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New Work Practices - "Desktop as a Service" and its Adoption by the Micro Enterprise

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Abstract
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THE PURPOSE OF THE STUDY

The purpose of the study was to investigate the readiness of micro enterprises to adopt a new service under development by a Finnish telecommunication company. The new service called "WebTop" aimed at delivering computing resources to knowledge workers based on the Desktop as a Service model. In addition to assessing the overall demand for such a service, the research was designed to advise the development team on a set of features and applications to be included in the value proposition of the service. The final goal was to advise the development team about the viability of the service and find triggers that could promote its adoption by the desired target group.

DATA

The data used throughout this research was collected in 2008 through desk research and by interviews. The purpose of the desk research was to find existing DaaS providers, analyze their value propositions and revenue models. The primary data was collected by the means of face-to-face interviews with CEOs or owners of 31 Finnish micro enterprises.

RESULTS

The results indicate an overall lack of triggers of adopting DaaS as a new way of acquiring and using IT resources. The current IT needs of the micro enterprise are sufficiently satisfied by current practices. The finding indicate that the structure of decision making in the company and the need for customer relationship management tools and collaboration and communication tools are most likely to influence the adoption of cloud computing based services.

KEYWORDS

cloud computing, utility computing, desktop as a service, software as a service, micro enterprise

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1. Introduction

A transformation is happening in the Information Technology industry that will convert computing resources from being assets companies own to being services purchased as a service. In the future, access to computing related resources, such as applications, operating systems, and computing capacity could become as simple and trivial as having access to electricity. Eventually, Information Technology will become a basic utility. Both in the media and in academic publications the above described phenomenon is often referred to as "Utility Computing" or "Cloud Computing".

Utility Computing can potentially alter the way businesses and individuals purchase and utilize computing capacity and applications. The Internet will play the most crucial role as utility providers will rely on it to deliver their services to end-users. This is what Clayton Christensen of the Harvard Business School might refer to as a "Disruptive Innovation" with a great potential of rendering the previous IT industry obsolete while creating a new one.

A new Utility Computing industry could emerge quite the same way as electric power generation was transformed in the beginning of the 20th century. Nicholas Carr in his article "The End of Corporate Computing" (2005) is comparing the emergence of "Utility Computing" to the emergence of central electricity generating facilities about 100 years ago. In fact, in the dawn of electric power, businesses owned their own generators due to lack of infrastructure and central suppliers, much the same way as companies today own hardware, software, data centers and take care of their own IT infrastructure.

The current IT infrastructure can be characterized by various inefficient practices. Most organizations have heterogeneous IT environments, which were planned before the rise of the Internet. Therefore, existing information systems are rigid and are unable to take advantage of its inherent flexibility. For instance, *in a typical day, the productivity of an IT environment can be staggeringly low: mainframes are unused 40 percent of the time….and most individual workstations actually produce work less than 5 percent of*

the time.[1] According to Carr (The end of corporate computing, 2005), one study of six corporate data centers revealed that most of their 1,000 servers were using just 10% to 35% of their available processing power. Furthermore, also according to the same paper by Carr (2005), IBM Corporation is estimating average capacity utilization rates of just 5% for desktop computers. Gartner Inc., the research consultancy is suggesting that between 50% and 60% of a typical company's data storage capacity is wasted.[2]

Unfortunately, not only computing capacity and data storage are underutilized resources. For instance, software applications should be highly scalable, which means that they should be able to serve additional users with very low or even zero incremental cost. Therefore, the practice of installing similar software to thousands, or millions of sites is rather inefficient and expensive due to upfront expenditures and ongoing fees. Such expenditures may include license fees, maintenance fees and salaries of employees maintaining the applications. According to a 2003 survey, about 60% of the average North American companies' IT staffing budget goes to routine support and maintenance functions.[3]

This should dictate a shift to centralized supply of computing capacity, data storage and of software applications. Ideally, all computing would become centralized in order to achieve ultimate resource utilization levels. Nonetheless, due to a lack of viable, reliable, and large scale utility model, companies are required to invest large sums in maintaining their IT infrastructures and even expanding their private, subscale data centers. These circumstances resemble the situation during the early 20th century when manufacturers needed to install private electric generators.

Hopefully, not far in the future, the World Wide Web will be a globally recognized intermediate for delivering all IT related resources. Eventually, the Internet will offer a time, location and device independent computing environment to both businesses and consumers.

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[1]John Palfreyman, EMEA Leader, Linux and Grid Services IBM Global Services The Basics of Grid - Grid Explained, Internet source from 22.05.2008, URL: http://www-935.ibm.com/industries/energy/

[2] Nicholas G. Carr, The end of corporate computing, MIT Sloan Management Review, Spring 2005 Vol.46 N0.3

[3] Nicholas G. Carr, The end of corporate computing, MIT Sloan Management Review, Spring 2005 Vol.46 N0.3

Throughout the following subsections of this chapter the following terms will be introduced: Software as a Service, Cloud Computing, Virtualization Technology and Desktop as a Service. Generally, these are all delivery models of "information technology related services" but one could find many different interpretations. In the literature (in academic and non-academic sources, such as online discussion forums, online technology magazines and whitepapers released by various companies) these terms are often referred to interchangeably and in slightly different context and often different definitions are attached to them. The next subsections will clarify this paper's interpretations of these terms.

1.1. Software as a Service

One major trend supporting the emergence of Utility Computing is the delivery of software applications in the "Software as a Service" (SaaS) business model. SaaS is a software deployment model offering applications that are hosted on a remote server and delivered over the Internet. In this arrangement, users are not required to download and install applications as they can access them from any computer, or from any other mobile device, connected to the Internet[4]. In addition, users do not need to purchase software licenses. Instead, they are charged for the use of the applications in the "pay as you go" model, by paying a monthly fee, often per user.

One of the most well-known forms of SaaS is E-mail. Although, nobody would consider E-mail as "Software as a Service", actually it the most classic and most trivial example one can think of. Both consumers and professionals use e-mail, which is an entirely web-based service. Often e-mail applications include calendars, group calendars, scheduling and allow for sophisticated organization of messages. Therefore, in a broader sense, e-mail may also support team work and it is a web-based knowledge management system.[5]

[4] Definition of Software as a Service from Wikipedia at http://en.wikipedia.org/wiki/Software_as_a_Service 21/05/2008

[5] Maureen L. Mackenzie, The Personal Organization of Electronic Mail Messages in a Business Environment: An Exploratory Study, Library & Information Science Research, November 2000 and M.L. Mackenzie, Storage and retrieval of e-mail in a business environment: An exploratory study, Library & Information Science Research 24 (2002) 357–372

In order to get a deeper understanding of SaaS solutions and the underlying business models of companies offering such services, the next subsections are going to introduce briefly two successful companies' SaaS offerings, namely Salesforce.com and Dell Inc. It will be evident that these companies have very different value propositions. Moreover, it will be also evident that the terms of SaaS and of Cloud Computing are used interchangeably in the industry. Unfortunately, it is not within the scope of this paper to elaborate in detail on the functionality of the software solutions these companies provide. However, these brief examples might be useful in clarifying the value propositions of SaaS and Cloud Computing.

1.1.1. Salesforce.com

Salesforce.com was founded in 1999 and it was a fast rising star among companies that were offering sales force automation software. As opposed to other traditional companies in the industry, Salesforce.com was offering a web-based solution. In a few short years, as the company gained experience, it broadened its service portfolio with full customer relationship management (CRM) products. Nowadays, the company is offering both software as a service and hardware in a similar setup. Clients that work with Salesforce.com actually outsource all their information technology needs, such as purchasing, managing, maintaining and securing both hardware and software. The company provides professional, Fortune 500 level systems that normally would be unaffordable for small to medium enterprises.

Salesforce.com provides clients with tools that can be utilized even by small sales departments. One example for the software solutions the company provides is called Sales Cloud, including 11 different applications supporting business processes involved in organizing, motivating, nurturing team-work and closing sales. Some of these applications are very simple like Accounts and Contacts which integrate account history, contacts, interactions, assets, as well as classifications of the importance of accounts. More sophisticated applications, such as the team productivity tool is keeping sales agents organized, working as a team and even harmonizes calendars, tasks, activity reports, and activity tracking. It promises to provide professional, coordinated communication that on the long run fosters stronger ties with customers. Other tools, like the Marketing and Leads applications, bridge the gap between marketing and sales

allowing the firm to maximize the effect of campaigns from lead capture to close, thus allowing for clever allocation of communication investments.[6]

The "Sales Cloud" offered here is strong development towards the direction of SaaS based offerings: incorporating several applications and other computing resources. This is a classic example of Cloud Computing, which will be introduced and defined in Chapter 1.2.

1.1.2. Dell Desktop Manager

Dell's SaaS based value proposition includes desktop management, software inventory and usage management, online backup and data restore, laptop data encryption, e-mail continuity, enterprise e-mail archiving, crisis management and alerting. Next, some of the features and benefits of selected services will be introduced in detail.

Dell's Online Backup and Restore service automatically backs up data from desktops and laptops. Therefore, users no longer need to remember to back up their computers. All data is stored in a highly secured data center in a different geographic location. A necessary complement to the above is the protection of data "stored" on Microsoft® Exchange or Lotus Notes® system. The e-mail Management Services and Email Continuity Service can be active in a time of need by switching to a web based system within minutes.

According to Gartner effective desktop management can cut total cost of ownership for desktop PCs by 42 percent.[7] One of the challenges is to oversee mobile laptops used by company employees. Dell's desktop management service is allowing IT teams for updating, patching and troubleshooting PCs via a Web-based console. Moreover, companies can deploy new software applications and discover and track all current assets without deploying on-premise systems management applications, which are often complex and expensive.

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[6] Dennis A. Pitta, Cloud computing comes to marketing, Journal of Consumer Marketing, Volume 28, Issue 1, 2011

[7] Software as a Service: SaaS Solutions for Remote Systems Management, Computer Wold Technology Briefings, Sponsored by Dell Inc., 2008, URL: http://www.techrepublic.com/whitepapers/saas-solutions-for-remote-systems-management/383573, 04.05.2013

1.2. Cloud Computing

As learned from the chapters above - introducing SaaS offerings by prominent companies, such as Salesforce.com and Dell - new types of SaaS services are emerging that are including not only application hosting but many other on-demand computing resources. Software as a Service is gradually becoming part of more integrated service package, which is referred to as "Cloud Computing". Indeed, especially Dell's SaaS value proposition resembles what Cloud Computing is all about.

The "Cloud" is offering users computing capacity, applications, data storage and on-line security from a remote, central location. In this setup, all computing needs are satisfied over the Internet by centralized suppliers that provide a scalable and flexible environment. Ideally, users should have access to as much computing capacity as they need - no more and no less - when and where they need it, device and location independently.[8] Leading Cloud Computing companies, such as Yahoo!, Amazon, Microsoft and Google can offer endless computing power and their clouds are able to handle a wide array of technologies.[9]

According to an IDC report, *the overall market for Cloud computing was already $16.2 billion in 2008 but is expected to grow to $42.3 billion by 2012, an impressive 24% compound annual growth rate (CAGR). But the true impact of cloud is more significant when measured against the CAGR for all software during 2008-2012, which IDC forecasts will be 6.24%. When seen in this light, what stands out is that while spending on Cloud IT services overall will comprise less than 10% of all revenue earned from software, it will comprise about 25% of incremental, year-over-year growth in 2011-2012. In short, Cloud services are set to take up a significant position in the plans and budgets of IT organizations worldwide.* [10]

[8] John Palfreyman, EMEA Leader, Linux and Grid Services IBM Global Services The Basics of Grid - Grid Explained, Internet source from 22.05.2008, URL: http://www-935.ibm.com/industries/energy/

[9] Steve Hamm, Cloud Computing Made Clear: It's the tech term of the moment, but what does it really mean, who has it, who wants it, and why? Business Week, New York: May 05, 2008. Vol. 4082, p. 59

[10] Randy Perry, Eric Hatcher, Robert P. Mahowald and Stephen D. Hendrick, Force.com Cloud Platform Drives Huge Time to Market and Cost Savings, white paper by IDC Research, Sponsored by Salesforce.com, 2009, URL: http://www.salesforce.com/fr/assets/pdf/whitepapers/whitepaper-idc-force-roi-study.pdf, 28.04.2013

Currently there are two major trends supporting the emergence of Cloud Computing: (1) Server Consolidation, which is the systematic reduction of the amount of servers in IT departments - and (2) Virtualization Technology. These trends are driving the need for increasing cost efficiency of IT departments and the ability to receive services in a dynamic form. To a certain extent, server consolidation is supported by virtualization technologies, which will be explained in the following section.

1.2.1. Virtualization Technology

Deployment of virtualization technology started at IBM around 40 years ago in the specific context of separate logical partitions running in parallel on a shared mainframe. Since then virtualization has taken on new life in a number of contexts: virtual servers to virtual storage, optimized networks, workstations in virtualized environments, and application virtualization. And like any major paradigm shift in business, virtualization has become a success because it delivers core practical benefits that drive business value by:

- Decreasing IT costs and business risks
- Increasing operational efficiency and flexibility
- Simplifying deployment and management
- Enhancing overall business resilience
- Enabling new forms of innovation

Virtualization technologies provide a layer of abstraction between computer hardware systems and the software running on them. The purpose of the technology is to provide a logical view, instead of a physical view of computing resources. It can make one computer operate like many computers by dividing the resources of a computer into multiple execution environments. [11] Or, it can trick operating systems into thinking that a group of servers is a single pool of computing resource and visa-versa. Thus, virtualization is providing the means achieve software-hardware independency.

[11] Amit Singh, An Introduction to Virtualization, January 2004 URL: http://www.kernelthread.com/publications/virtualization/ 24.06.2008, 04.05.2013

For example, virtualization technologies allow users to run more than one operating system on a single workstation and receive all the benefits of additional programs and hardware without having to purchase or install them on their computers. [12] Moreover, users no longer need to have their own storage and processing capacity as they can have these resources from virtual computing, which is allocating resources more efficiently and effectively than ever before.

According to IDC Research, the virtualization services market, especially its implementation segment is expected to hit $11.7 billion by 2011.[13] IDC also reports that virtualization architectures can now safely leverage over 90% of a server's capabilities. Certainly, Virtualization Technology could provide a solution for solving inherent IT infrastructure problems, expand capacity and finally take advantage of "economies of scale". In other words, the virtual version is considerably easier to adjust to suit changing business goals as it has been freed from its physical constraints. *This is a tremendous advantage in a business context, where IT services must continually be revised, adapted, or developed from scratch to meet emerging needs.*[14]

1.3. Desktop as a Service

Desktop as a Service (DaaS) solutions are emerging in parallel to Software as a Service (SaaS) solutions. A traditional workstation is mostly equipped with local computing resources such as data storage, processing capacity and applications. Desktop as a Service can be seen as a SaaS solution, bundling several computing resources in the form of a desktop while mimicking local computing resources, which in reality are residing on a remote server. In other words, Desktop as a Service is taking the SaaS value-proposition a step further.

DaaS offers a complete virtual working environment including applications, storage and related services that reside on the cloud on a remote server, but used locally. These are the most important perceived benefits of using DaaS:

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[12] McKenna, Patti. "How Virtual Computing Works", July 2007, From: HowStuffWorks.com. <http://computer.howstuffworks.com/how-virtual-computing-works.htm> 28 April 2013

[13] Lynn Greiner, Business: the 8th layer, Virtually Yours, September 2007

[14] Why Virtualization Matters to the Enterprise Today, IBM, IT optimization white paper, December 2007 URL: http://www.techrepublic.com/whitepapers/why-virtualization-matters-to-the-enterprise-today/1378965, 28.4.2013

- Computing resources are presented on desktop interface that looks and feels like as if these resources would have been local
- End-users of Desktop as a Service do not need to adapt to new ways of using computers
- Location and hardware independent use of computing for greater flexibility and mobility
- Computing resources can be scaled up and down easily, such as file and data storage, application availability and processing capacity
- Modifying, monitoring, managing and backing up data requires significantly less effort from IT staff
- DaaS could cater for increased data security by the means of centrally managed data centers

Essentially, DaaS has the potential of becoming the heart and soul of digital service delivery, interacting directly with the final consumer of the service. Therefore, it seems that there could be numerous business benefits for using DaaS, even for micro and small enterprises.

The Delivery of DaaS is dependent on the availability of Virtual Desktop Infrastructure (VDI), because it is providing the backbone for hosting desktops from centrally managed and sometimes remote servers. Similar to server virtualization, VDI is allowing multiple PC operating systems to be concentrated onto a few servers as virtual machines that can be accessed over the network. *According to a Yankee Group survey released in March 2009, 41% of SMBs are experimenting with desktop virtualization.*[15] Indeed, some small financial services companies would benefit from such technologies in the form of higher data security. Also according to Forbes (Phil Hochmuth, The Benefits of Virtual Desktops, December 2010), *The U.S. Transportation Security Administration reports that more than 12,000 laptops are lost each week at U.S. airports.* Some other companies would be interested in centralized access to high-end desktop applications.

[15] Phil Hochmuth, The Benefits Of Virtual Desktops, December 2010, from: Forbes.com URL: http://www.forbes.com/2010/01/12/desktop-virtualization-software-business-intelligence-hochmuth.html 25.04.2011

Gartner estimates that the worldwide hosted virtual desktop (HVD) market will accelerate through 2013 to reach 49 million units, up from more than 500,000 units in 2009.[16] Indeed, studies have determined that traditional desktop resource utilization rates are alarmingly low, and that large amount of hardware capacity sits idle for prolonged periods. Overall, while capacity utilization on Windows/Intel servers is generally only between 8% and 15%, for the desktops accessing those servers, it is only 3% to 5%.[17]

Virtual desktops are also more attractive in terms of costs. Although, the networking software that supports deployment of virtual desktops is often expensive, the maintenance costs are much lower than for traditional computing. For example, in a scenario of software error, the technician can fix the problem by logging into a central server, without even touching the employee's computer. Indeed, some companies expect to save up to 20% on technology expenses by utilizing virtual desktops. *With an estimated half billion workplace computers around the world and $3 trillion spent each year on corporate computing, that ordinarily would mean a lot of purchase orders for big, brawny new hardware.* However, desktop virtualization may break this pattern by allowing the replacement of a $1000 PC with a thin client that costs only $150 with the promise of lower support costs, higher security and greater simplicity.[18]

Based on the information presented above, it seems that medium and large organizations could reap many benefits by switching to centralized computing. However, the literature available on the topic rarely considers the perspective of small and micro organizations, although they play a prominent part in the economy in terms of GDP and employment. Chapter 2 is going to explain in detail the motivations behind this research and outline the research questions posed by the company that commissioned this research.

[16] Gary Orenstein, Virtual Desktops are Hot Again, July 2010, URL: http://gigaom.com/2010/07/25/virtual-desktops-are-hot-again/, 25.04.2011
[17] Mainline Information Systems, Inc., Desktop Virtualization: The Pendulum Swings for the PC, Mainline Information Systems 2008
[18] Lee Gomes, Taylor Buley, The Death of the PC, Forbes Magazine, December 28, 2009 or URL: http://www.forbes.com/forbes/2009/1228/technology-virtualization-vmware-wyse.html, 30.04.2011

2. Motivation, Research Questions and Methodology

2.1. Motivation

This research was commissioned by a Finnish Telecommunication Company which will be referred to throughout this paper as "TELCO" to maintain anonymity of the organization. TELCO's corporate strategy was changed dramatically in 2007 to reflect its goal to become a world class Internet based Services Provider.

In 2007, TELCO's annual turnover was €1,568 billion[19], which positioned it among the largest telecommunication companies in Finland. However, the industry was suffering from stagnating and even declining value of "Average Revenue Per User" or ARPU.[20] In the telecommunications industry ARPU is as important measure of success because it takes under consideration fluctuation in individual consumption of communication and related services. This is especially crucial in developed countries, such as Finland, where mobile phone penetration rate is above 100%, meaning that there is no possibility to increase revenues by increasing the number of subscribers. It is not to say that revenues or profits are not to be taken under consideration but under the above circumstances ARPU is defining whether a given telecommunication company is able to innovate and offer *additional services* to cater for its future growth.

Therefore, whether customers are willing to spend on *additional services* is a factor that is influencing company performance significantly and thus, strongly indicates if a given enterprise is able to grow. In order to improve ARPU, telecommunication companies were diversifying their services, from providing only traditional telecommunication and broadband services, to offering various valued adding services. For this reason, TELCO in 2007 established a unit for investigating and piloting various new business ideas to support its new strategy. The name of the new unit was "New Services and Markets".

One of the many projects the New Services and Markets unit decided to undertake was the introduction of a Desktop as a Service environment, dedicated to serve micro and small size entrepreneur customers. A Commission Recommendation from 3 April 1996

[19] TELCO, Annual Report 2007 (please keep confidential)
[20] Wikipedia, Definition of Avarage Revenu Per User, URL: http://en.wikipedia.org/wiki/Average_revenue_per_user, 04.05.2013

provides a definition of small and medium-sized enterprises (SMEs), namely[21]: **Micro-enterprises**: employ fewer than 10 persons; **Small enterprises**: employ fewer than 50 persons and have either an annual turnover not exceeding 7 million EUR, or an annual balance-sheet total not exceeding 5 million EUR; **Medium-sized enterprises**: employ fewer than 250 persons and have either an annual turnover not exceeding 40 million EUR, or an annual balance-sheet total not exceeding 27 million EUR;

This research was commissioned in 2008 when the service in question was already in development for about a year and was already being tested in private beta environment. Following some of the original reasons for initiating the project will be outlined.

In 2007 TELCO had over 100,000 small entrepreneurs among its customers.[22] Calculated based on an OECD report on Structural and Demographic Business Statistics (see Figure 1), specifying the structural indicators on enterprise population during 2007 in Finland, the overall amount of micro and small entrepreneurs was 210,849 accounting for 98,7% of the total amount of enterprises registered.[23] Based on these numbers, TELCO was already counting nearly half of the total micro-enterprises among its customers. Therefore, it seemed that ARPU could be increased by designing services specifically satisfying the needs of these companies. This was the most important trigger for initiating the project.

	Number of enterprises					Total employment					Value added (factor costs)		
	Industry		Services		Total	Industry		Services		Total	Industry	Services	Total
	No. firms	%	No. firms	%	%	No. engaged	%	No. engaged	%	%	%		
Micro	61546	89,9	136752	94,1	92,8	96059	16,7	204320	27,9	23	11,4	28,5	19,4
Small	5394	7,9	7157	4,9	5,9	107756	18,7	141935	19,4	19,1	13,8	19,9	16,7
Medium	1232	1,8	1084	0,7	1,1	124620	21,7	106600	14,6	17,7	18,5	16,2	17,4
SMEs	68172	99,6	144993	99,8	99,7	328435	57,1	452855	61,8	59,7	43,8	64,5	53,5
Large	298	0,4	311	0,2	0,3	246991	42,9	279732	38,2	40,3	56,2	35,5	46,5

Figure 1: Structural indicators on enterprise population, 2007 in Finland, Source: OECD, Structural and Demographic Business Statistics

Moreover, it was assumed that Finland would serve as a suitable test bed for such service development and launch, given the widespread adoption of computers and Internet among businesses. Indeed, compared to other European countries in 2001 a larger share of small enterprises in Finland had Internet access and was using computers to conduct their work. To compare, in Greece 16 % of small enterprises did not use a computer and only 49% of small enterprises have Internet access. At the same time, only 3% of small enterprises in Finland did not use computers and 90% of small

[21] Manfred Schmiemann, Enterprises in Europe - does size matter?, Published by Eurostat, ISBN 92-826-8767-8, October, 2002
[22] TELCO, 2007 Annual Report
[23] SMEs, Entrepreneurship and Innovation - OECD © 2010 - ISBN 9789264080317, 2010

enterprises were having access to the Internet.[24] These figures provided additional indication that Finnish small and micro enterprises would be more favourable towards a Virtual Desktop service.

Another strong incentive for studying the needs of micro and small enterprises originated from the fact that these companies are the backbone of the EU economy. They account for 99% of all companies and provide some 75 million jobs.[25] Micro enterprises (employing less than 10 persons) account for about nine out of ten enterprises, almost three out of ten jobs, and just over one fifth of value added. Thus, it was assumed that providing services to small and micro enterprises would be profitable and cater for long term growth. Moreover, since these companies make a substantial contribution to the economy of the European Union, TELCO assumed that it might have a chance to penetrate foreign markets and support internationalization of the company.

Therefore, TELCO decided to engage in a project developing a Desktop as a Service for micro and small enterprises through several stages. First, TELCO needed to attain *proof of concept* to demonstrate to the company's top management the viability and the need for such a service. This was to be achieved by introducing the new service to selected Finnish businesses in a private beta environment and, if proves to be promising, by developing the service further, move into a public beta introduction. During this period, this research was commissioned to provide additional insight into operations of micro enterprises and support the *proof of concept* phase of the project.

The *proof of concept* phase required to list the most critical factors that were perceived essential for success of the new service. At this stage of the project, when the service in question was already in development, these factors are defined more explicitly than during previous stages. The evaluation and validation of these served as evidence to be presented to the management team of TELCO, in order to authorize the dedications of further resources for the project In addition, the examination of the critical success factors also served as a guiding tool for the project team. Next, these are going be detailed in Chapter 2.2.

[24] European Commission, Small and medium-sized enterprises (SMEs), Facts and figures, URL: http://ec.europa.eu/enterprise/policies/sme/business-environment/failure-new-beginning/facts-figures_en.htm, retrieved on 30.04.2011

[25] European Commission, Small and medium-sized enterprises (SMEs), Facts and figures, URL: http://ec.europa.eu/enterprise/policies/sme/business-environment/failure-new-beginning/facts-figures_en.htm, retrieved on 30.04.2011

2.2. Critical Success Factors

To justify the investment in developing the WebTop service, the development team had to provide a proof of concept and indicators of success. These were determined in the form of success factors that needed to be examined and evaluated during this specific phase of the project. More basic factors were already cleared earlier, before this research was commissioned, and investment was already made to initiate the project. The selected success factors at this particular stage of the project were more specific than at the beginning, as the project team learned more about services offered through cloud computing.

The evaluation and conclusions of the success factors were determined based on information attained through the interviews. The goal was to validate each factor or to find out if it can be partly validated or cannot be validated at all. Each of these three outcomes was to be communicated clearly to the management team in order to decide if the project was to be continued. Working with critical success factors was a commonly agreed and approved method in the company during business development and was used to support decision making. Following, factors relevant for the project are listed. A detailed evaluation of the factors can be found in Chapter 5.5 and a summary of results in

Table 3: Summary Evaluation of Critical Success Factors.

Critical Success Factors:

- # 1 *Decision makers of micro enterprises are experiencing challenges with delivering reliable computing tools to their employees* – the target companies for the service would be rather small, from one to 19 employees at most. Thus, it is assumed that companies of this size have not turned to professional IT providers and employees and decision makers are lacking expertise in managing their individual computers and software applications. Particularly, security would be a major concern as well as regular software updates and hardware maintenance.
- # 2 *The costs associated with delivering and maintaining computing is considered to be a significant expense that is not scalable and often difficult to predict in advance* – therefore, micro-enterprises would be interested in a computing solution that is affordable and the expense is uniformly distributed throughout

the fiscal year; paid in a monthly or quarterly instalments, such as in the software as a service business model.

3 *Mobility and hardware independency are becoming important aspects of doing business* – due to globalization and increasing competition, even micro enterprises are forced to work across different time zones and need to work outside of official office hours or while traveling. This means that the boundaries between work time and free time are blurring, which would indicate that people need to access work related assets from anywhere, even while at home or on holiday.

 # 4 Data security is a serious concern of micro enterprises that can be solved by switching to cloud computing based services – Micro enterprises do not take sufficient precautions for securing and backing up their files and other business critical data. Moreover, many professionals use laptops and keep mobile all work related material stored on the laptop. This carries additional risk of data loss if the laptop is dropped and gets damaged or stolen.

5 *Collaboration and communication by means of web based tools is required by micro enterprises to facilitate team work and to maintain close working relationship with customers, suppliers and business partners* – in addition to using e-mail, small companies would need other means of engaging within the company and with external entities. These tools should facilitate distributed team work, customer relationship management and other communication necessary to conduct business. Examples of these are Voice over IP, chatting applications, web-conferencing tools, document sharing, CRM systems, and project management tools.

2.3. Research Questions

This research is aiming at investigating the adoption of DaaS services from two major angles. One angle is to evaluate the critical success factors in order to provide information to support decision making of TELCO's management team. On this regard, each of the factors listed in Chapter 2.2 will be evaluated.

The other angle is to support the project team developing the service and provide valuable insight of professionals' preferences when they use computing related resources as the goal is to develop a service that is truly appreciated by them. The

conclusion regarding this will be reached by investigating whether DaaS providers could replace traditional IT service providers and serve the Micro Enterprises successfully. Therefore, the following questions should be answered:

I. **What is the present value proposition of DaaS providers?**
II. **Is DaaS the way for a comprehensive cloud computing environment for micro and small enterprises in the future?**
III. **What factors would be triggering adoption of DaaS by the micro-enterprise?**

2.4. Methodology

This research will attempt to answer the above questions by investigation of both secondary and primary data sources. The first question is answered by identification and study of the current supply of "Desktop as a Service" offerings through desk research, as it seems that such service companies will play a crucial role in providing a platform for Cloud Computing to both consumers and organizations. Following this, comparing supply of DaaS to demand for DaaS will determine the answer for the second question. The demand side of the equation is investigated through interviews of the target group and their use of IT. The third question will open a discussion based on all the understandings gained throughout this research and introduce a framework that perhaps is able to shed light on factors influencing adoption of cloud based computing services.

The following sub sections will explain in further detail the research methodology.

2.4.1. Interviews

The empirical part of the research was carried out by interviewing micro-enterprises that were identified by TELCO as the target customer segment for the WebTop service. The definition of a micro-enterprise according to TELCO is including companies with up to 19 employees. In addition, it was assumed by TELCO that service based organizations (employing knowledge workers or perform activities that are considered knowledge work) would be the future users of the new service, as this type of work requires the use of computers and various productivity tools. Each interview was scheduled for around two hours as a semi-structured interview. The questionnaire was divided to 3 parts, including both open-end and close-end questions.

These parts were the following:

1. General IT Issues
2. Awareness to Cloud Computing or SaaS
3. Workforce Mobility

The first part of the interview, *General IT Issues,* was investigating if there was a person responsible for purchasing, managing and maintaining IT in the company. In addition, it aimed to determine what type of hardware and software was used by employees of the companies. An open ended question simply enquired about frustrations interviewees had with regard to IT. Only at the very end of the interview the interviewer informed the subject that TELCO is in the process of developing a DaaS type of service. Special attention was paid to avoid leading the interviewees to avoid bias when answering open-end questions.

The second part of the interview, *Awareness to Cloud Computing or SaaS,* aimed to determine if small businesses were familiar with these concepts, awareness to services offered in this setup and if they were using such services already or considering using them in the near future. It was assumed that if they were not even aware of these terms then they are further away from adopting such services. After explaining the nature of this delivery method (especially, to interviewees that were not familiar with the concept) the last questions also asked if they had concerns regarding this delivery method.

The third part of the questionnaire, *Workforce Mobility*, aimed at revealing if employees were working remotely from home or if they were required to travel for their work. The underlying assumption was that companies depending on workforce mobility or allow their employees to work at home would require cloud based services more than companies where employees worked mostly at the office. Therefore, the questions in this section were aiming at revealing their degree of dependence on mobility and if that would be relatable to Cloud Computing on some level. The complete questionnaire can be found in Appendix D.

2.4.2. Framework for Business Model Analysis

The following framework is provided by TELCO, containing three major components: *Value Proposition, Value Creation and Value Capture.* The purpose of using the framework is to understand and analyze proposed business models.

Value Proposition

Parameters belonging to the *value proposition* category define the type of services and their inherent value that will be offered to prospective customers. In the context of this paper, parameters belonging to the *value proposition* category are applications, service availability, security features, data management, user support, administrative features and additional services.

Service availability and quality is defined by a Service Level Agreement (SLA) which is usually formulated by the service provider. SLA can include guaranteed uptime through the Internet, security, data storage, backup and management services. In some cases the service provider may extend the access to the environment through an "offline access" system, which is considered as an additional service. Security features are meant to protect the service users from security breach, such as data theft, viruses, and spam or other applications with a malicious intent. Data management is the automatized service of data backup that would happen at a predetermined time interval, on regular bases. In addition, it may also include a data and file storage that is also accessible online.

Other important feature is user support. In the context of this research, this means whether users can by the means of placing a simple phone call to discuss with an expert their problems and preferably receive an immediate response or even solution to that problem. In some cases the users might be able to chat online with an expert, which may be as satisfying as having a phone conversation. Lesser degrees of support would not include a service such as described above but would provide it by e-mail correspondence, forums, blogs and answers to frequently asked questions.

The value proposition may also include the productivity tools or other collaboration and communication tools the service provider can offer to end-users. These could be applications offered by or similar to Microsoft Office or to Google Docs. On the other

hand, these could be also applications that support customer relationship management or other new innovations not yet used by the mainstream.

Value Creation

Value Creation is a pool of resources and capabilities a service provider should have or should be able to develop or purchase in order to provide DaaS to business users. In this particular case, value creation is highly dependent on the availability of a technical backbone or in other words, the Virtual Desktop Infrastructure (VDI), upon which the service is delivered to the end user. Without the availability of VDI, service providers would not be able to guarantee and deliver reliable and secure services.

It was not within the scope of this paper to investigate VDI providers or technologies that allow for Virtual Desktop management and delivery. Thus, this paper is not going to evaluate and describe the Value Creation of the benchmark services. However, this should not diminish the importance of Value Creation in the framework. Due to high dependency of on infrastructure and data warehouses, competencies belonging to this category are crucial in answering the question whether the service provider, in this case, TELCO could provide these services at all and scale it up successfully to serve several thousands of micro enterprises.

Value Capture

The *value capture* category determines how the service provider is generating revenue/income from the services provided. In the DaaS business model, most commonly the fee is calculated based on the amount of users per month. The fee can vary based on the type of services offered, such as type of applications available, storage size, security features and support features. In some other cases, regardless of its features, the service is free for the users and the provider would charge for advertising fees from third parties. These variations, and more, will be discussed when individual service providers are discussed in detail.

3. Existing Desktop as a Service Solutions

This part of the research aims to benchmark on various Desktop as a Service (DaaS) providers with regard to their Value Proposition and Value Creation. The companies that were selected conform to a very narrow definition of Desktop as a Service, as introduced in Chapter 1.3. In addition, as TELCO was targeting small and micro enterprises with the new service, the selected benchmark companies also needed to serve a similar target group. The companies that were selected are:

1) Google Apps for Business
2) MokaFive LivePC
3) EyeOS Cloud Desktop
4) Extrasys Hosted Desktop

During the same time period several other DaaS providers were identified. Table 4 in Appendix C is listing all the companies that were identified in 2008. However, currently, some of these companies are no longer providing such services. Perhaps, this phenomenon further reinforces the claim that this industry is still in its infancy and thus, smaller players that cannot reach critical mass of users and cannot turn profit are not viable players in the industry.

Table 1 is summarizing the most common Value Proposition and Value Capture of companies providing DaaS solutions based on the framework introduced in Chapter 2.4.2. The third element for business model analysis, Value Creation is not within the scope of this paper and therefore, it is not included in this summery. A more detailed description of the services in question can be found in

.

	Most Commonly Identified Features or Characteristics

Value Proposition	• Users can work at any place, any time and from any device with Internet connection
	• Availability of various applications, such as
	  ○ productivity applications (MS Office, Google Docs, Open Office or similar tools to create presentations, documents, spread sheets),
	  ○ expert applications (project management, CRM, apps facilitating online meetings)
	  ○ communication tools (IP phone, instant messaging/chatting, e-mail, documents sharing/editing)
	• Document storage and backup, as well as data synchronization with other compatible devices, such as smart phones and other mobile devices
	• Service level Agreement: guarantees access to the DaaS, such as 99,9% uptime and availability of support services (by phone and/or e-mail or other means)
	• Administrative features: an administrator in the company can decide what kind of application set a certain employee can use and access

Value Capture	• Charges are dependent on amount of users per period (month or year) and on type of service, basic or premium • Charges could be also dependent on size of data storage and backup options • In some cases, the service provider may call the charges as a license fee (for the entire DaaS solution, including a comprehensive Value Proposition) that is charged annually, based on number of employees

Table 1: Most Common Value Proposition and Value Capture of DaaS Solutions

3.1. Answer to the first research question

The result of the desk research of DaaS providers is a benchmark of applications and services TELCO was considering to develop. More specifically, the benchmark provides a guideline of features suggests a successful revenue model as well as an appropriate price level and even validate or invalidate the selected target group of micro-enterprises. In addition, the benchmark also helped in answering the first research question, which was the following:

I. What is the present value proposition of DaaS providers?

The desk research reveals that both start-ups and large corporations are active in providing DaaS type of solutions. At large, their value propositions are very similar however; there are significant differences in the following features:

- the type and variety of applications offered by the service,
- size, security and back up options of on-line data storage,
- access to support and type of support provided to users of the service
- availability of SLA, and varying degrees of SLAs offered
- availability various administrative features to define different user types

Bottom line, all DaaS providers rely on the Internet to deliver their services to users. Therefore, access to fast and reliable Internet is the most important factor influencing the adoption of cloud based services.

For example, the barriers to entry are relatively low as service providers can opt for including opens source productivity tools in their value proposition, such as Open Office. Further, data storage capacity is cheap and easily available either by investing in own servers or outsourcing to 3rd party providers. On the other hand, many DaaS providers opt for providing well known productivity tools, such as Microsoft Office applications that are more costly. Naturally, larger service providers can afford to offer more professional applications, such as web conferencing tools, CRM tools and in general applications that would require larger investment and more robust virtual infrastructure for enabling delivery through the cloud.

The value capture, in other words, the revenue model of DaaS providers is based on the same logic. Some providers charge fees on a monthly, quarterly, or yearly base and allow the client to choose the option they prefer. In most cases, the price is also dependent on the size of the company that uses the service, in terms of number of employees. In some cases, the service is not offered to companies with lower than 50 employees and in some other cases, such as Google, the service if offered free of charge to small companies. Thus, the spectrum and features of the DaaS in question can diverge greatly.

In addition, price level may defer based on the type of service package. Providers may differentiate between service packages by offering varying sizes of data storage and backup or varying types of support services. On one hand, standard support could be in the forms of answers to list of Frequently Asked Questions or listing of the most common problems and remedies. On the other hand, support could be provided via a call center that can be reached by all end-users of the service. Naturally, differences between services translate to different price levels.

Nevertheless, there is one significant distinction between purchasing computing resources in the DaaS setup compared to the traditional, license by license method. DaaS is allowing greater flexibility for companies to scale up and down the resources needed based on actual demand, which is mostly defined in terms of number of employees, application need, data storage and backup and user support (or type of Service Level Agreement).

It seems that current DaaS providers have what it takes to deliver sufficient computing for knowledge workers of small and micro organizations. To sum it up, most of the features offered by these companies are rather basic, catering for the needs of knowledge workers that need productivity tools to prepare documents, presentations and spread sheets. On the other hand, the features enabling communication and collaboration seem to be comprehensive by allowing document sharing, customer relationship management and by various messaging tools to assist in quick and simple ways for coworkers to get in touch. Further, DaaS based environments also assist in storing, securing and backing up data, which is crucial for business continuity.

Therefore, it can be concluded that if these companies are truly able to deliver what they promise, DaaS could be a way of providing a location and device independent computing. However, all this is highly dependent on the availability of Internet connectivity, which is significantly influencing access to remote computing resources. Now, the only important question is whether micro enterprises are interested in switching from traditional computing to cloud based computing. Following the paper will elaborate on the demand side of cloud computing which was investigated by interviewing companies belonging to the supposed target group for the service developed by TELCO.

4. Interviews – The Demand for Cloud Computing

In the course of this research 31 companies were interviewed mostly from the greater Helsinki region. These companies were selected based on two main criteria: company size and operational area or industry.

The first criterion was established based on company size which was determined according to number of employees on payroll. According to TELCO, the ideal users of the WebTop would be micro enterprises, employing at most 19 people. TELCO believed that companies of this size would be the desired target group for the DaaS. The rational for this decision was explained in Chapter 2.1 under Research Motivations.

The second criterion of "field of operation" or "industry of operation" is dictating a selection of companies that need to use information technology in order be successful and employees' degree of dependence on computing would vary in accordance with the nature of the business they do. The degree of dependency on computing was classified to four groups: Light Dependency, Medium Dependency, Heavy Dependency and Super Heavy Dependency.

In order to establish the degree of dependency, their software needs, hardware needs and mobility were all considered. The following assumptions were made about the computing needs of each group and these will be clarified next.

I. **Light Dependency.** Employees working in light computing dependency companies do not require special software in order to complete their day-to-day work and the quality of their work is not suffering do to the lack of special software. This means that they work with productivity tools and e-mail is sufficient for facilitating their communication needs both with clients and co-workers. Moreover, they do not require high capacity hardware or mobile devices. Employees of these companies conduct most of their work in the office and are not required to travel. If they are mobile, they can save all the files and information needed in a laptop or memory stick. On the other hand, they might even get by without a computer or other mobile device, such as smartphone or tablet computer on these occasions.

II. **Medium Dependency.** Companies belonging to this category might need slightly more sophisticated software because their employees are knowledge workers. This means that either in teams or individually, they are analysing information and solving problems. Therefore, in addition to basic productivity tools they might be dependent on project management software and data analysis or statistical analysis software. Moreover, communication between co-workers and with client might need to utilize multiple mediums. For example, they might require VoIP, instant messaging and document sharing outlets that enable distributed team work. If these employees travel, they cannot do without their information technology resources.

III. **Heavy dependency.** Employees of companies from this category use special applications that need high computing capacity. Computers used need capacity to run the special software and screens should be of good quality. The results and quality of work is highly dependent on the devices and software used. If employees from this group are required to travel, they need access to their files and data which can be presented and altered only by the same applications that were used to create it. In addition, these applications would not be able to run on any computer due to compatibility and capacity issues. Communication between workers cannot be limited to asynchronous channels because of the need for real time feedback and visual information exchange.

IV. **Super Heavy Dependency.** Companies in this category are working directly in the IT industry and even providing IT services. Therefore, they are experts in computing related topics and are comfortable using complex applications in challenging IT environment. For example they might use software programming tools, maintain application and hardware, such as servers and special software. For these reasons, companies from this category need not only PCs but also other hardware, such as servers and high capacity computers that support software development.

Each degree of dependency was paired with a certain field or industry of operation to allow in the sample a selection of companies that were thought to be future customers of the DaaS solution:

Degree of Computing Dependency	Field or Industry of Operation
I. Light Dependency	Import and Export
II. Medium Dependency	Business and Technology Consulting
III. Heavy Dependency	Advertising and Graphic Design
IV. Super Heavy Dependency	Information Technology and Software Development Services

Table 2: Classification of Companies Based on Computing Dependency

4.1. Type of Companies Interviewed

As mentioned earlier, 31 companies were interviewed: four companies from the Import Export field, eight companies from the Advertising, Graphic Design and Publishing field, ten companies from the consulting field and nine companies from the Information Technology and Software Development Services. The interview arrangements were made by phone, whereas 200 companies were contacted for requesting a two hour long interview about their computing habits. These 200 companies were selected from TELCO's customer data base based on their respective industries of operation and the amount of employees in the company. Chart 1 illustrates the above information.

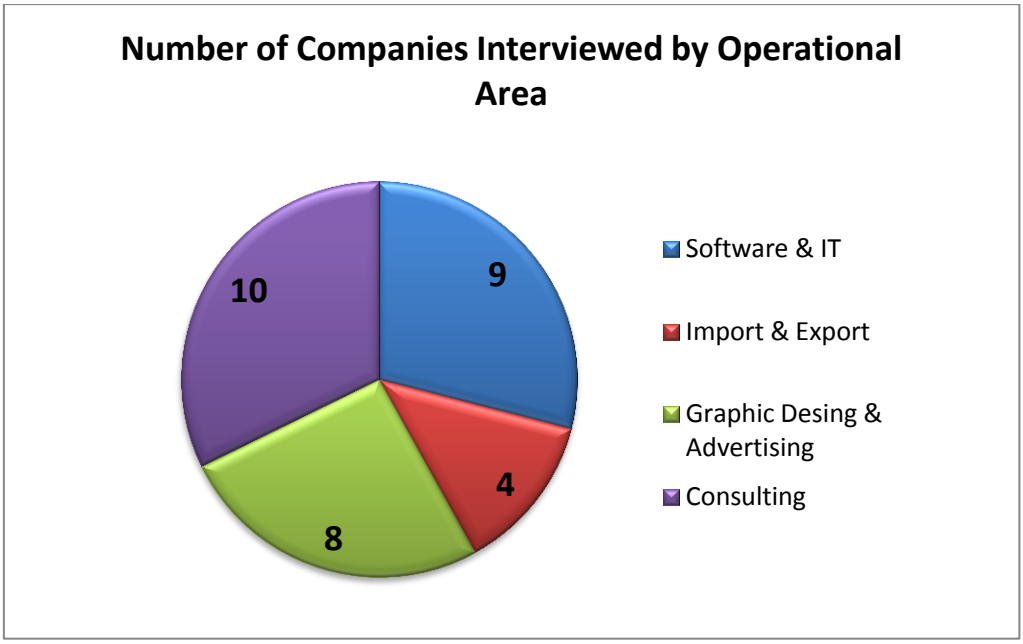


Chart 1: Number of Companies Interviewed by Operational Area

4.2. Company Size - Based on Number of Persons Employed

Most companies that were interviewed were small in size as measured by the number of people employed in the company.

The smallest companies from the sample had only one employee, who is also the owner and the CEO. These company owners can be said to be self-employed. In total, five companies from this size were interviewed, constituting 16% of the total sample. Next in size were the two employee companies. In total, six companies of this size were interviewed which constituted 20% of the sample. Three employee companies represent 10% of the sample which translates to three companies out of the 31. Four employee companies represent 16% of the sample, translating to five companies. Companies employing 7, 9, 11, 12, 14, 16, and 23 employees were each 3% of the total, corresponding to one company in each. Chart 2 on page 31 illustrates company size based on the amount of their employees and their relative share in the total sample.

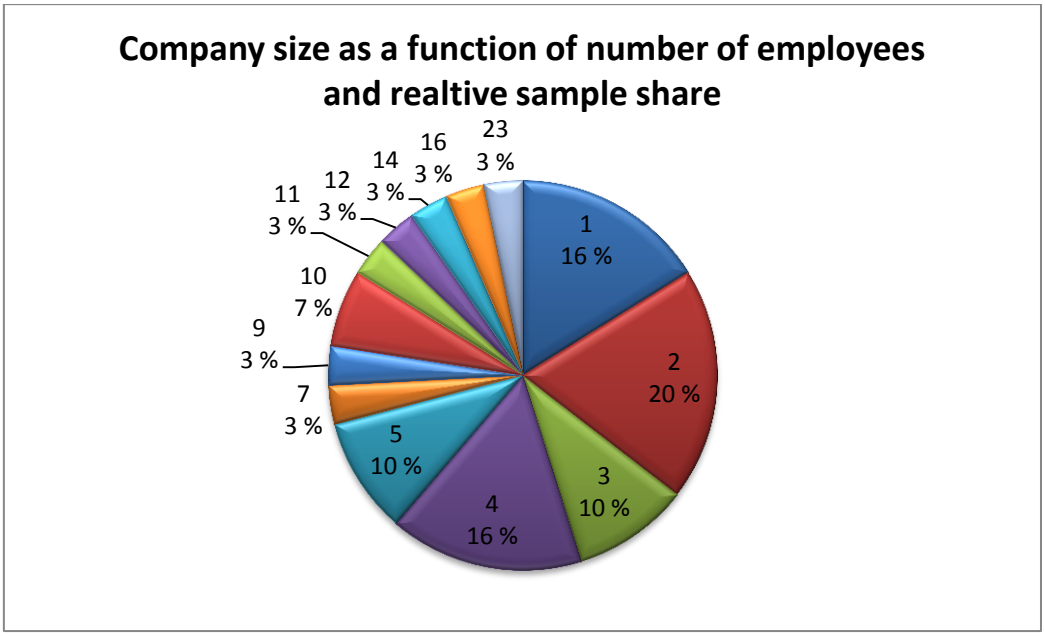


Chart 2: Company size as a function of number of employees and relative sample

The following chart illustrates further the size of the interviewed companies based on the number of people each employed. Each company is illustrated by a code that indicates their field of operation. The letter "I" stands for Import Export firms, the letter "C" stands for consulting firms, the letter "M" for Advertising, Graphic Design and Publishing firms and finally, the letter "S" stands for firms providing Information Technology and Software Development Services.

Since TELCO defined its target customers for the WebTop service as micro-enterprises, employing between 1-19 persons, company M2 that employed 23 persons was excluded from the overall analysis. It seemed that due to its larger size, company M2 deviated in many aspects from other companies in the sample, providing additional reasons for its omission from the analysis.

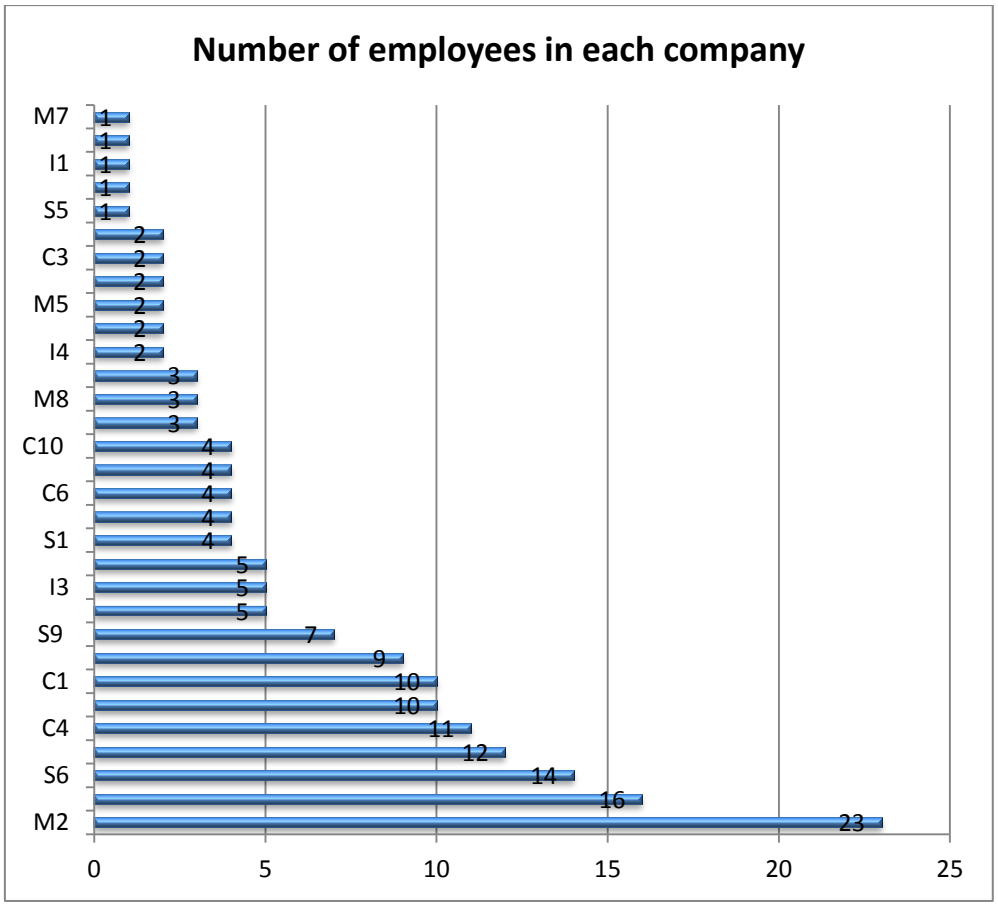
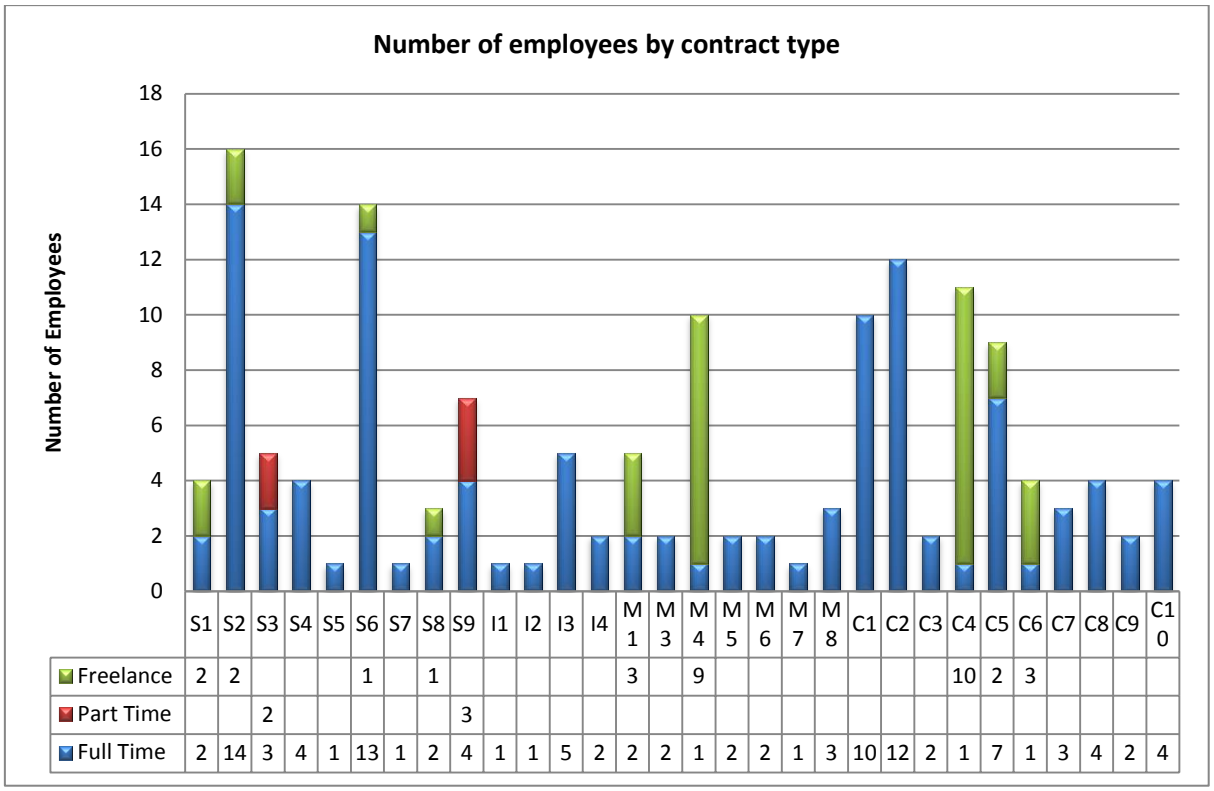


Chart 3: Number of employees in each of the companies that were interviewed

Employees in each of the companies can be broken down by type: full time, part time or freelance employees. The first two types are rather straight forward to understand. However, the term "freelance employee" requires some clarification. Due to strict labour laws in Finland, small companies with limited resources have difficulties with achieving labour force flexibility. For this reason, they utilize freelancers when they require additional resources that bill the company for their work.

The following chart illustrates the number of employees at each company by employment type. Some companies rely heavily on freelance employees to run their operations. For example company S1 has four employees but two of these are freelance employees. At company M4 all employees are freelancers and only the owner/CEO is a permanent employee of the company. This allows company M4, to reduce its workforce to near zero immediately without the need for negotiating terms of release and paying compensation. Company C4 is also operating in a similar manner.



	S1	S2	S3	S4	S5	S6	S7	S8	S9	I1	I2	I3	I4	M1	M3	M4	M5	M6	M7	M8	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Freelance	2	2				1		1						3		9								10	2	3				
Part Time			2						3																					
Full Time	2	14	3	4	1	13	1	2	4	1	1	5	2	2	2	1	2	2	1	3	10	12	2	1	7	1	3	4	2	4

Chart 4: Number of employees by contract type

4.3. Computing Habits of the Micro-Enterprise

Among general IT needs, TELCO was interested in finding out how small companies handled their computing. The interview questions in this section were open ended because TELCO was not sure what type of IT related activities small companies needed to handle or how company owners approached this matter in over-all. However, there were several activities that were assumed to be relevant in this context such as, troubleshooting, maintenance, purchasing hardware and software, and even handling issues arising when a new employee joins the company.

The specific questions that were asked first, whether the company had IT dedicated employees and second, if they turned to outside professional help for handling IT. In the context of this paper, IT dedicated employee is an employee who is hired for and paid for handling exclusively IT matters in the company. Since all of the companies in the sample are small, it was not assumed that these companies would have the need or the resources for employing a person just for handling IT. The answers of the first question have given an important indicator for the complexity of handling IT in small companies. The answers of the second question have also shed some light on whether the companies were able to handle IT on their own or if they needed to turn to outside help.

As Chart 5 illustrates, only 12.13% of the companies employed their own IT dedicated personnel but 54.84% utilized outside IT help.

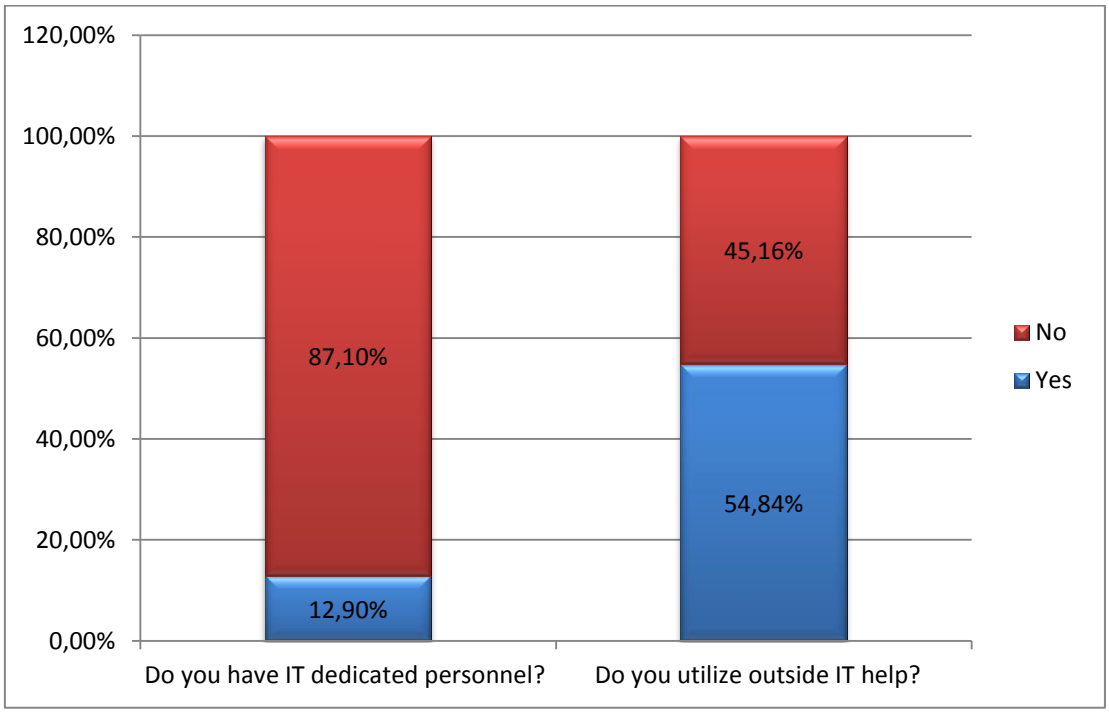


Chart 5: IT support and maintenance

Additional questions under this topic revealed further details about how companies were handling IT matters. In 45.16% of the cases, IT issues were handled by any company employee and by occasional consultation with outside experts. In 38.71% of the cases IT was handled only by company employees, while none of these were dedicated only to IT. 12.90% of the companies needed both own IT dedicated support personnel and outside experts.

Chart 6 is depicting the type of office productivity tools used in the companies. Not surprisingly, 96% of companies were using Microsoft Office tools. Only one company indicated not to use these office tools. An unexpectedly low percentage of these companies were using other types of productivity tools. 30% of the companies used Open Office, 10% used iWork and 10% used Google Docs. Further, in most cases, as seen from the data, alternative productivity tools were used not instead but in addition to Microsoft Office tools. Due to the wide spread usage of Microsoft, companies stated compatibility as a major drive for using it, even if they preferred a different tool set.

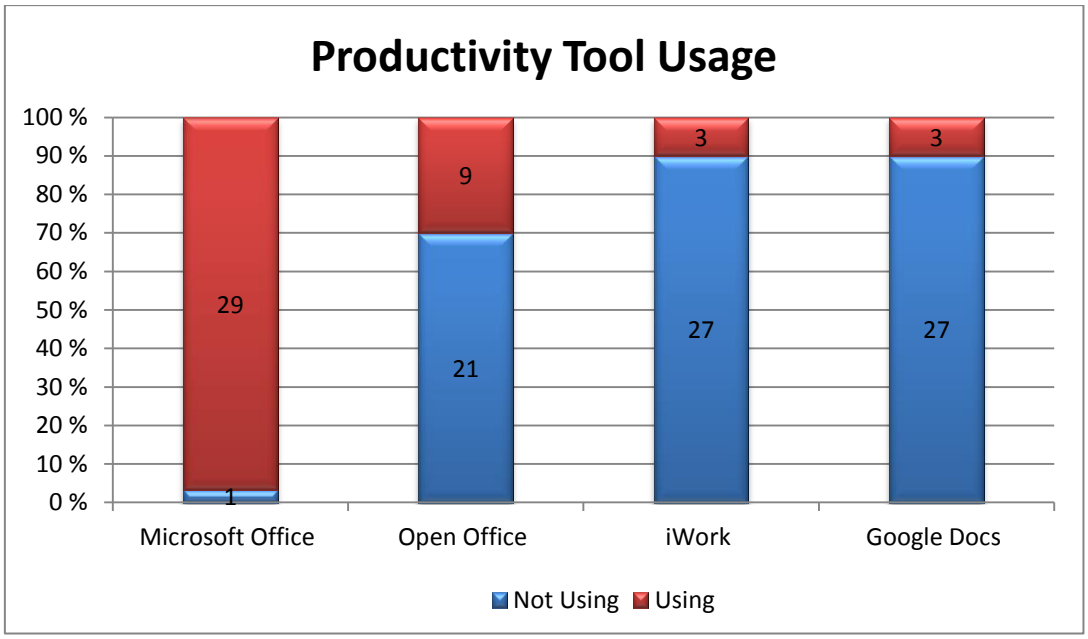


Chart 6: Productivity Tool Usage

TELCO considered the willingness to adopt a large variety, and more importantly, web based productivity tools as a positive indicator for adopting the WebTop service. On the other hand, TELCO also wanted to use the understanding gained here to determine the type of productivity tools that should be incorporated in the WebTop service. Based on the results displayed in Chart 6, Microsoft Office tools should be incorporated in the value proposition in order to mimic successfully a traditional computing environment for end-users of the service.

As one of the critical success factors for adoption of DaaS based solutions and the WebTop service was a high demand for collaboration and communication tools, such as displayed in

Chart 7. Thus, the interview was designed to enquire about current usage of specific tools that were deemed to be crucial in this context. Again, not surprisingly, all companies were heavily relying on e-mail. Although, this specific tool is not considered as a "collaboration tool" by companies due to its triviality in every-day life. Having said that, as mentioned in Chapter 1.1 under the Software as a Service section, e-mail is one of the most widely used SaaS solutions although, it is not necessarily considered one.

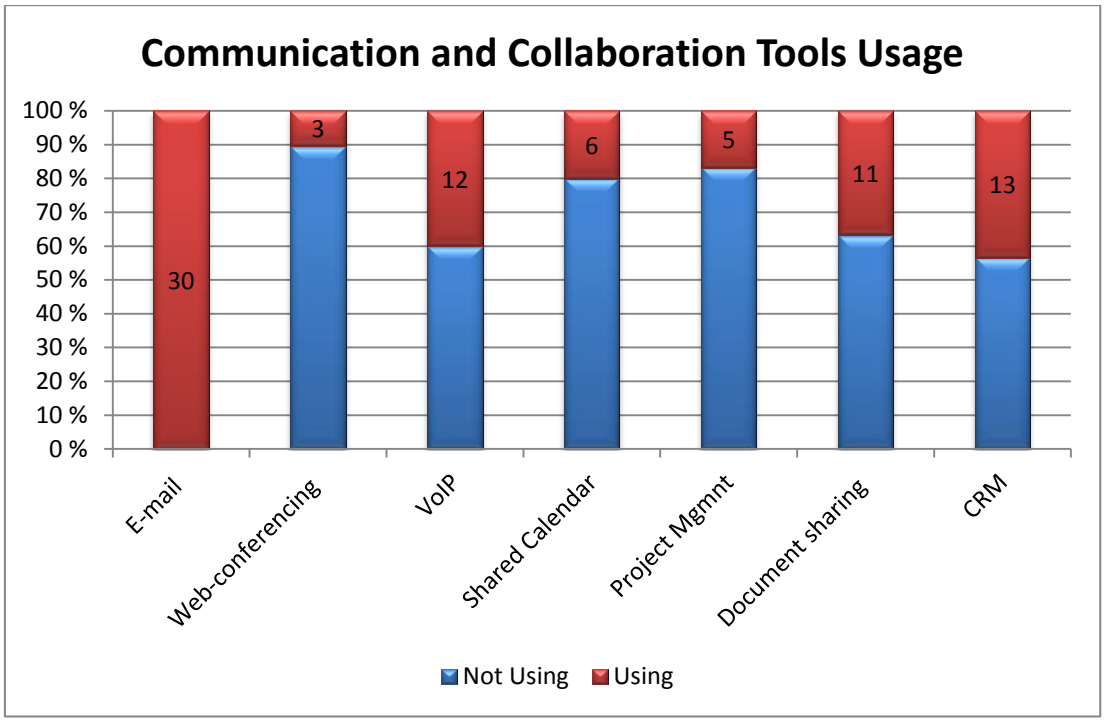


Chart 7: Communication and Collaboration Tools Usage

Further, Chart 7 shows that less than half of the companies were using Customer Relationship Management software, less than 20% of the companies were using Project Management software, and only 20% of the companies utilized shared calendars. All this is indicating a lower than expected rate of use of Communication and Collaborations tools. As seen on the chart from the total of 30 companies, 13 companies were using CRM systems, 11 were using document sharing and 6 were using shared calendars. VoIP (Voice over Internet Protocol, such as Skype) was used by 12 companies. It seems that small companies get by in this regard simply by using e-mail and perhaps by arranging occasionally traditional conference calls. The overall impression is the micro enterprises can and are able to conduct their business without heavy reliance on various IT tools supporting communication and collaboration.

The following topic, which was discussed during the interview, was enquiring about the type of applications companies were interested in having in the future. Chart 8 is depicting the findings, whereas the overall interest in new software solutions did not exceed 20% of the total companies interviewed. In other words, very few companies gave thought to this matter. The highest interest was in Customer Relationship Management Software, followed by Web Conferencing, Group Calendar and Project Management software.

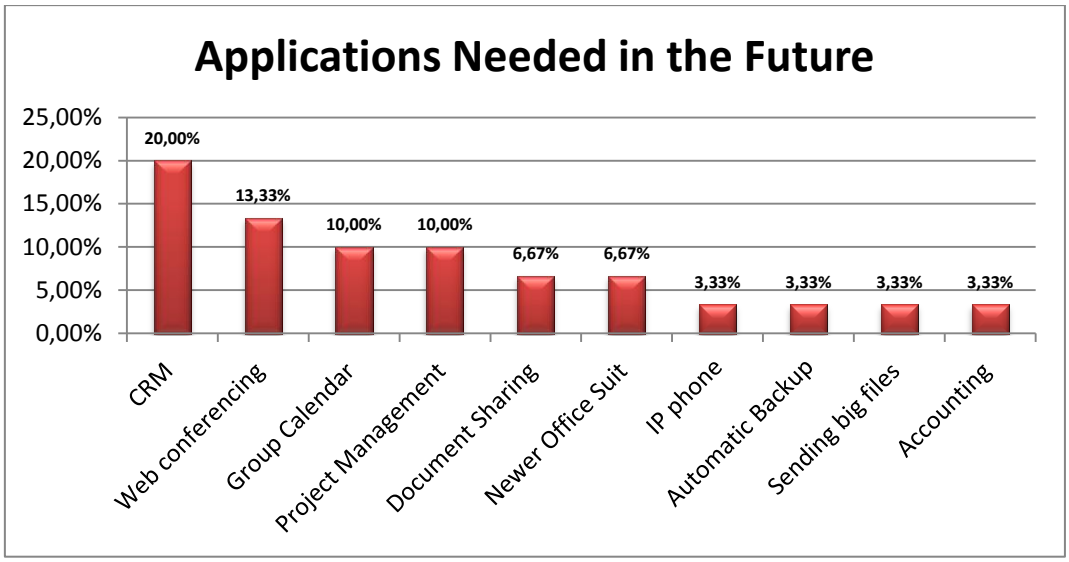


Chart 8: Applications needed in the future

4.4. Awareness to Cloud Computing or SaaS

This part of the interviews had two main objectives: (1) to discover if the concept of Software as a Service is becoming known by decision makers of companies, (2) to find out if companies were considering to adopt or continue to use SaaS based applications and if so what kind of applications.

Around two third of the companies were aware of software offered in the SaaS business model and almost 40% of companies were using certain SaaS based application as seen on Chart 9 below. However, interviewees did not hear before the term "Software as a Service", which can be partly attributed to the fact that the interviews were conducted in English when all the interviewees were natively Finnish speakers. Once they were explained what the terms meant and what type of software delivery model it represented the interviewees were able to identify the business model in question. Although, they were not aware of the term, they were aware of the type of service and understood the difference between the SaaS based and the license based software delivery method.

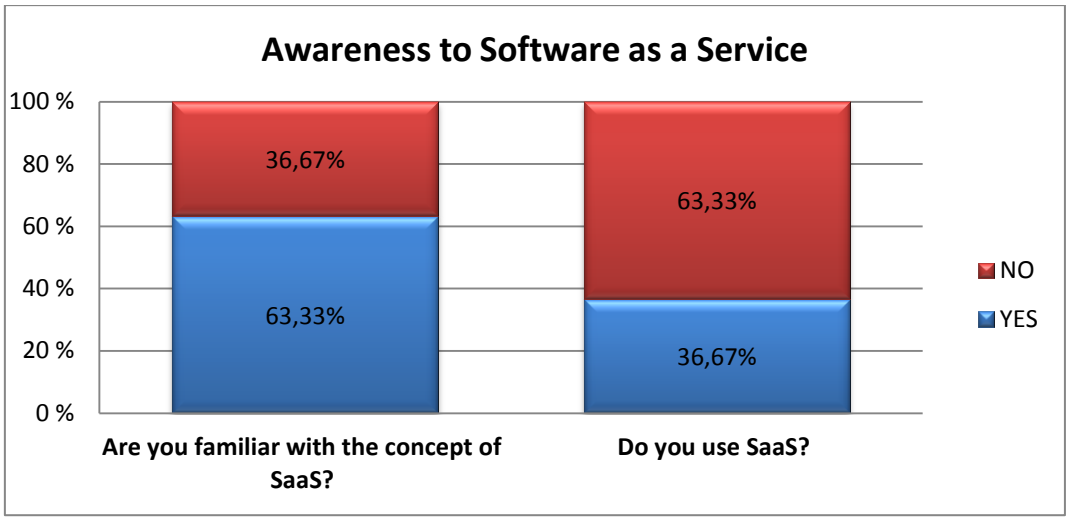


Chart 9: Awareness to Software as a Service

Furthermore, (not shown on Chart 9) companies, that did not use any SaaS based applications, were asked if they would consider such solutions in the future. Out of these companies only about 15% indicated that they would consider using applications delivered by SaaS and 84% said that they would not consider this application delivery method. The main reasons for avoiding SaaS were the lack of confidence in the service delivery method and the lack of need for the perceived benefits of using SaaS.

Companies that were already using SaaS based applications were asked if they would consider using additional applications. Again, only 18% of these companies said that they would adopt additional SaaS applications and 81% indicated that they won't consider adopting additional applications. There was not much difference in perception of benefits stemming from SaaS solutions between companies that already had experience with SaaS based application and companies that did not have prior experience. Thus, prior experience with SaaS based applications did not contribute to demand of using SaaS based services.

The applications that companies indicated that they would consider adopting in the SaaS model were Customer Relationship Management systems, Project Management, and shared company calendars. Applications that were already used in the SaaS model were Customer Relationship Management systems, accounting software, Google docs and Google calendar. In total, 20% of the companies indicated using Google docs and Google calendars at work. In the case of these solutions the perceived usefulness of the environment is tied to the delivery method, which is allowing the real-time update and of sharing of information between employees of the organization. The conclusion is that

if companies used SaaS based applications the reason for that was not originating from the delivery method but rather from perceived usefulness of the application in question. Of course, the usefulness of these applications is dependent on the delivery method, which is enabling cloud based access to information.

4.5. Workforce Mobility and Device Independency

To evaluate overall desire and need for mobility, employers were asked to rate on the scale of one to six the importance of workforce mobility for their operations, their employees' interest in mobility and their interest in device independency,

Following, Chart 10 displays the average and median scores received for the companies in the sample. On the importance of workforce mobility for the company's operations the average score was 4,1 and the median was 5. This is indicating a stronger than average preference for workforce mobility by employers. On the importance of workforce mobility as seen by employees the average score was 3,5 and the median 4. This is indicating an average preference for mobility by employees. On the importance of device independency the average score was 3,1 and the median was 2,5 pointing to a less than average preference towards device independency.

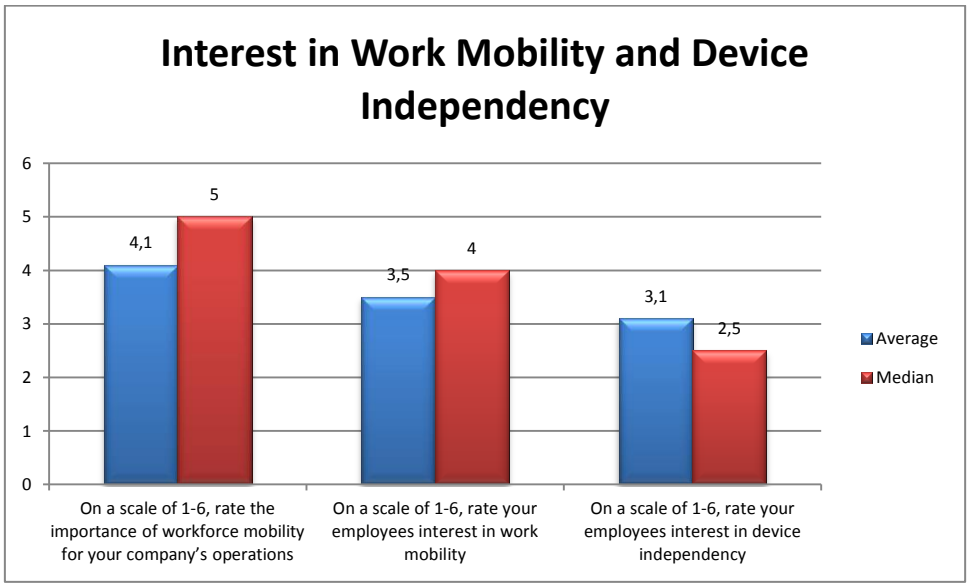


Chart 10: Interest in Mobility and Device Independency

Especially comparing the value of the mean and the median, reveals that the importance of device independency is smaller since the median value is lower than the average, placing half of the respondent to below the average of 3,1. While the topic of workforce mobility, for the company's operations and for the employees, seems to be of higher

importance due to higher average values and higher medians than the scores given for device independency.

In order to determine how important device independency and work mobility are (including the possibility to work from home) to employees of companies, these questions should have been asked directly from the employees. Unfortunately, due to limitations of the study, these questions were directed towards the CEO/owner of the company. Therefore, the results attained are subject to the beliefs of the individual asked and his understanding of his/her employees' needs. On the other hand, since the largest company in the sample employed only 16 people, most likely that the CEO/owner is aware of the employees concerns and wishes.

The rational for these questions is originating from the assumption that employees that travel often are required to work outside of the regular office hours (which is in Finland between 9 AM to 5 PM). Thus, they will use their computers outside of the office, for example while working or at home or, while traveling. Therefore, the need for traveling would positively correlate with the need for device independency. On the other hand, as seen further below, mobility issue can be addressed by assigning employees laptops that can be taken everywhere.

As seen in Chart 11, 63 employees are using PCs and 101 employees are using laptops. The total amount of employees in this sample is 150, meaning that 67% of the employees are equipped with laptops and 9% of the total employees are having both a PC and a laptop to their disposal.

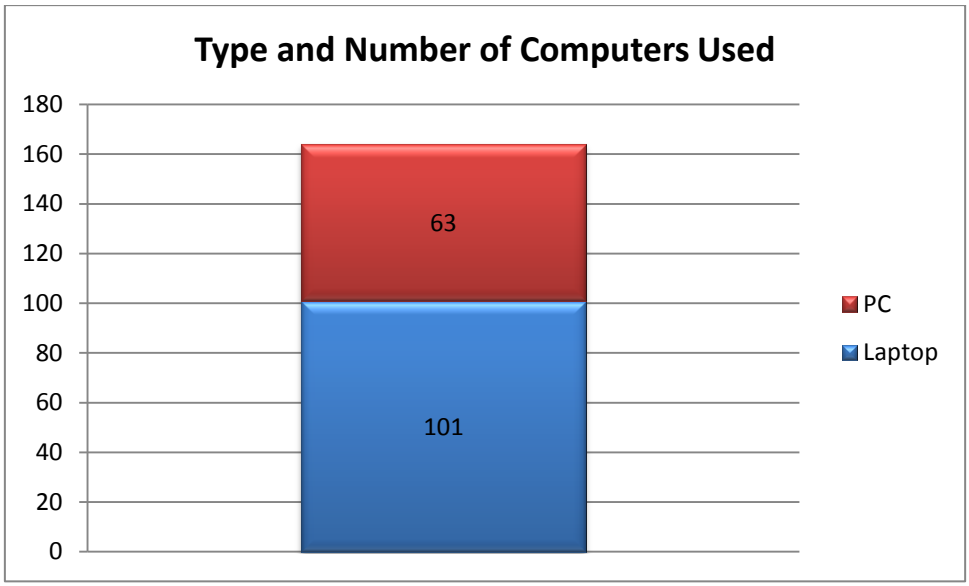


Chart 11: Type and Number of Computers Used

Further, by means of open ended questions, the company leaders were asked if their employees were working from home (either during or outside of the regular office hours) or required to travel for work. Most commonly, the answer was that people might work a few hours per week from home, for example, reading e-mail but in general, all work is being done at the office, during regular working hours or at customer's site.

Only company S9 (belonging to the Software and IT provider category, with 4 full time employees and 3 freelance employees) indicated that they all work from home and report back by e-mail. People from consulting companies indicated the need for travel to conduct their work, especially for sales related activities or meeting clients for consultations. However, due to the use of laptops, this did not pose a difficulty. In companies belonging to Export Import and Advertising, Graphical Design categories, most employees were working at the office and the aspect of working from other locations was not on the agenda. In general, the thinking of decision makers did not imply a dire need to enable further remote work.

For example, employees working in Advertising and Graphical Design required the availability of large professional screens and applications that required large, locally installed processing capacity which was crucial to conduct their work. Therefore, in this sector, working from home for instance would have necessitated an investment in

expensive hardware and software also for home use. On the other hand, storing and backing up ready designs did not receive the appropriate attention in these companies.

4.6. Answer to the second research question

II. Is DaaS the way for a comprehensive cloud computing environment for micro and small enterprises in the future?

As seen from the analysis of existing DaaS solutions, the value propositions of service providers are rather strait forward, mostly catering for the needs of employees that belong to the Light Dependency and Medium Dependency category of on IT needs. The categories in question are defined at the beginning of Chapter 4 and summarized in Table 2. The introduction of IT dependency categories helped in selecting companies for the research. Although subjective, these classifications proved to be rather useful while the interviews revealed the type of applications employees of the companies use and in general, how they manage their IT needs.

The most commonly used productivity tool is Microsoft Office. Other productivity tools are used by less than 10% of the companies in the sample and mostly, in addition to Microsoft Office tools. Collaboration and communication tools are used by less than 50% of companies, whereas the most used tool is simply e-mail. The second most used tool is Customer Relationship Management software, following by Document Sharing systems. Therefore, it seems that IT requirements of companies, even those that belong to the Heavy Dependency category, are rather simple and could be well catered for by existing DaaS providers.

On the other hand, looking into the IT habits of companies, it seems that IT management and mobility of IT related assets are not posing a problem to employees of companies. Purchasing new applications, maintaining or updating applications and handling other IT related issues can be easily taken care of by the knowledge workers themselves. Often, employees can freely decide on the type of hardware and software they prefer to use. Further, mobility issues are solved by using laptops whereas storing data and having locally installed application are not causing an overload on the memory of these devices. Data backups can be done easily on external hard drives to mitigate the risk of theft and breakdown. In the DaaS setup access to all IT resources is dependent

on Internet access. This poses a problem, as interviews revealed that the confidence in availability of Internet, especially while traveling, and the price of these services abroad can be of great concern.

Based on the understanding gained through the interviews, IT needs of micro enterprises could be satisfied by DaaS solutions. On the other hand, since existing IT resources already seem to satisfy users, WebTop would need to deliver benefits to users that could differentiate its value proposition from these practices. Simply providing the same benefits with the added risk of dependence on Internet access will not motivate micro enterprises to switch to a DaaS based solution.

5. Evaluation of Critical Success Factors

In this chapter the paper is going to detail the evaluation of the critical success factors based on the findings of the interviews. The critical success factors were first introduced in Chapter 2.2 and were used by TELCO during the development project as indicators for the need and viability of the new service in question.

The evaluation of the factors gives three types of results: validated, not validated and partly validated. This perhaps sounds somewhat simplified but it is rather practical for supporting decision making. Since the evaluation is based on results of primary and secondary sources it provides a valuable insight to decision makers about the actual need by the target groups for the services developed. Further, the results can be used as guidelines for the next steps, such as continue investing resources in the project, cancel the project or investigate further the success factor and invest resources in deeper evaluation of the factor, regardless if it was validated, partly validated or not validated at all. Of course, besides these results, the project team provided reasons for reaching a particular conclusion, as seen in
Table 3, detailed under the result column.

Critical Success Factor	Evaluation	Result
1. Decision makers of micro enterprises are experiencing challenges with delivering reliable computing tools to their employees	Not validated	Decision makers can handle computing with relative ease and employees are responsible for their own devices and applications
2. The costs associated with delivering and maintaining computing is considered to be a significant that is not scalable and often difficult to predict in advance	Not validated	The cost of providing basic computing is low, thus scalability and predicting future costs of IT is not an issue.
3. Mobility and hardware independency are becoming important aspects of doing business as boundaries between work and private life blur	Partly validated	The high rate of laptop usage indicates preference for mobility. However, hardware independency is not a significant enabler of doing business
4. Data security is a serious concern of micro enterprises that can be solved by switching to cloud computing based services	Not validated	Owners of micro enterprises are not aware of these risks and are not planning to change significantly their computing habits to mitigate this risk.
5. CRM, collaboration and communication by means of web based tools is required by micro enterprises to facilitate team work and to maintain close working relationship with customers, suppliers and business partners	Partly validated	As a mean of communication, e-mail is the most used web based medium. In some cases, document sharing and CRM tools are also web based. However, these tools being web based is not the most important attribute companies care about.

Table 3: Summary Evaluation of Critical Success Factors

Decision makers of companies do not perceive the task of delivering computing tools to their employees to be challenging. Most employees can handle their own computing needs, for example update their applications and make their own data backup. As seen on Chart 5: IT support and maintenance, only 13% of the companies employed IT dedicated support personnel. Indeed, employees of micro-enterprises need computing to complete their tasks and achieve organizational goals. However, employees from three out of four types of companies, namely from Import & Export, Consulting and Graphic Design & Advertising, have only basic computing needs. The most common practice is that each employee will receive a laptop, which they will use both at work and at home. The applications they use are Microsoft Office (Word, Excel and Power Point) with occasional editions of project management software, or communications tools as show in Chart 6 and Chart 7.

1 These requirements are easy to satisfy and maintain by the management of the company and they do not consider this as challenging or even expensive. Companies from the fourth field of IT and Software Development Services are operating on an expert level when it comes to computing and their needs cannot be satisfied even

with the most sophisticated DaaS solution. These companies, even if very small in size, handle their own data storage and backup and the applications they use are mostly for software development. Further, employees from this field are well aware of various free and open source applications and use them extensively.

2 Costs associated with delivering computing to employees are not significant according to decision makers and owners of micro enterprises. In most companies interviewed, employees are using mostly office productivity tools. In graphic design and advertising companies employees need more professional applications to support their work, such as for example, Adobe Creative Suit. However, even in these companies, decision makers were not concerned with the cost of purchasing the needed software licenses. Only one company indicated the need for scalability of IT resources while the number of employees is changing in the company. Further, cost of data storage and processing has not been considered as a factor of decision making in the companies interviewed.

3 Mobility is no longer a barrier, due to the wide scale usage of laptop computers. While traveling, companies are concerned about the price of roaming and availability of mobile data but the companies in the sample did not indicate a need for remote work as a significant factor in their decision making. Device independency as such, the option to access all data from any device, is not seen crucial either. Loss or damage to personal computers can be easily substituted by backing up on external hard drives. Further, capacity available on laptops is quite sufficient to perform knowledge workers every-day tasks. Therefore, there is no need for larger cloud based computing capacity. Further, based on the interview part of Workforce Mobility an Device Independency, we learned that while mobility is preferred, device independency is not a desired feature employees of micro-enterprises.

4 Data security in micro enterprises is not dictated in the same manner as in large corporations which can be a subject to threats, both intended and natural (such as natural disaster: fire, flood, etc.) and these can pose a significant risk to the operation and survival of the enterprise. In micro organizations, the loss and damage of electronic data may cause damage but it can be recovered or replaced more easily than in for example, a Fortune 500 Company. According to leaders of small companies, the risk of security breach is low and the chances for a malicious attack on their IT system are miniscule. Therefore, micro enterprises are not motivated to

change their computing practices due to lack of triggering factors. Among the most needed applications in the future companies mentioned CRM, Web conferencing, group calendar, project management and document sharing tools. However, only 20% of the companies in the sample indicated need for additional applications that they wanted to utilize in the company, as seen on Chart 8: Applications needed in the future.

5

6 Chart 7 is showing how many of the companies were already using software to support their communication and collaboration needs. On this regard, the outlook is much more positive as 43% of the companies were already using CRM tools, 36% were using document sharing, and 40% were using VoIP. Naturally, all the companies in the sample used e-mail but only 10% to 20% of the companies were using web-conferencing, shared calendars and project management tools to support their operations. Therefore, this success factor is not entirely but only partly validated.

To sum it up, factors 3 and 5 were partly validated while the rest of the success factors were proven to be not validated. This means that the micro enterprise in lacking the motivational factors that would direct or even push it to adopt the DaaS. This conclusion alone is indicating that since, the critical success factors are not proven to be critical for adoption of a new IT delivery method, TELCO should consider other target groups for the WebTop or consider other angles that could redesign the service to address real concerns and needs of the desired target group. The next chapter is going to introduce a framework designed to assist with the above task and also answer the third research question.

6. Conclusions and Discussion: The Desktop as a Service Adoption Model

The conclusions of this research will be delivered through an adoption model, titled: **Desktop as a Service Adoption Model** which is linked to the evaluation of the **Critical Success Factors**, presented in Chapter 5. In addition the third research question will be also answered in this chapter.

As seen from the evaluation of the critical success factors, leaders of micro enterprises are not under any kind of pressure to switch from traditional computing to DaaS based computing. From the total of six critical success factors only two were partly validated and four were not validated - to support the adoption of SaaS based solutions. The two factors that were partly validated are:

3 Mobility and hardware independency are becoming important aspects of doing business

5 CRM, collaboration and communication by means of web based tools is required by micro enterprises

Factor #3 is partly validated due to wide spread of laptop computers indicating the need for mobility. However, this factor is not seen crucial for the adoption model since hardware independency is not required as mobility can be easily achieved by using personal laptops. On the other hand, factor #5 is seen relevant for the decision of adopting DaaS due to the apparent need for CRM, communication and collaboration tools. Therefore, factor #5 is singled out to be incorporated in the adoption model as follows:

i. ***The need for CRM, communication and collaboration tools*** - it seems that the higher the need for customer relationship management and various communication and collaboration tools, the more likely that the adoption of a cloud based solution would be considered. The need for the following applications would influence decision making, provided that these applications are updated in real time and information can be shared on the cloud with access to employees of the company:
    a. Customer Relationship Management Software
    b. Company Calendar
    c. Document Sharing and Editing

ii. ***The structure of decision making in the company*** – the more central and focused the decision making in an organization the more likely that a DaaS

based solution could be adopted. In other words, the degree of how centralized the decision making of the organization.

Among micro enterprises, which are the target customer segment for the new service, the decision making is rather central, as seen from the results of the interviews. The adoption of DaaS would be changing significantly the ways IT is managed in the company and not the way IT is used by employees. Therefore, the people responsible for IT management and procurement in the company are the ones that need to be convinced of its usefulness, which is indicating that the decision making should come from the top layer of the organization.

At first look, the structure of decision making might seem as a trivial variable to include in the model. On the other hand, especially in micro and small enterprises employees have a relatively free hand in making their IT related decisions, such as what kind of computers and smart phones they prefer to use and what kind of applications they utilize to conduct their work. Further, as seen from the interview results, commonly the choice of productivity applications is rather strait forward, such as using Microsoft office tools. Deviation from the most common way of using IT resources would require top decision makers to drive the change.

The above variables are captured on Figure 2 below, depicting the **Desktop as a Service Adoption Model**, which is dividing the demand space to three degrees of readiness, namely: low, medium and high. Based on the model, companies that belong to the first quadrant of high readiness are most likely to adopt such a service. In these companies, most employees can benefit from DaaS and use it to conduct and manage their day-to-day work. The third quadrant is representing low readiness to adopt DaaS and the second and the fourth quadrants have a medium readiness to adopt such services.

In the context of this paper, the variables that could be used to establish the degree of need for CRM, communication and collaborations tools are established based on the type of tools used by the company and their desire to adopt additional tools as such. The results attained from the companies interviewed are depicted on Chart 6 titled, Communication and Collaboration Tool Usage and Chart 8 titled, Applications Needed

in the Future. These reveal that the overall current usage and need for such tools is lesser than expected. The general impression is that micro enterprises are able to conduct business and communicate with customers and colleagues alike by using e-mail and occasional phone calls.

Consequently, on this regard, the companies interviewed could get at most a mid-range score for need of CRM, communication and collaboration tools as only less than 40% of the companies used some of the tools that were deemed relevant.

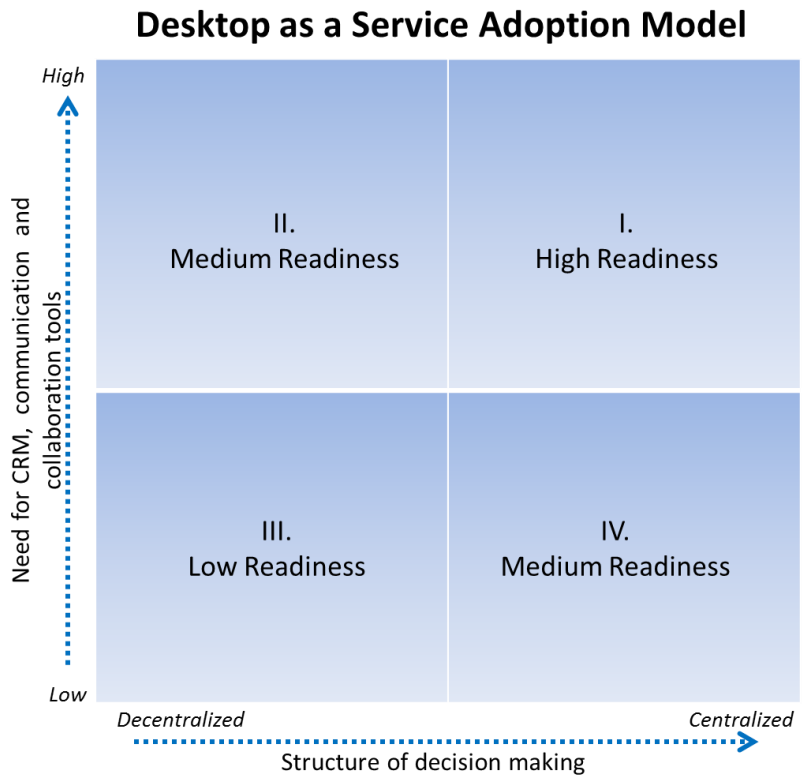


Figure 2: Desktop as a Service Adoption Model

On the other hand, this paper found that in micro-enterprises the structure of decision making is very much central, whereas the CEO/owner of the company is making all the IT related decisions. Therefore, with this respect, the companies interviewed would be on the centralized end of the axis. Therefore, the combined result would point at most to a medium readiness or even to low readiness to adopt DaaS based services. Unfortunately, it is not within the scope of this paper to elaborate on whether medium readiness of the target group justified the investment in developing the WebTop service by TELCO.

6.1. Answer to third research question

III. What factors would be triggering adoption of DaaS by the micro-enterprise?

There are certain types of companies that appreciate the difference between cloud based and traditional IT environments and can reap real benefits by switching to using SaaS solutions. Some of these benefits translate to differences in how people conduct their work. Other benefits arrive in the form of purchasing and managing IT resources in the company. In turn, these benefits may result in cost savings or more convenient access to different IT tools.

As shown on the adoption model, these benefits become relevant dependent on (1) the need of communication and collaboration tools in the company, which is influenced by the type and nature of the company's operations and on (2) how central the decision making is in the company. In the case of the micro enterprise, the decision making is central but, contrary to what was assumed at the beginning of this research, IT management or IT related issues are not the driving force for investment in IT resources, whether in the form of software or IT professionals. On the other hand, the type or nature of the operations could be a driving force for adopting SaaS based solutions, if the benefits of these could support the business.

Therefore, the need for communication and collaboration tools could be the most significant driving force for adopting DaaS solutions, provided that the proposed DaaS solution would improve the ability of employees to communicate with each other and with customers. Deriving from this, the triggers for adoption could be a significant increase in the customer base, requiring more sophisticated electronic tools to follow up and manage projects and transactions. Another trigger could be the need for additional applications that are expensive to purchase and update and thus, using these in the SaaS model could be more cost effective for the company.

However, based on this research, the micro enterprise is not a desired target group for a DaaS type of solution as these triggers do not seem strong enough to switch to this IT

delivery method. In addition, TELCO was looking to find more triggers, arising from the critical success factors. However, most of these factors were not validated which indicated the overall lack of demand for the service.

6.2. Discussion

The demand for Utility Computing seems to be also supply driven. As mentioned during the introduction to the Software as a Service Business model, the emergence of companies offering customer relationship management software in the SaaS setup is contributing to how the demand of companies is shaped for this and to other similar services. Consumption based on actual demand, and the flexibility offered by service providers in the industry, is creating an appetite for various services to be offered in the SaaS model. However, business leaders are going to stay cautious about whom they trust with their business critical assets and they demand reliable and trustworthy services.

Desktop as a Service is pushing the boundaries of trust further. There could be some benefits for using such systems but it seems that the envisioned target group of this service in Finland is not on the verge of giving up their current ways of handling IT assets. There is also a general lack of urgency and triggers for adopting such a service while there is a serious concerns regarding consistent, high quality access to the Internet, even in Finland. Since the DaaS would have relied on the Internet to deliver services and applications to users, this is posing a significant barrier to service adoption by company leaders.

Further, the wide spread use of laptops is allowing for the much desired flexibility of employees to work from home, from a restaurant near the office or simply at a different office perhaps at the other end of the corridor. Laptops are becoming ever smaller, thinner and lighter while continue to increase in capacity. External hard drives can be used to safeguard data and this can be easily achieved without expert IT help. In addition, other devices, such as smart phones and tablet computers are also aiding the knowledge worker on the move. Basically, there is no need for device independency as such because; people prefer to use their own personal gadgets and they have the means to get them.

Trust in the security and availability of cloud services is identified as a must have precondition for initiating a decision making process in the organization for switching from traditional computing to a cloud based computing environment. As the interviews revealed, trust in the service provider's ability to guarantee a stable cloud environment is a prerequisite for adopting the WebTop as an IT delivery method. As off today, in micro-organizations workers are using their own computers for creating, modifying and storing information. In addition, the applications they use are installed on their computers, meaning that they are not dependent entirely on Internet availability to conduct their work. Naturally, as the most common way of communication is by e-mail, they are dependent on Internet availability for electronic correspondence.

But, according to the new setup, employees would be dependent on Internet availability for all aspects of their work, even if they wish to compose a document or prepare a presentation. Therefore, without high level of trust in service availability and reliability as well as user support, companies will not choose this IT delivery method. Granted, technology is developing rapidly and solutions of the cloud type in the Software as a Service model are being introduced by many companies. But, as industry consolidation will concentrate the supply in the hands of fewer, larger, and more trusted players, reliability and trustworthiness of cloud based services are expected to improve significantly.

It is not within the scope of this paper to examine why service providers might prefer for example, to offer applications in the SaaS model instead of selling licenses. If eventually applications and other computing resources will be delivered via cloud computing then companies will have no other choice but to switch to purchasing these as a service.

Perhaps, as this research focused on the micro enterprise (companies that employ at most 19 employees) it could be beneficial to assess how medium and large size companies feel about switching to DaaS and what would be the most crucial triggers for these companies to adopt such a solution. In addition, as it was not within the scope of this study to interview or survey employees of these companies, it could be an interesting endeavor to learn more about computing habits and preferences of

knowledge workers. After all, they are the ones that should be satisfied with using such a service.

Further, as this research was initiated in 2008, it could be interesting to reexamine the companies that were used for benchmark and find out about the most recent developments in the industry. This could provide additional insights about the success rate of DaaS or SaaS based solutions and provide more useful information to companies that already provide or are in the process of developing such services.

7. Summery

This research was commissioned by a Finnish telecommunication company in 2008. The purpose of the research was to investigate the viability of a new service under development; a Desktop as a Service solution for micro enterprises, called later on "WebTop". The origin of the service development project by TELCO came from the necessity of increasing the "Average Revenue per User" (ARPU), an important determinant of profitability in the telecommunication industry that was suffering from steady decline due to saturated markets. Therefore, the company was looking to offer other value adding services to customers both to consumers and corporate clients.

The project of planning, designing and delivering a Desktop as a Service solution was born from seeing the effects of transformation that started taking place in 2008, namely the development of so called "Utility Computing" or "Cloud Computing", which influenced how software and other IT resources were being sold and delivered. In this scenario, instead of selling licenses, service providers would sell subscriptions and provide these, on demand, delivered through the Internet. Furthermore, in this scenario, even computing capacity and data storage would be delivered from the cloud, allowing the scaling of IT related resources with greater easy, without the need for upgrading local computers or smaller, company data base systems. All this is allowed by and dependent on the Internet.

A more specific development related to this phenomenon is a delivery of applications by the cloud, called "Software as a Service" and a more comprehensive form of IT resource delivery, called "Desktop as a Service", which has been the subject of this research. Desktop as a Service is a complete IT environment, delivered through the

cloud to knowledge workers or employees of the company. This environment is completely device independent, as the image users see is "delivered" from a remote location and therefore, the same image can be brought up and the same resources can be utilized on any device. This form of computing has much potential for more effective and efficient IT resource management, which in turn is cheaper and flexible.

The project team at TELCO decided to put focus on investigating the viability of such a service for development and named the service "WebTop". The WebTop came to replace traditional way of using IT by knowledge workers for the every-day work. More specifically, the aim of the research was to aid the development of the service by investigating the value proposition of similar services and to find out about the needs of the selected target audience of the service. The results of the research were used to provide valuable insight to the development team for determining the type of features the new service should have in order to satisfy the target group.

The objectives of this research were to answer three questions, which were as follows:

I. What is the present value proposition of DaaS providers?

This research question was answered by investigation of existing DaaS providers and by gaining an understanding of the type of applications and features these companies offer. The companies that were selected for the benchmark were:

1) Google Apps for Business
2) MokaFive LivePC
3) EyeOS Cloud Desktop
4) Extrasys Hosted Desktop

To analyze the business models of these companies, this research used a framework that was used by TELCO for business development. The framework is equipped with three components, namely: value proposition, value creation and value capture. The scope of this research was limited to value proposition and value capture. Parameters belonging to the *value proposition* category define the type of services and their inherent value that will be offered to prospective customers. In the context of this paper, parameters belonging to the *value proposition* category are applications, service availability,

security features, data management, user support, administrative features and additional services. The *value capture* category determines how the service provider is generating revenue/income from the services provided. In the DaaS business model, most commonly the fee is calculated based on the amount of users per month. The fee can vary based on the type of services offered, such as type of applications available, storage size, security features and support features.

The most common value propositions and revenue models are summarized in
Table 1: Most Common Value Proposition and Value Capture of DaaS Solutions. The desk research reveals that both start-ups and large corporations are active in providing DaaS type of solutions. At large, their value propositions are very similar however; there are significant differences in the following features:

- the type and variety of applications offered by the service,
- size, security and back up options of on-line data storage,
- access to support and type of support provided to users of the service
- availability of varying degrees of service level agreements
- availability various administrative features to define different user types

To sum it up, most of the features offered by these companies are rather basic, catering for the needs of knowledge workers that need productivity tools to prepare documents, presentations and spread sheets. On the other hand, the features enabling communication and collaboration seem to be comprehensive by allowing document sharing, customer relationship management and by various messaging tools to assist in quick and simple ways for coworkers to get in touch. Further, DaaS based environments also assist in storing, securing and backing up data, which is crucial for business continuity.

II. Is DaaS the way for a comprehensive cloud computing environment for micro and small enterprises in the future?

To answer this research question 30 companies belonging to the target category of micro enterprises were interviewed. The companies were selected firstly, based on their size, as a function of the number of employees and secondly, based on their dependence

on computing. The first variable was set to a maximum of 19 employees. The second variable of dependence on computing assumed four different levels of dependency, namely: light, medium, heavy and super heavy. This was to ensure that the selected companies vary in their type of operations and in their requirements when it comes to computing. Therefore, each degree of dependency was paired with a certain field or industry of operation as follows:

- Light dependency – Import and Export companies
- Medium dependency – Business and Technology Consulting
- Heavy dependency – Advertising and Graphic Design
- Super heavy dependency – Information Technology and Software Development Services

Interviewees from each of these companies were asked about topics that interested TELCO the most in context of the new service development. These were, (1) General IT Issues, (2) Awareness to Cloud Computing or SaaS and (3) Workforce Mobility.

Based on the understanding gained through the interviews, IT needs of micro enterprises could be satisfied by DaaS solutions. On the other hand, existing IT resources and practices for example, using applications that are purchased as a license and locally installed, are already satisfying users. Therefore, the WebTop solution would need to deliver benefits to users that could differentiate its value proposition from these practices. Simply providing the same benefits with the added risk of dependence on Internet access will not motivate micro enterprises to switch to a DaaS based solution. Mobility is not a factor that is influencing decision makers in their IT decisions Further, IT services provided by the SaaS delivery method has been used due to the nature of the delivery method which is allowing the instant and simultaneous update of information for all users, such as in a CRM system. Therefore, only if this delivery method is required the system carries benefits for companies to adopt and use.

III. What would be triggering adoption of DaaS by micro enterprises?

This research questions is answered by combining the learning gained through the interviews and using these to evaluate five critical success factors posed by TELCO. The results of the evaluation are summarized in
Table 3.

The conclusions of this research are being delivered through the "Desktop as a Service Adoption Model". Based on the evaluation of the critical success factors, only factor #5 has proven to be critical for influencing the decision making process of micro enterprises, namely "The need for CRM, communication and collaboration tools". Therefore, this factor is incorporated in the adoption model. The second factor is "The structure of decision making in the company". The second factor is that is incorporated in the adoption model has risen from the understanding gained through the interviews about the application usage and future application needs of the micro enterprise. The model is depicted on Figure 2: Desktop as a Service Adoption Model. The model is dividing the target group to three different levels of readiness of adopting this form of computing: Low Readiness, Medium Readiness and High Readiness.

Unfortunately, this research concludes that the target group of micro enterprise is not in a hurry to switch from current practice of using computing for their day-to-day work. The conclusion is that there could be a couple of triggers for adoption by this target group such as, significant increase in customer base or strong demand for application through SaaS. However, these triggers were not seen as sufficient to initiate a switch to DaaS based computing especially as most of the critical success factors were not validated following the results of the interviews.

Reliability and trustworthiness in the service provider's ability is also an additional success factor as this could be a major inhibitor for wider adoption of such services. The psychological barrier associated with having all data and software access on a remote, central location is dictating the choice between service providers. While for private use cloud based data storage is becoming more and more acceptable, for corporate use the requirements of data and privacy protection are of crucial nature and if neglected can be fatal to business continuity. Therefore, trusting DaaS providers, being able to perform

with stringent security and with availability at all times, is a determinant of service adoption.

Appendix A

Virtual Servers

One of today's most evident trends is server consolidation. Until now, companies replaced large mainframes by smaller units, each dedicated to specific applications, serving specific business needs. On the other hand, this approach is carrying several hidden problems and increasing the complexity of IT management.

- First, in this instance logical management is extremely challenging, since tracking the servers as to which applications they have and which services they provide is absolutely necessary.
- Second, the rapid increase of servers in the IT infrastructure (in some cases to thousands of servers in one data center), means more potential fault points demanding more attention from the IT department and more downtime for end-users.
- Third, the processing capacity of these servers is constantly underutilized and thus they provide a low return on investment, waste electricity and cause unjustified CO2 emission.
- And last, the IT infrastructure is rigid due to its over-reliance on hardware, which is bound by physical constraints. Thus, the practice of deploying many smaller and cheaper servers is becoming expensive and inefficient.

Virtualization technology can improve significantly the above mentioned shortcomings. Server virtualization is consolidating the functionality of several servers onto one physical server through virtualization which can easily host multiple virtual servers - each a logically separate entity partitioned from the others.

- First, management and tracking of the servers will be much simpler and cheaper since it is easier to look after one physical server than doing the same for several (see how many virtual servers could fit). Nevertheless, each virtual server is delivering all the same services as smaller physical servers did in the old setup.
- Second, less hardware means less potential fault points while maintenance and repair can be handled without causing downtime for end-users.

- Third, capacity utilization will improve because each virtual server is actually only a software residing on one "real" server and thus sharing computing capacity and saving electricity.
- Fourth, virtual servers are easier to move and modify and hence they increase infrastructure flexibility which is essential to serve changing business goals.

To sum it up, server virtualization will return higher business value by increasing return on investment and decreasing costs associated with maintaining the IT infrastructure. The indirect business benefits including increased flexibility of the infrastructure and freeing up valuable IT staff from tedious tasks and allowing them to concentrate on strategic issues.[26]

Virtual storage

It was already mentioned before that virtualization is allowing for a more dynamic and flexible IT infrastructure. This could not be truer for data storage. Organizations have ever increasing storage needs which are coupled with the need for accessing data centres from various geographic locations. Without the deployment of storage virtualization the above needs are time consuming and expensive to satisfy. The traditional approach would require addition of hard drives on the servers, migration of data from smaller drives to bigger ones and reconfiguration of the servers. Often this process has to be repeated several times depending on the organization's data storage requirements.

Virtualized storage approaches are faster and more flexible because, storage is not treated as an element of a hard drive, but as an abstract resource, which can fluctuate in accordance with changing business demands. It can be treated as an aggregated, logical pool regardless of its physical location in the IT infrastructure. Thus, storage capacity doesn't need to be allocated to a specific spot, rather it can be assigned from a common pool, or returned to that pool based on the requirements at that time. In addition, the allocation or reduction of storage can be triggered by automated monitoring solutions, which can also address capacity problems before they occur. Thus virtualized storage is cheaper, requiring fewer resources in terms of employee time, hardware investment and

[26] Why Virtualization Matters to the Enterprise Today, IBM, IT optimization white paper, December 2007 URL: http://www.techrepublic.com/whitepapers/why-virtualization-matters-to-the-enterprise-today/1378965, 28.4.2013

underutilized storage space. Return on investment is also improved through virtualization in this context.

Appendix B

Google Apps for Small Business

Value Proposition – Google Apps for Small Business is promising to simplify information technology for small and micro organizations. As all applications are browser based thus, new features and improvements can be implemented without the execution of expensive, labor intensive software upgrades by simple browser refreshment, for all users at the same time. Google claims that since they have usage statistics from millions of users and are able to stress test new innovations by consumers, business users reap the benefits in the form of well refined and extremely useful features. Moreover, since users see only frequent, small changes to their applications instead of less frequent, large changes, employees adopt more easily and change management becomes less challenging for organizations.

Google's cloud based platform is promoting hardware, software and location independent computing by allowing users to access their files and documents from any device and any location, such as work, home or vacation destination. Further, viewing and modifying documents is not dependent on the availability of specific software on different devices because all applications are browser based. Collaboration and team work is also easier as users can save and modify documents on the cloud, eliminating the need for sending countless e-mail messages with attached versions of the modified document that often causes difficulties in version control. In this setup, availability of documents and other relevant data will be dependent of Internet access whereas without appropriate connection all work would be impaired.

Google emphasizes that it spends large amounts on physical and process bases security, hires leading security experts and conducts cutting edge security research. Therefore, its data centers are equipped with the latest technology and vigorous access protocols. Google has implemented a multi layered security process protocol that has been verified by a third party for confidentiality, integrity and availability of customer data. Through Google's homogenous global cloud computing infrastructure all security updates are deployed efficiently to every customer, eliminating vulnerabilities that would appear if they did not perform the necessary updates well in time. In addition, security is further

increased because there is less need to store data on hardware that gets stolen, lost or damaged.

Google Apps for Business offers more features in the form of additional business applications for Video support and Google Groups. Users have larger e-mail storage with 25GB storage space and these can be synchronized with Outlook and Blackberry. In addition, it offers stricter security measures in the form of SSO, forced SSL and custom password strength requirements that are important for any cloud computing environment. For this service, Google guarantees a 99,9% uptime and 24x7 support.[27]

Value Capture – Google offers two types of payment plans for small business: Flexible Plan and Annual Plan. The flexible plan does not require from the business to enter a contractual agreement with Google. The fee is USD 5 monthly per user account without a cap on how many user accounts would be created. The Annual Plan requires from the business to enter a contractual agreement for a period of one year. The fee is USD 50 yearly per user account that equals a USD 10 savings per user account in a year. As in the Flexible Plan, there is no limit to the amount of user accounts that can be created.

Moka Five

Value Proposition – Moka Five's solution is called Moka Five Suite, including five main components: LivePC, MokaFive Player, MokaFive Creator, MokaFive Console and MokaFive Management Console. Following these components will be explained in detail[28]:

- LivePC – The LivePC is MokaFive's virtualized end-user computing environment. The LivePC is downloaded to the local computer, running on top of the local operating system and therefore, it is not entirely dependent on server connectivity and it is also operating system independent. In addition, the LivePC could be downloaded to a USB key, to portable hard disk and even to mobile phones, which is further catering for hardware independence and mobility. The LivePC is separated into three virtual layers: system, application and user

[27] Google Apps for Small Business, URL: http://www.google.com/apps/intl/en/business/features.html retrieved 20.11.2011
[28] Ian Song, A Comprehensive Analysis of MokaFive Solutions and Strategies, 2011 and Beyond, IDC Opinion Paper, 2011 URL: http://www.mokafive.com/papers/IDC_Opinion_Paper.pdf retrieved 22.11.2011

personality. Thus, user can personalize their LivePCs while their employers are able to secure core system resources.

- MokaFive Player – The MokaFive Player is a software program that runs the LivePC images or in other words, the user interface. These images, both of the MokaFive Player and of the LivePC, are entirely isolated from the host operating system. Consequently, viruses, malware and spyware cannot affect the virtual machine, even if the host OS is completely destroyed. In such a situation, the user can simply make a copy of the Live PC and download the MokaFive Player to another host.
- MokaFive Creator – The Creator is used by IT administrators to create the LivePC images, update images with additional applications and integrate patches and policies. The MokaFive Player will compare the previous and the new version of the LivePC and download only the "difference". This is an efficient and quick way of updating virtual working environments.
- MokaFive Management Console – The Management Console is used to remotely modify and even destroy unauthorized LivePC images.
- MokaFive Management Server – This is the Management Server where all the server side resources reside.

For now, the Moka Five Suit is not available for micro-enterprises. On the other hand, this solution was selected for introduction because it is a good example of a company that is operating in the field successfully and provides a service that is not dependent on Internet access availability at all times. This unique capability is differentiating Moka Five from other DaaS providers by eliminating one of the main weaknesses associated with other cloud based services. These could be performance related, due to fluctuation in bandwidth and a complete dependence on Internet access.

Moka Five is a client-based solution, runs locally on user's computers and thus users can access their desktops online and offline. On the other hand, the Moka Five Suite requires local resources, in other words, individual computers must be equipped with a 1.6 GHz processor or faster (dual core recommended) and a 4 GB RAM Hard drive with at least 8 GB of free space[29]. As all computers become more powerful while overall prices decrease, the above requirements would not rule out the use of thin clients, which

[29] Moka Five Suit Overview, URL: http://www.mokafive.com/papers/MokaFive_Suite_Overview.pdf retrieved 05.05.2013

is of course dependent on the definition of a thin client. Furthermore, as smart phones become more powerful, these requirements can be achieved without much effort.

Value Capture – The MokaFive Virtual Desktop solution cost $495 to set up and $99 per user annual licensing fee.[30]At the moment, it seems that this solution in not available for an organization with up to 19 employees.

eyeOS

Value Proposition – eyeOS is offering a server based Cloud Desktop that is completely browser based. The Cloud Desktop is managing, presenting, organizing, and managing applications, data and files. Users can access their computing resources from any location and from any device, depending on the availability of Internet connection.

- The eyeFiles solution offers a file management system to create, delete, modify and organize files, just like any other traditional operating system. However, it also enables users to share files and set different privileges.
- The eyeMail is an e-mail application that is coupled to users' Cloud Desktop. Although, this e-mail is web based like all other e-mail, if a document needs to be downloaded or viewed while using a public device (like a computer in a library) it will download only to the cloud, without leaving a trace on the device that was used.
- EyeDocs is text editing tool, with simple features.

The eyeOS professional addition is addressing and countering several weaknesses associated with cloud based environments:

- EyeRun is one of the latest additions to the Cloud Desktop Value Proposition allowing torun heavy applications to run local. Therefore, users will not experience poorer performance when running heavy application but all the files are still saved to the cloud.
- EyeSync is making sure that all the files that have been modified while working offline would be automatically synchronized with the eyeOS account and also between different devices. The eyeOS Mobility Solutions is responsible for synchronizing calendars, contact lists, e-mails and files.

[30] Moka Five Virtual Desktop Solution, TechTarget.com, URL: http://searchvirtualdesktop.techtarget.com/feature/MokaFive-Virtual-Desktop-Solution, retrieved 04.12.2011

- EyeCal is working similarly to eyeSync, synchronizing calendar items between different devices and between different calendar systems. It is also a collaborative tool with group function, file sharing online chatting. Moreover, users can receive real time alerts for calendar invitations or contact requests and can share their files via URL.
- The "Viewer" is allowing users to view their files from any device, without the need for the corresponding program to open it.

The eyeOS Cloud Desktop can be customized to conform to corporate and individual user needs. For example, icons, menus and design can be modified. There is also a choice between various applications from the above eyeOS professional solution. This can be further enhanced by integrating third party web services, which is fully supported.

Value Capture – According the service's website, there is an option for a subscription based contract or a license based contract. However, the site did not explain or detailed the differences between these two options; neither gave indication of pricing.

Extrasys Hosted Desktop

Value Proposition – Extrasys is providing "IT on demand" to small and medium sized businesses. Users can work at any place, any time and from any connected device. In this sense, the general value proposition of this company is very similar to the previously introduced companies. However, the idea is more tangible and comprehendible to business users because the remote environment offered by this company would look and feel exactly as user of Microsoft applications would expect.

Extrasys hosts remote Microsoft Windows desktops for customers on a Citrix server farm in their own data centre. Users can access remotely their hosted data, email and applications via the web using SSL and a security token that generates new passcodes to use every time users log on to the system for maximum security.[31]

The following applications are included in the Hosted Desktop:

- Windows Server 2008 desktop including Microsoft Windows Server Enterprise User Licenses, Windows Terminal Server User Licenses and Citrix Licenses.

[31] Hosted Desktop – A Virtual IT Infrastructure, Extrasys.com, URL: http://www.extrasys.com/hosted_services/products/hosted_desktop.php 05.12.2011

- Microsoft Office 2007/2010 applications, namely Microsoft Office Standard Edition 2003/2007 including Excel, Outlook, PowerPoint and Word with the possibility to upgrade to Professional Plus Edition, including all the Standard Edition software plus InfoPath, Publisher and Access. Extrasys is able to host also non-Microsoft applications, such as OpenOffice or various accounting software.
- Microsoft Exchange email & webmail that is accessible through the hosted desktop with any mobile device, including calendar and contacts. This is achieved by forwarding business email addresses to the Extrasys Exchange Server. Internal email distribution lists and shared email inboxes can be set up.
- Anti-virus & Anti-spam protection

These are the main additional services provided to Extrasys Hosted Desktop users:

- Collaboration is reinforced by allowing users to create, merge and view PDF files and by sharing files on the network drive
- Each desktop user account has an initial allowance of ½ GB of data storage for emails and ½ GB for files. Additional storage is charged per GB per month and is tallied up at the end of each month. The system generates automated back-ups and
- Security token for remote access: In addition to user names and passwords, each user is supplied with a keyring-sized SafeWord® security token that generates new passcodes to use every time they log on to our system; and we can provide a list of passcodes to log on with until the token is delivered or if it is misplaced.[32]
- Email, telephone & remote support is available by support ticketing system during regular working hours

Value Capture – The company is charging a monthly fee per user starting at GBP 75 for organizations with 11 or more users. In addition, Extrasys is charging for services related to implementing its solutions, such as IT infrastructure design and integration with ERP solutions.

[32] Hosted Desktop – A Virtual IT Infrastructure, Extrasys.com, URL: http://www.extrasys.com/hosted_services/products/hosted_desktop.php, retrieved 05.12.2011

Appendix C

Table 4: DaaS Providers Identified in 2008

Company Name	Google	Virtual Office Desktop	Mokafive	Extrasys	Virtual Desktop	Stoneware	eyeOS.org
Ownership	Public	Private	Private	Private	Private	Private	Private
Company URL	http://www.google.com/ig	http://www.virtualofficedesktop.com/	http://www.mokafive.com/	http://www.extrasys.com/	http://www.virtualdesktopinc.com/	http://www.stonewarewebos.com/	http://eyeos.org/en/
Country of Origin	USA, California	UK	US	UK	USA	USA	Spain and France
Year of Establishment	1998	N/A	2005	2000	N/A	2000	2005
Number of Employees	20123	N/A	10	Few hundred	N/A	N/A	8
Known Partners		Citrix IBM VMware Swiftwork Virtual Iron	USB partners: SanDisk Ironkey Intel	Microsofot Gold Partner Citrix	Citrix Cisco	http://www.stonewarewebos.com/webos/partners/partnerlist.html	Interdominios (spanish company)
Target Niche	Consumers & Business	Business	Business	Business	Business	Business	Consumer & Business

Appendix D

Company Questionnaire

Interviewee's name:
Position in the company:
Contact info:
Company's name:
Contact info: address, phone number, URL:
Annual Turnover:
Number of employees:
Operations' characteristics:

General IT issues

1. Have you got your own IT department/dedicated IT personnel?

   1.1. If the answer was YES: What kind of functions do the IT dedicated personnel fulfill?

   Anticipated answers or guidelines of example answers (to be used if interviewee does not understand the nature of the question):

   - *Server maintenance*
   - *Hardware supply*
   - *Software supply*
   - *Data storage and backup*
   - *Administration of user accounts/groups/access to apps*
   - *Maintenance of hardware*
   - *Strategic support of the company*

   1.2. If the answer for question 1 was NO: How do you manage your IT needs?

   Anticipated answers or guidelines of example answers (to be used if interviewee does not understand the nature of the question):

   - *IT is outsourced completely*
   - *IT is handed ad-hoc by company employees and there are no solely IT dedicated people in the company*
   - *IT is handled by company employees and in case of special issues/problems by IT service providers*

2. Who makes in the company your IT related decisions?
3. Who is purchasing hardware and software in the company?
4. Where do you store your data?
5. How do you handle data back up and administration?
6. What kind of hardware your employees use to conduct their day-to-day work?

Anticipated answers or guidelines of example answers (to be used if interviewee does not understand the nature of the question):

- *Laptops*
- *Personnel Computers (that are not "mobile), also referred to as PC*
- *Smart Phones (mobile phones that can be used to read e-mail and view documents with 3G or WiFi connections)*
- *Computers at home (that are not purchased by the company for the employee)*

6.1. Have you standardized the type of hardware of your employees in your organization? In other words, does everyone needs to use the same brand and type of computers, for examples or phones?

7. What kind of applications and tools do your employees use?

A list of applications and tools of special interest of the research:

- *Office productivity tools for example, spreadsheets, or applications to create presentation or documents*
- *E-mail systems*
- *Calendar sharing*
- *Document sharing*
- *Project Management*
- *CRM (Customer Relationship Management)*
- *Accounting/book keeping*
- *ERP (Enterprise Resource Planning)*
- *IP phone, Voice over IP*
- *Web conferencing*

7.1. What kind of applications would you like to have in the future?

7.1.1. What is keeping you from purchasing these applications?

Anticipated answers or guidelines of example answers (to be used if interviewee does not understand the nature of the question):

- *Not sure of the overall benefits*
- *Wasn't able to convince the company that we need the application*
- *Concerned that it will be too complicated for employees to use the application*
- *Too expensive*
- *Capacity of current hardware is not sufficient for such an application and taking it into usage would require an investment in upgrading hardware*
- *Didn't have time to consider the issue yet more seriously*

- *Not a priority at the moment as this application is not critical for the business in general*

7.1.2. How do you acquire software licenses?

Awareness to Cloud Computing and SaaS

1. Are you familiar with the term SaaS?

    1.1 If the answer to the previous question is yes: What do you know about the above offer? What is your general impression?

2. Have you considered using applications or information systems in the SaaS delivery form?

    2.1. Which specific SaaS applications or information systems would be suitable for your company?

3. Do you have concerns regarding this delivery method of IT and related services?

Workforce mobility

1. Is most of the work done by your employees is being done at the office or are they active at home (maybe after the regular office time as additional hours or by splitting the working time between home and office)?

2. On a scale of 1-6, to what extend workforce mobility is important for your company's operations?

3. On a scale of 1-6, rate the degree of interest of your employees in work mobility?

4. How would your company benefit if employees would be provided with more convenient and flexible mobile working environment?

5. Is device dependency an issue, and how?

    5.1. On a scale of 1-6, rate the degree of appreciation of device dependency of your employees. 1 represents the least interest in device independency and 6 represents very strong interest in device independency.

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