activities. These models provide valuable information on why firms should manage risks but less information on how they should turn the incentives to manage risks into actual decisions on the choice of risk management measures, how risks change and how the risk management strategies evolve over time [7].

It has been argued that with formal risk management practices, companies actually try to organise an area in which complete control is not possible. Approaches developed for ensuring business continuity help companies identify potential impacts that threaten a business, and provide a framework for building resilience and a capability for effective response that safeguards the interests of its key stakeholders, reputation, brand and value-creating activities [8].

Risk management is an important part of business continuity management and it provides a way to identify and manage the various sources of uncertainties that can give rise to threats that, at worst, can end in failures but which can also lead to opportunities and success. Factors that affect the development of new service business positively are critical if an organisation wants to succeed, but if they are ignored or they fail, there is a risk that the service development may fail. Therefore, risk can be considered as the 'other side of the coin' to the success factors [9].

The foundation of quick and effective service development is based on the strategic operation choices made regarding the use of teams, information technology and the process design of new service development [11]. In addition to these, success factors that influence new service development include, e.g. management support and involvement of managers and other employees, interaction with customers, skilful project leaders, and a formal new service development process that also has some elements of improvisation. Besides external communication, it is important to manage internal communication among the company's personnel [e.g. 12, 13, 14, 15].

The role of customers has been recognised as especially important, and the more successful new service developers have typically made more use of information about the customer in idea generation, business evaluation and marketing plan preparation [15]. Understanding the customer is said to be the key to commercial success and, therefore, when developing and launching new services, attention should be paid to the customers' needs, expectations, usability process, quality perceptions and values. The service culture and strategy of a company

should be customer-centric and in line with customers' values and priorities. It is also important to involve the customer in the actual development process. Besides customers, however, the company needs to monitor and understand the market and future trends [13]. De Brentani [16] also stresses the importance of ensuring an excellent customer/need fit by developing an intimate knowledge of customers. In the study of the so-called global success factors that govern the outcome of new service ventures, regardless of their degree of newness, the findings also emphasise involving expert front-line personnel in the process and implementing a formal and planned launch programme for the new service [16].

Different success factors are emphasised at the different stages of the new service development process. Johnson et al. [10] present new service development as a process cycle that has four stages. In the development stage, new ideas are screened and winning concepts developed and tested for feasibility. The first steps of the new service development process, in particular, require deep understanding of the customers' production, business processes and needs [e.g. 17]. Concepts that pass the development stage are considered in the analysis stage to determine their potential as part of a profitable business venture. Successful concepts then move to the design phase where a new service product and process are created and field-tested with appropriate personnel training and a marketing campaign. Finally, a proven new service is given a full launch. According to Johnson et al., the new service development process is driven by enablers that include cross-functional teams, tools and an organisation context that includes a culture of accepting innovation [10].

Given the emphasised importance of customer orientation and customership in the service business development process, however, there are also great challenges and risks in the collaboration between the customer and supplier as well as in the activities of the service network [10]. Possible obstacles may also relate to a lack of information about specifications, goals and markets, uncertainty about the sponsor, difficulties in dividing responsibilities, resource allocation, and a lack of systematic documentation, reporting and feedback [12]. Besides these obstacles and challenges, the aforementioned success factors also need to be considered in order to be better prepared to make use of the opportunities and avoid the pitfalls and risks when developing new service business.

Based on the literature review, new service design is a process that needs to be formalised and carefully considered from the risk management perspective. When identifying and assessing threats and opportunities related to the new service design, it is important to take the following topics into account:

- Strategic choices regarding teams, process design and information technology
- Management support and involvement
- Resource allocation
- Customer interaction
- Service value network structure and relationships
- Market and business environment.

Case study

Case study objectives

The methods used in this study were a literature review and a case study. The literature review focused on studying existing literature on how the development of service business should integrate risk management. The case study is the preferred strategy when 'how' or 'why' questions are posed, when the investigator has little control over events, when the focus is on a contemporary phenomenon within some real-life context and when new areas of research are explored [18,19]. The current, ongoing case study was started in autumn 2010 and it has been carried out in four companies, of which two are from the manufacturing sector and two from the real estate business. To understand the actual risk management processes in service business, specific service business cases were chosen from each company. The service business cases from the manufacturing companies concerned delivery of after-sales services and service business as part of new product offerings. The real estate cases were related to the development of rental services. This paper reports the results from one of the manufacturing case companies that aimed to widen its product offerings and develop new service business. The case company is currently in the development and analysis phase of the service design process and is moving towards the design and launch phase.

The data gathering in the case study has included interviews, working groups and workshops. First, the key personnel of the company were interviewed to find out the current status and the key development areas of the company. The interviews were recorded and transcribed. The data from the initial interviews were used to learn about the company and its current practices and key development

targets. The data were analysed to create an overview of the main challenges and strengths related to the new service business development.

The next step was to establish a working group with the company representatives. With this group, a series of workshops was organised. In these workshops, the threats and opportunities related to the new service business were discussed using various methods that included market study, PESTE analysis, business network analysis and roadmapping.

Results

The analysis of the case study data showed that the company had set targets for developing new product offerings and related new services. It was not clear, however, how these targets could be reached. The market potential had been analysed in the company but more detailed information about the market potential of the service business and, in particular, the international market opportunities was needed.

The study of the threats and opportunities relating to new services revealed that there were significant external and internal factors that the company needs to take into account when developing new services. The threats were related to reaching new customers, collaboration with new partners, failures to develop new product and service offerings, a lack of required resources and competence, and new competitors. The new services can provide opportunities to expand the customer base, increase revenue and form new, profitable partnerships and long-term relationships with customers.

The results of the case study identified the following key challenges related to managing risks in the development of new service business:

- Allocation of resources for the development of new service business
- Networking and forming partnerships required for delivering new services
- Designing the new service business offering
- Development of new technologies and related services concurrently
- Setting clear objectives for the development of new services
- Following changes in the operational environment.

Based on the results of the case study, the following key steps for managing risks related to new service business development were identified: 1) analysis of

the market potential of the new services, 2) analysis of internal resources and capabilities available for the service development, 3) analysis of external factors affecting the business environment, 4) identification of the key players and their role in the service business network, and 5) development of measures that mitigate threats and use the opportunities related to new service business.

Discussion

The aim of this paper was to present an approach for developing new service business and at the same time take into account both threats and opportunities related to the development of new services. Based on existing literature, the key factors related to success factors that can pose risks when developing new service business were discussed. The case study results indicate that service business changes the business and risk environment, forcing organisations to identify new risks and adapt their thinking on risks and ways of managing risks. The results from the case study show that it is important to explore both organisations' internal and external environment and their future development when analysing new services and related threats and opportunities. Risk assessment and management need to cover the whole service business value network.

Based on this study, a framework for integrating risk management into service business can be proposed. The framework includes five main phases: market potential analysis, internal resources and capability analysis, external business environment analysis, value network analysis and the development of risk management measures. In each of these phases, risks should be identified, their significance assessed and risk management measures designed and implemented.

The case study is currently being continued to cover the design and launch process of a new service development process. This will provide further results on how to integrate risk management to cover all phases of the development of new services. There are limitations on this research, as the study analysed one case company in depth, and the significance of the results to a broader organisational population can be questioned. The case reported in this paper is part of a multiple case study analysing risk management in service business. The analysis of other case companies will provide further evidence of the applicability of the results reported in this paper. There is a need for further research in which the approach proposed in this paper would be tested in practice.

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Services, open innovation and intellectual property

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Abstract

This paper describes findings from an interview study that focused on knowledge and intellectual property (IP) management in the development of service innovations with external actors. A few studies are available in literature on the protection of knowledge and innovation in service business, but aspects relating to open innovation are scarce in these. Our research question is therefore: How do service firms manage their knowledge and IP in the development of innovations with external actors? A qualitative multiple case study approach with semi-structured interviews with 14 service organizations was used in the study. The findings show that open innovation as such is actively used in service firms, and various forms of knowledge and IP management are linked to it. The result means that service companies and service innovations cannot be considered a unified group: it is necessary to understand the specific type of service and then consider the management of IP and open innovation for this type of service.

Introduction

Service innovation is the combination of technology innovation, business model innovation, social-organizational innovation and demand innovation to improve existing or create new service value propositions (offerings or experiences) and service systems [1]. In a complex service system (i.e. a dynamic value co-creating configuration of resources consisting of people, technology, organizations and shared information), service innovations are increasingly a result of interaction between two or more actors in the value network [2,3].

Many service innovations are intangible in their nature. The formal system for the protection of intellectual property (IP) has mainly been developed to cater for the needs of industrial manufacturing of physical goods. The intangible nature of many service innovations creates challenges for existing IP systems [4,5]. The protection of knowledge and IP, however, is as relevant in the service business as in the manufacturing of physical goods, as the imitation and copying of services may happen almost instantly once the new service has been launched on the markets. There are services and service systems that include elements that are not easily imitable [6], but for most service innovations the protection is essential. The challenge of protection is that formal IP rights cover only some of the elements of service innovation [4,5]. An additional challenge for the protection of knowledge and IP related to service innovations comes from the abovementioned fact that there are often two or more actors involved in the creation of service innovation. Service providers actively apply the paradigm of open innovation [2,3,7].

In this paper, we have studied how service firms manage their knowledge and IP in the development of service innovations. Few studies are available on the protection of knowledge and IP in service innovation and new business development [3,4,5], and aspects related to open innovation are scarce in these studies. The goal of this work is therefore to deepen understanding of the way service firms manage their knowledge and IP when their new services are developed with external actors.

Management of knowledge and IP in service business

The ways of protecting knowledge can, generally, be divided into three categories according to their formality: formal protection methods, which are often called intellectual property rights (IPR); contractual (semi-formal) protection methods; and informal protection methods. An overview of typical methods of knowledge protection in business is given in Table 1 (modified from the report by PRO INNO Europe [8]).

The studies by Miles et al. [4] and by Päällysaho and Kuusisto [5] on the protection of IP in the service sector reveal that, in addition to formal protection methods, contractual and informal methods of knowledge protection play an

important role. In that sense the situation is not different from that of firms manufacturing physical goods [9,10]. The difference between service and manufacturing firms is that service firms patent much less than manufacturing firms due to the intangible nature of services. In Europe, a patent describes the parameters of a technology (product or process) over which the patentee owns limited rights. Thus, the patent system is better suited to manufacturing than to service firms.

The works of Miles et al. [4] and Päällysaho and Kuusisto [5] provided a general overview of IP protection in a service context, especially in knowledge-intensive business services. They did not discuss possible differences between the service sectors. However, we argue that there may be great differences in knowledge and IP management between service sectors and even within a sector. For example, in the financial service sector, the service system and the value network of providing the service could be very different in classical banking service, based on face-to-face interaction, compared with novel on-line banking, based on virtual interaction through a web-site, or compared with the business incubation services offered by many finance actors. When studying IP management in services, particularly in the context of open innovation, the actual service system and the value network of the service should also be considered, and not only the sectors of service, in order to understand what opportunities and risks open innovation will bring.

Table 1. Common methods for the protection of knowledge.

Formal protection methods	*Contractual protection methods*	*Informal protection methods*
– Patent – Utility model – Trademark – Right to a commercial name – Copyright	– Prohibition of competition – Confidentiality – Recruitment freeze – Employee invention – Proprietary and access rights	– Secrecy – Publishing – Restricted access to information – Database and network protection – Confidentiality – Client relationship management – Loyalty building among personnel – Circulation of staff between tasks – Division of duties or subcontracting – Distributed product design – Fast innovation rhythm – Complex design

(Modified from the report by PRO INNO Europe [8])

Research question and methodology

The findings from the extant literature related to services and open innovation as well as services and IP management can be summarized in two statements: 1. service innovations are typically developed in interaction between two or more actors, and 2. the protection of knowledge related to these interactions goes beyond the formal methods of IP protection. With regard to the former statement, there are many studies describing the co-creation of innovation between the provider and the customer [11]. Recently, this perspective has been supplemented with analyses of the broader network and the value chain surrounding the dyad [12]. The literature does not go deeper into the combination of the two issues mentioned above (i.e. IP protection in a multi-agent environment), however, giving a motivation for the present study. Accordingly, the research question of the study is the following: *How are service firms managing their knowledge and IP in the development of service innovations with external actors?*

A qualitative research methodology – a multiple case study method with qualitative data – was used in the study as an in-depth understanding of a scarcely studied area was needed [13]. The empirical findings were based on semi-structured face-to-face interviews in 14 Dutch and Finnish organizations with their main business in services or, at least, with significant service business separated from their tangible product business. The case organizations were ABM Amro, Arcusys, Fugro, Kolster, KPN, the National Board of Patents and Registration of Finland, Nokia Research Center, NVI, Rabobank, Stevens Idepartners, Strukton Rail, Tamlink, Vebego and VTT. The after-sales and design services of the manufacturing firms were not included in the study as we addressed specific features of services, departing from knowledge and IP management related to tangible product business in which after-sales or design services were just 'add-ons' for the product business. The selected organizations were known to be innovative and among the leading companies in their fields of business. The firms represented different fields of industry and different firm sizes, bringing diversity to the empirical material. The interviewees were, specifically, senior corporate, R&D, business unit or IP managers. All the interviews were recorded and transcribed.

The analysis of the interview data was based on a computer-assisted analysis of the transcribed data combined with the notes garnered during the interviews. The interview findings were categorized during the analysis in order to gain a deeper understanding of the subject. We considered several factors as the criteri-

on for categorization, including sectors of business, size of organization, knowledge used in innovation, etc. Finally, we chose the categorization according to critical knowledge in service innovations and business because it seemed to best reflect the empirical data of the study. This categorization did not arise from the literature but from the empirical material.

Findings

When speaking about innovations related to their services, the managers of the interviewed organizations usually spoke about technological innovations (including software). These technological innovations were often developed together with an external actor. The knowledge and technology related to the innovation were either transferred to the service firm by some form of open innovation (buying of technology, acquiring a firm, licensing of technology, subcontracting the knowledge, etc.) or co-created together with a technology provider. The front-stage activities of the service, in which the interaction between the service provider and the customer takes place [14], were typically developed by the firm itself. However, they were often enabled by a technological innovation at the back stage of the service (consisting of all the activities related to the production of service other than the actual service interaction) applying some model of open or networked innovation. In some cases the technological innovation led to infrastructural changes at the back stage of the service system that enabled radically new services and business at the front stage.

Some interviewees mentioned customers (either firms or consumers) as an important source of ideas and feedback for innovations, but only in one firm did the interviewees consider customers as co-creators of innovations. The interviewees also mentioned that feedback from customers only gives rise to incremental improvements in existing services; it will not lead to radical service innovations.

All the interviewed organizations paid attention to the protection of their service business. In their inter-organizational relationships, they underlined contractual methods for the protection of IP. For example, confidentiality agreements were common practice in each firm. The organizations also actively used informal methods of knowledge protection in their innovation activities with external actors. Most of the interviewed firms had patents related to their ser-

vices. The patents covered technological or process elements of services, but, in general, the firms' interest in patenting technological or process innovations was low. Reasons for this included the short life cycle of many service innovations (which is not in favour of formal methods of IP protection) and difficulty monitoring and defending infringements of patents in service business. Although most of the firms were not active in patenting their service innovations, they could use other methods of formal IP protection. Most of the service firms were keen on formally protecting their brand by, for example, using trademarks. With regard to the protection of IP in inter-organizational relationships, our general findings are very similar to those of Miles et al. [4] and Päällysaho and Kuusisto [5] who did not address the inter-organizational aspects of service innovation protection.

In order to go deeper into the subject, we classified the services that the interviewed organizations provide into four distinct categories according to the critical knowledge in service innovations and the actual service business. The categories were named: technology-based services, human resources-based services, research and engineering services, and innovation support services. Research and engineering as well as innovation support services are both knowledge-intensive business services, but they are considered here in different categories. IP management and open innovation were considered differently in all four categories.

Technology-based services

Technology-based services are built on an enabling technology (software or hardware). Examples of technology-based services include Internet and mobile services as well as expert services based on a special enabling technology. In this category, service innovations typically take place in back-stage activities in the development of enabling technology. The technology development can take place internally in the service organization or in the spirit of open innovation. There was a wide range of evolving methods concerning the solutions to the way open innovation activities between a service provider and a technology supplier were arranged in practice, the way the ownership and right to use the generated IP were arranged (sometimes the ownership was retained by the technology supplier), and the way the costs and benefits of innovation were shared (a variety of methods was used for this in addition to the traditional single payment of subcontracting work). The enabling technology may also be co-created together

with a technology provider. The special knowledge of firms in technology-based service systems is technological in nature (including hardware, software, processes), and it is inherent in skilled people who have knowledge of customer needs and enabling technology. These firms actively use formal, contractual and informal methods of knowledge and IP protection. The emphasis among the three depends on the life cycle of the service innovations.

Human resource-based services

Human resource (HR)-based services typically have strong and well-developed processes at the front stage of service, allowing easy replacement of the persons providing the service. Accordingly, the special and critical knowledge of a firm offering HR-based services is in processes, and service innovations are typically process innovations. Examples of HR-based services include classical banking, cleaning and personnel services. According to the findings of our interview study, if the HR-based service could be standardized, the service firm tended to innovate alone and only use customers to gain input for its innovation. On the other hand, if the service required tailoring, a customer was typically a co-creator of innovation. The way this co-creation is contractually arranged in respect of the results of innovation is case dependent. In some cases it may eventually lead to joint ventures. Protection of knowledge and IP related to innovations of HR-based services typically takes place through contractual and informal methods, such as restricted access to information. The firms may also actively use trademarks.

Research and engineering services

Research- and engineering-type services are customized, one-time performances to solve a problem or need of a customer using the special expertise of personnel in the service firms. Accordingly, the critical knowledge of a research- and engineering-type service provider lies in its people. Secondarily, it can also be in the processes of the service firm. The service typically creates new IP that often belongs to the customer, although the interest of the service firm could be different (i.e. creation of its own IP) if its role in the creation of the new IP has been significant. The service may be confined to the front stage, but it may also include a large back-stage service network including one or more actors. In the latter case, the service provider may act as a system integrator by integrating the

knowledge and technology of third-party actors into creating a desired solution for the needs of a customer. In research and engineering services, contractual methods are emphasized in the protection of the knowledge. Confidentiality agreements are standard practice. Commission agreements are typically well defined and service firms tend to use their own model agreements for commissions that also grant some rights to the service firm (not necessarily directly to the generated IP but to the expertise related to it).

Innovation support services

There are also service firms that are involved in the innovation process of their customers, not as active innovators but by providing supporting, knowledge-based services for innovation and new business development. Examples of such service firms include innovation intermediaries and IP management service providers. Services of such firms are standardized and based primarily on well-developed processes of the service firms and, secondarily, on the expertise of the personnel. Providers of innovation support services do not aim to create their own IP when working with their customers. This is an essential difference from the other three categories and we have therefore separated the innovation support service firms into their own category, although they have much in common with research and engineering firms. The service firm's own knowledge is protected by a wide range of informal methods of knowledge protection.

Discussion and conclusions

In this work, we have studied how service firms manage their knowledge and IP when their new services are developed with external actors. The interviews showed that external actors are actively involved in the new service development. At the front stage of service, firms actively gather input from customers for their innovation work. However, the firms only named customers as co-creators of innovation in a few specific cases. At the back stage of service, the firms effectively applied the paradigm of open innovation. The involvement of suppliers and other external actors in the innovation process was more of a rule than an exception. There was a variety of ways in which knowledge and technology for the innovation were gained from suppliers.

The results show that the service firms use formal and contractual as well as informal methods of knowledge protection in their new service development with external actors. The way they do this, however, depends on the characteristics of the service. The results underline that service firms and service innovations cannot be considered a unified group. Instead, the specific type of service has to be understood and, then, the management of knowledge, IP and open innovation considered for that type of service. In this study, we identified four different kinds of services among the offerings of the firms, based on our interview material. The categorization was performed according to critical knowledge in service innovations and business: technology-based services, human resource-based services, research and engineering services, and innovation support services. The management of knowledge, IP and open innovation differed in each category of services. The main characteristics in each category are summarized in Table 2.

As a practical implication of the categorization, the results would help service firms to understand different types of services and the opportunities and challenges that open or networked innovation would bring them.

Table 2. Main characteristics related to technology-based, human resource-based, research and engineering-based, and innovation support services from the viewpoint of open innovation and knowledge management.

Service category	*Description*	*Role of open innovation*	*Special knowledge to be protected related to*	*Protection methods of own knowledge*
Technology-based services	Services built on an enabling technology	Enabling technology developed by external technology suppliers or co-created with them	Technology	Formal, contractual and informal
Human resource-based services	Services based on well-developed processes at the front stage of services	Customers as a source of input for innovation or co-creators of innovation	Processes	Contractual and informal
Research and engineering-based services	Customized one-time performance services to solve a problem/need of a customer	The service firm itself as an open innovation actor for its customer's innovation process	People and processes	Contractual
Innovation support services	Services aimed at supporting the innovation process of a customer	The service firm itself as an open innovation actor for its customer's innovation process	Processes and people	Informal

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Title

VTT Symposium on Service Innovation

Abstract

VTT organized the Symposium on Service Innovation in August 2011 in order to disseminate the results of its service research to existing and potential clients and other stakeholders. The symposium provided an overview of the service research at VTT. The topics covered the whole service value chain and the spectrum of different types of activities, from the production of 'pure' services to the delivery of product-service offerings for which part of the interest lay in service-enabling technologies. Business-to-business and business-to-consumer services were covered, as well as the private and public sectors. The topics were structured under three main titles: 1) servitization and deepening of service-dominant logic, 2) customer needs and user-driven service innovation, and 3) new approaches in service research. The papers prepared for the symposium have been collected into this publication.

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