



Need for Speed

Yearbook 2014

N4S-program Year 2014



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Foreword

N4S-program: Finnish Software Companies Speeding Digital Economy

The internet is the first truly global platform for the digital economy and will create significant new business, economic, and social opportunities. Products and services are increasingly developed by a network of collaborating companies. Even domains such as embedded software and complex cyber physical systems are increasingly being opened for more networked development, agile creation, testing, integration, and deployment of new features and services on the internet.

Need for Speed (N4S) will create the foundation for the Finnish software intensive businesses in the new digital economy. N4S adopts a real-time experimental business model, and provides capability for instant value delivery based upon deep customer insight. The program is executed by the forefront Finnish software companies. The consortia consists of 11 large industrial organisations, 14 SMEs and 10 research institutes and universities. The four-year program of Digile (2014–2017) is partly funded by Tekes, Finnish Funding Agency for Innovation. Tekes is the most important publicly funded expert organisation for financing research, development and innovation in Finland.

New, evolving ecosystems and new competitors will alter industry structures, the public sector, supply chains, and many other aspects of the future business environment. Thus the long-term plan of N4S is to serve other companies where software plays a dominant role in engineering – for instance, those associated with the auto-mation industry – by making the program’s results, tools, and processes widely available.

DIGILE aims to increase the pace of development of Finnish ICT and digital business, which in turn will ensure growth of the business of the whole sector, and the eventual creation of new jobs. Nowadays, digital business is an essential part of all kinds of business as well as public services -not just ICT.

As one of Finland’s Strategic Centres for Science, Technology and Innovation (SHOKs)—DIGILE’s role is not only to bring together and systematise research and development, but also to ensure that the results of research are understood, applied and adopted as part of companies’ business practices faster than ever before.

From Agile and Lean Development to Real-time Delivery

The N4S program will act as a catalyst for a new way of working where companies can identify future market transformations and create new digital on-demand services. This will mark a quantum leap from agile and lean development to real-time value delivery that uses continuous deployment and market experimentation. Competitiveness is increased because individual experiments can be validated with real users, in turn increasing the ability to deliver the right product or service at the right time.

New revenue streams will be generated from a number of different directions:

- Vendors who provide tools for managing the complexity of business

- Companies that help analyze and understand the results of experiments
- New business opportunities
- Start-ups

Areas of Focus

Mercury Business – Find the New Money: This target focuses on how companies and societies can behave like liquid mercury, finding and flowing into new grooves. Mercury Business is the ability to adapt to new business conditions and search aggressively for business opportunities in new markets with minimum effort. This new approach to business growth is enabled by continuous and active strategic focus, a new leadership style.

Deep Customer Insight—Better Business Hit-Rate: Software-intensive industries in Finland are utilizing new technical infrastructure and capabilities as well as various sources of data and information to gain and apply deep insight into customer needs and behavior. This knowledge will enable the industry to improve sales and make significant returns on investment in the development of both products and services.

Delivering Value in Real Time: The Finnish software-intensive industry has renewed their existing business and organizations towards a value-driven and adaptive real-time business paradigm. Technical infrastructure and required capabilities have been established to support the transformation.

www.n4s.fi | www.digile.fi



Ari Turunen

The N4S-program is Building New Infrastructure for Industrial Software Applications

The N4S-program creates new business models and methods for accelerating service development and production of software-intensive products. The digital economy requires that services are created in nearly real time – while continuously listening to the customer.

The digital transformation in economy has been intense. Digital commodities are instantly available to everyone, at any time of day. The challenges of real-time services do not concern merely small and agile gaming companies or mobile application producers. The transformation has an impact on traditional industries as well. Managing and analyzing the data collected about products and customers is also critical. This is the reason why the partners cooperating in the N4S-program are IT companies and large industrial companies, whose business is increasingly relying on software.

Ari Turunen

Companies focused on data analysis in the Program are the top in their field. For example, Avaus is designing and implementing solutions related to data management for many large companies in the European market. Whereas Invenco specializes in data storage and its operations cover all the important database products.

The N4S-program includes expertise in designing embedded systems. Applications where microprocessors have been used to provide intelligence for the devices are abundant in consumer electronics, automation, mobile phones or, for example, in switchboard operations. These applications exist in vehicles in particular: combustion engine control systems, anti-lock brakes, traction control and on-board computers.

Metso operates in many sectors and is a leading supplier of device and service solutions for industries that design embedded systems for the process industry. Another Finnish company, Elektrobit develops the most progressive embedded technology solutions in its field for the car industry and wireless systems.

Digitalization is taking traditional industries by storm. Future devices and home appliances consist increasingly of embedded systems that use information networks to communicate with each other. Ericsson, a world-leading supplier of internet solutions, forecasts that by 2020 there will be more than 50 billion devices operating with a network connection.

Janne Järvinen, External R&D collaboration Director of F-Secure and Focus Area Director of the N4S Program, believes that the business operations of traditional large industrial companies will gain new opportunities when the latest technology developed by software companies is utilized.

“It will not merely be small and medium-sized software companies leveraging the new opportunities, there are also large companies, such as Ericsson, Huawei and Elektrobit, involved in the program.”



Ari Turunen

N4S Project Director Janne Järvinen in the lobby of F-Secure, under the monitor where data security attacks all over the world can be monitored in real-time.



Data Collection, Analysis and Quick Reactions are Foundations for Success

It is not sufficient enough that digital products are available to everyone in the cloud. In addition to mobile applications, successful companies must also collect data regarding customer behavior in a sensible manner. According to Janne Järvinen, companies must understand their customers very well and engage in constant interaction with them. This applies to traditional industries as well as sectors of new innovation.

“The transformation of the new digital economy is so rapid and immense that companies must be able to follow and manage their business with a new flow and rhythm. This is how the best gaming



Younited is F-Secure's new flagship cloud solution.

companies operate already. If large companies wish to maintain their competitive edge, I do not see any other possibility but to adopt a new kind of rhythm. This requires critical inspection of existing structures, and their possible elimination."

Järvinen believes that change is possible if the companies build an infrastructure that enables real-time reactions and service. The N4S-program is actively creating this type of infrastructure.

"In practice, you have to have the technical competence to produce, test and deliver software to customers customer almost in real-time. You also have to be able to obtain feedback and react to it just as quickly."

As an example, Järvinen mentions F-Secure, which has developed such a system for virus protection. It is proven that F-Secure provides the best data security in the world. The company, who has received many awards and certificates, has quickly started developing different cloud services. Younited, their new private cloud solution for everyone, specialises on security with sharing and syncing capability for any device, any-time and anywhere. F-Secure can process as much as 300,000 malware samples per day, and it can provide a nearly real-time response at best.

"Reacting through the system developed by F-Secure is very quick, because it is a system dedicated to combating malware in particular. Similarly, some gaming companies are able to provide a very quick response too. The idea is to apply the same method systematically and broadly in Finnish software-intensive industry."

Even though reacting to changes must become faster, it cannot be done at the expense of quality. Traditional quality assurance methods are not sufficient in real-time business operations. Therefore, new analytic methods and testing techniques are needed, based on lean thinking. New methods for designing, developing and testing software and accelerating production are being created during the N4S Program.

Finnish software competence is also used in icebreakers, whose design is very lean and agile. In the 1990s, Järvinen was installing the new special program on icebreaker Kontio when the ship had an immediate duty call and had to storm out to fulfill a mission. It took half a day of icebreaking before Järvinen was taken back to the harbor.

"New methods are related to making the whole production chain faster. These methods include dividing things into smaller parts, iteration and strong automation. In practice, therefore, one small amendment can be made for the customer, which will be implemented and reviewed. Then it will be locally tested and integrated with other parts, against the whole system. When this has been done, it will be

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delivered to the customer for deployment. The change is significant, since previously even the smallest amendment was delivered to the customer but only together with a larger update.”

Järvinen’s vision is an application with which, just by clicking, it is possible to easily conduct “business experiments”, as he puts it - for example, testing two or three versions of the new property for the product or service. Through the system, the different versions are implemented and tested with different customers in different countries. The following day, Järvinen would obtain information about the purchase behavior of the customers. If, for example, 64% of people in a certain country liked version C, it will be selected for further development.

Before becoming the Director of the N4S program, Järvinen spent four years as the Director of the Cloud Software Program. What were the lessons learned from the Cloud Software Program and what kinds of good practices did it bring to the N4S Program?

“Cooperation, cooperation and cooperation. The Cloud Software Program proved that even large joint projects can be successful, if common values are discovered and genuine cooperation constantly sought. A tangible innovation was to apply incremental techniques known in the software industry, such as SCRUM, in the research project. In this manner, transparency was gained for work in different organizations faster compared to the traditional models.”

There are 33 companies and research institutions operating in Finland who are involved in the NS4-program. These include: Aalto University, Åbo Akademi University, Avaus, Cybercom, Descom, Digia, Elektrobit, Ericsson, F-Secure, Gosei, Huawei, Inno-W, Invenco, Ixonos, JAMK University of Applied Sciences, Jutel, Lappeenranta University of Technology, Metso, Nokia Solutions and Networks, PacketVideo, Qentinel, Reaktor, Tampere University of Technology, Tieto, Tribeflame, Visma, University of Helsinki, University of Jyväskylä, University of Oulu, Vaadin, VividWorks, Vincit and VTT.

Managed by DIGILE, the four-year program is funded by Tekes and participating companies.

F-Secure Cloud Services

Freedome

F-Secure’s latest application for privacy protection is Freedome, which hides traffic and makes its user anonymous online, without collecting any personal information about the users. It enables completely anonymous online presence, hidden from tracking. Freedome hides the device’s IP address and shows the F-Secure address selected by the user. The application hides connections, prevents tracking, protects browsing and provides virus protection. It does not collect user data and does not require registration – the users are completely anonymous to F-Secure as well.

Younited

Younited gathers photos, videos, documents and all other content that users have on different devices to one place. It includes virus protection and the best data security in the field. It has been designed especially for securing your privacy. The information saved by Younited users in the service is located in Finnish data centers, providing excellent privacy protection for the data. All the data in the service is encrypted, and the user information is not given to advertisers, unlike in many other popular online services.

SAFE

Smartphones or tablets can easily be lost or stolen. Due to F-Secure’s SAFE application, the user can lock their device and locate it.

www.f-secure.com



Ari Turunen

The Sprint in Large Projects

When there are many organisations involved in a project, the danger is increasing bureaucracy and unnecessary work performances. The N4S-program utilises the principles of good software design also in the management of the entire project.

In software design, it is essential to grasp the factors that hinder the project's progress. The aim of agile and lean methods is to quickly obtain concrete and usable intermediate results, to reduce futile bureaucracy and improve the quality of the work. The aim is that the software and its sub-areas gradually change to become more correct and complete during several rounds of implementation, i.e. sprints.

N4S-program Coordinator **Tua Huomo** was involved in the 4-year Cloud Software Program, where these principles were tested for the first time in the management of a research project.

"We discovered that the research projects cannot be isolated from the ever-changing business environment. Therefore an agile approach was integrated into project management. The aim was the quick utilisation of the research results in business operations, as well



N4S-program Coordinator Tua Huomo

as an iterative manner of disseminating the results to the entire consortium,” says Huomo.

Nowadays, a similar model is utilised also in other DIGILE programs, as well as in the new N4S-program, which was launched in the beginning of 2014. Huomo believes that the agility of large projects can and should be increased. If the vision and the goals are clear, the sprint model also works well in large joint projects between many organisations.

“We discovered that the research projects cannot be isolated from the ever-changing business environment. Therefore an agile approach was integrated into project management.”

Added Value for Business Operations

Since changes in the ICT field are rapid, planning a vast research program is challenging. The research program must prepare its own guidelines and profit targets. It is particularly important to invest in the initial preparations of the program.

“You must consider carefully for what purpose the research program is needed. Often joint projects only seem to engage in cooperation and the common goals are mere rhetoric.”

Huomo believes that the research operations in the field of ICT should always include a clear link to business operations and their exploitability. It is also essential to achieve good cooperation between the industry and research organisations.

“In research, scientific advancement is of the essence, but it is also important that the research results provide real impact on business operations.”

“You must consider carefully for what purpose the research program is needed. Often joint projects only seem to engage in cooperation and common goals are mere rhetoric.”

Sprint Model for Administration

Huomo emphasises that the results of a program such as N4S are evaluated based on its impact on business operations. Therefore it is important to understand what happens in the surrounding world, and how companies could be at the forefront as exploiters of new opportunities. “In the rapidly changing world, we should not prepare 4-year project plans with result lists. It would be better to focus on long-term vision and goals, and plan concrete action and results in the short term. For example, in large projects, presenting and critical evaluation of results every three months saves time and resources.”

In joint projects, it is essential that all results are disseminated as transparently as possible. This can be easily done with the sprint model and the right tools and methods.

In a research project, the sprint model functions so that the organisations involved develop products, services or even operations in cooperation, within a certain framework and in a manner agreed upon together. The goal is that the whole and its sub-areas gradually



change to become more correct and complete during several rounds of implementation. These rounds are referred to as sprints. A sprint ends with a demo and result evaluation event, where, for example, the next software version can be introduced. Within different sub-areas, smaller sprints can be made according to need. In software development, the length of a sprint may vary from a few days to a few weeks.

The sprint model turned out to work particularly well in the Cloud Software project. It was not used only in software planning, but also in the management of the entire project.

“The sprint model focuses on creating results regularly. As a result, the manner of proceeding has supported the profit-orientation during the entire project, and there was no final rush typical of joint projects to finalise the promised results before the end of the project.”

During the Cloud Software Program, all in all more than one hundred demos were presented and the events were held every quarter of a year. These events called bazaars were open for all organisations participating in the project. The idea was to introduce the results with a few minutes’ pitch. In this manner, the information travelled efficiently and, at the same time, premises for utilising the results and generating new cooperation were created.

“I consider the biggest advantage of the sprint model to be that it supports cooperation, dissemination of results and, above all, regular networking between the people working for the project, so that they get to know each other on an organisation and personal level. With these sprint model working methods, the information within the project has travelled better, the utilisability of the results has been more efficient and time has been saved for promoting important issues.”

According to Tua Huomo, a similar model has not yet been used elsewhere in jointly funded projects. “However, this is not merely a matter of regular meetings but a “change of mindset”—focusing on creating results and learning. The focus is on creating results and learning. The project plans and profit targets can be changed if the surrounding world changes. The focus is on value creation and not following the reports in the project plan.”

The Goal is to Advance Global Business Operations

There are many Finnish information technology innovations out in the world that have been financially exploited outside the borders of Finland. One of the aims of the N4S is that the productification of innovations happens in Finland, launched by Finnish companies. In

Tua Huomo’s view, one important area is data-intensive cloud services and their utilisation.

“There are many companies in the N4S consortium that have competence in data utilisation. On the other hand, this area also has potential for significant new business operations.”

Open Software Cloud

Information security also provides many different opportunities. The need for secure data-intensive cloud services will increase in the coming years. The Cloud Software Program had its own information security section, led by Ericsson Finland and the University of Oulu. During the Cloud Software Program, Ericsson and F-Secure developed their own cloud services. Ericsson’s virtual cloud service platform has been optimised for the needs of telecommunication companies’ communication services. F-Secure’s cloud service is independent of the device environment and it has also incorporated e.g. virus protection.

At the moment, Tua Huomo has an excellent view over the development of European secure cloud services, because she is also the action line leader of the Future Cloud area at the ICT laboratory of the European Institution of Innovation and Technology (EIT ICT Labs). The partner network is vast and it covers a significant part of ICT research and companies in Europe.

“The aim of the Future Cloud area is to develop reliable European cloud services and solutions that are successful globally.”

Guidebooks

available: www.cloudsoftwareprogram.org



100 tales of Flying Finns to Cloud Software Development is a collection of some 100 tales on how to transform software organizations in Cloud environment especially with respect to operational excellence using Lean and Agile methods.



Landmarks for the User Experience in the Cloud is a unique book on the user experience that provides help with service design.



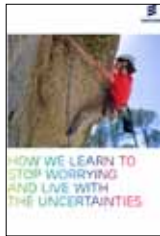
Quick Guide to Cloud Success is an informative, easy-to-read book which presents current methods with examples on how best to move to the Cloud by showcasing Finnish organisations and their experiences.



Developing Cloud Software, Algorithms, Applications, and Tools contains selected contributions by the Cloud Software Program partners focusing on innovative algorithms, applications, and tools to develop new services and applications to be deployed in public and private cloud infrastructures.



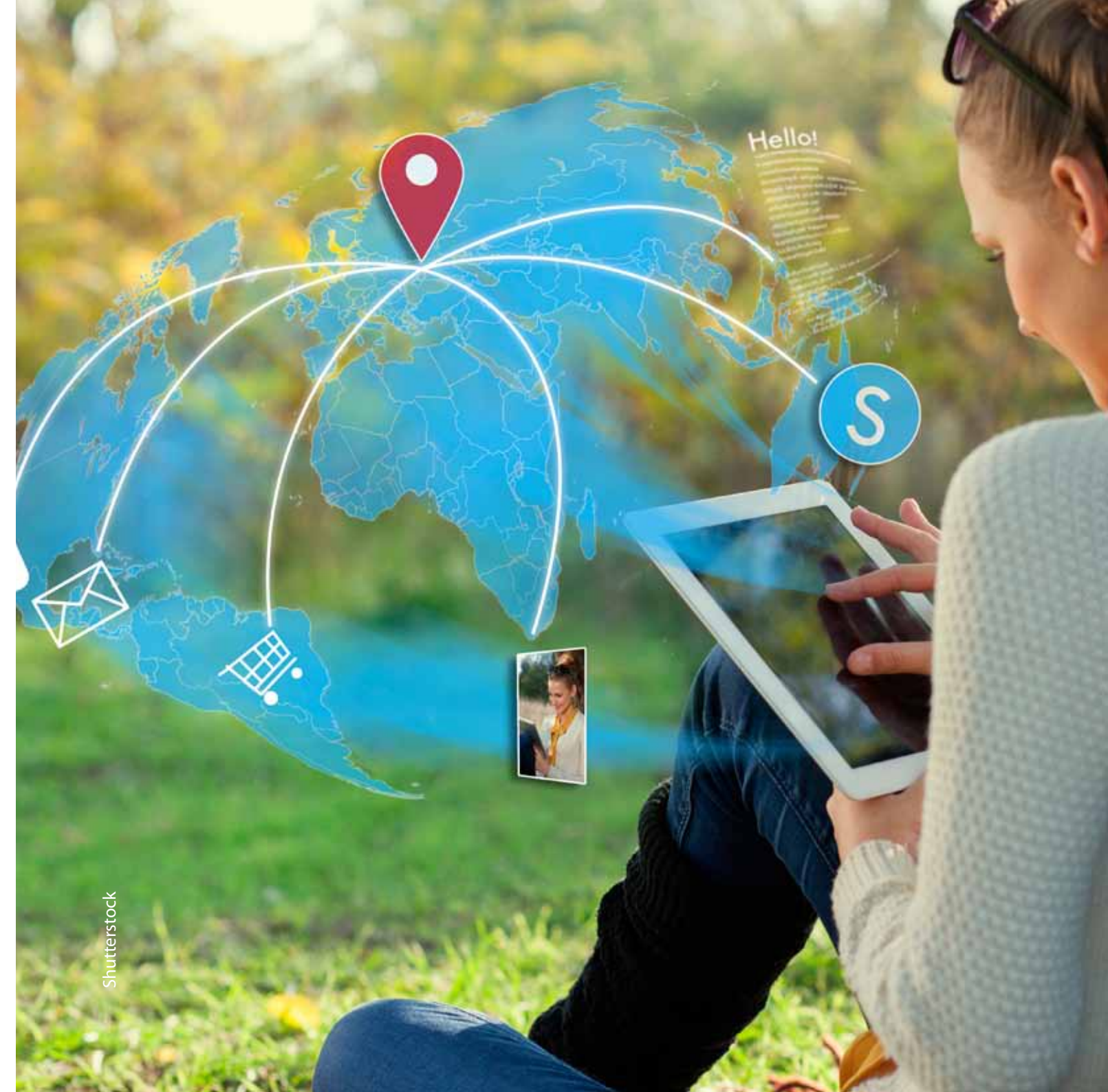
Value-driven business in the Cloud – VTT's Research Highlights is to showcase a diversity of cases that VTT has been involved in and to provide practical examples on how companies can apply different approaches and methods.



How we learn to stop worrying and live with the uncertainties describes how Ericsson Finland changed a traditional functional silo-based telecom R&D center towards a Lean and Agile software development center. It describes the major steps and methods utilised.



The Secure Agile Software Development Life Cycle. Software quality problems, wide impact vulnerabilities, phishing, botnets and criminal enterprise have proven that software and system security is not just an add-on despite past focus of the security industry. Cloud computing introduces a whole ecosystem of clients, services and infrastructure, where trust boundaries are moved even further into components, where physical location or even ownership is unknown. Add-on security therefore becomes more futile than it ever was. This book brings together experiences and results from security research done in liaison by the authors during the Cloud Software Program, each bringing in their own viewpoint.





Ari Turunen

Better Software for Companies

Employees have to use more and more often software selected by the company, and their own work performance is dependent on them. For this reason, the functionality and usability of the software significantly affects the company's performance.

According to many psychologists who have conducted research into working life, work has never been as demanding on the brain's information processing capacity as it is now. Information expires quickly and technological applications are constantly updated. Adopting new information is difficult if the software in use do not work properly. The N4S-program strives to solve how companies would be able to obtain better software, and what kinds of new tools could be created for software developers.

The academic coordinator of the program, **Tommi Mikkonen**, wants to examine how the software used by industrial companies could be improved to become more user-friendly. Therefore the program develops new tools for analytics and systems that report bugs directly to the developers.



"Office employees need – and deserve – better software", says Tommi Mikkonen.

It took Mikkonen three months at the time to realise that you had to click on the globe icon in Mosaic browser. Since then, he has been hoping for better interaction between software developers and end users.

"It is silly to work with devices that only irritate you. These include badly working software."

It is Easy to Collect Data, but Difficult to Analyse It

Professor Tommi Mikkonen from the Department of Information Technology at the Tampere University of Technology has actively participated in developing open source code programming environ-

ments. One such has been the ambitious Lively Kernel community, developing a platform for web applications based on JavaScript. Mikkonen was involved in the development work for Sun's Lively Kernel project, together with Dan Ingalls and Antero Taivalsaari. Ingalls is a pioneer in object-oriented programming, and Taivalsaari was the first to develop a Java platform for mobile phones. Based on the experiences in the project, Mikkonen is convinced that the web browser has changed more and more towards a programming environment.

"The idea has been to explore how agile the development of web software can be. The intention is to utilise the experiences from Lively Kernel in the N4S-program. Nowadays, there are several similar projects, where the browser is an important executing environment. With their help, cooperation between users can be utilised, and the application can be transferred from one device to another for easy and effortless performance."

According to Mikkonen, the N4S-program builds strategic competitive edge for companies that use the software. The companies involved have different needs. What kinds of interfaces do the software developers need? Are there bottlenecks in the programming process? Are there some futile processes that delay the opening of the factory? How can customers best utilise the software properties? Are there such properties that have never been used or found?

"Now everyone is collecting data and hoping that it will be useful. It is frustrating when you do not know whether something useful will come out of it. It is easy to collect data, but it is difficult to analyse it. Rovio and Supercell have realised this, and they know how to utilise the data they collect and receive customer feedback quickly. Adopting this idea in traditional big industry creates vast possibilities," believes Mikkonen.

The aim is to have a comprehensive collection of different kinds of software for future employees.

"These include automatic testing tools and basic configurations, which help utilise the data generated via analytics software and also

"It is silly to work with devices that only irritate you. These include badly working software."

programming work in the development work. The data collection software are based on open source code, when the products can be tailored for the needs of different companies. At the same time, open source tools will be available to everyone. The aim is to create the best java analytics framework that would provide developers with similar information on using the application and its users as Google Analytics does in the online world."



Customers Need Better Software

According to Mikkonen, software used by professionals require immediate improvements. When all unnecessary properties have been left out of the software, productivity improves also outside the IT world.

"Poor software used by professionals leads, at worst, to employees not doing their travel invoices. Therefore good software design improves productivity in terms of those who use professional software," Mikkonen believes.

As an example, Mikkonen mentions the CRM software used in companies.

Prof. **Tommi Mikkonen**, Tampere University of Technology and Dr. **Janne Järvinen**, F-Secure, talk about how the N4S-program works to create better software for companies

"If adding the new customer in the system requires 12 clicks, this takes an unreasonable amount of working hours, especially if there is a large number of people in the organisation performing the same work. When the work is done 500 times, the multiplier effects of wasted working hours are enormous."

Poorly designed software can also work against its own purpose, as it is easy not to enter the new customer into the database.

"Everyone takes shortcuts and this drains the organisation's knowledge".

Mikkonen believes that the daily routine work should be quick and effortless. Therefore the software developer must understand how to enter customer information. If all the work is outsourced to the end user, software development ends and people become frustrated.

"Office employees need – and deserve – better software", Mikkonen states.

"If an error is detected it should always be fixed quickly. The alternative is not enhancing training, which is what has traditionally been suggested."

More Focused Data Analysis Tools with the Sprint mModel

Mikkonen believes that there should be more emphasis on testing.

"If an error is detected it should always be fixed quickly. The alternative is not enhancing training, which is what has traditionally been suggested."

Web-based software also uses good analytics tools, such as above-mentioned Google Analytics. But with software for professional use that requires installation, these do not exist.

According to Mikkonen, the analytics functions are the first thing that the software needs.

"Analytics is cheap online, but in installed software such tools do not usually exist, and this is not good."

In the N4S-program, this challenge is met with universities collecting information and data from companies. This is analysed regularly using new tools, in the joint events organised four times per year.

"Universities build the first guess i.e. the first dataset. Every sprint then considers whether the dataset is sufficiently comprehensive, and it is expanded to the following sprint. Then this technical framework is completed with questionnaires, which comprise 15% of the entire research volume."

The important part is knowing whether the software met the customer's wishes and if the software development process was good.

"The studies collect information regarding the usefulness and usability of the software. The studies aim to find out whether the customer received sufficient information from the analysis. No one wants a fancy tool that they cannot use."

Surprisingly, Mikkonen also asks whether the customer uses the software for the purpose that it was intended for.

"The software may have properties that have never been found and used!"



When all unnecessary properties have been left out of the software, productivity improves and office workers have more time to relax.

Cross-disciplinary Research between Universities, Companies and Students

The research conducted in the N4S program is extensive. There are eight universities and VTT Technical Research Centre of Finland in-

volved in the program. Normal academic publications and theses are produced during the program, but in addition there are joint publications with companies.

"This expands the competence base and enables extensive cooperation beyond organisation borders also in the future. Joint publications will naturally be available to everyone after some time."

There is also a large number of students involved. There are two student networks involved in the N4S program, Demola and Software Factory.

"By involving students in the research work, the possibilities of the program to invent something new are bigger than with the methods used in ordinary research."

Demola has 2,000 students involved in 350 projects. The network established in Tampere in 2008 includes seven centres in addition to Tampere and Oulu in Finland, located in Lithuania, Latvia, Sweden, Hungary and Slovenia.

The first Software Factory was established at the University of Helsinki in 2010. The Software Factory concept is used in Finland also at the University of Joensuu and the University of Oulu, and in Bolzano, Italy and Madrid, Spain. The Software Factory is a cooperation environment where students, researchers and company representatives further develop applications and operational models of the client company. The projects utilise open source code operating system (Linux), applications, libraries and components.

www.lively-kernel.org

Demola

demola.net

Youtube: www.youtube.com/user/DemolaFi

Twitter:

#demola: twitter.com/search?q=%23demola

University of Helsinki Software Factory

www.softwarefactory.cc

University of Oulu Software Factory

www.oulu.fi/mgroup



Tiina Autio

Big Data Knows the Customer's Shopping Trail

Customer analytics making use of Big Data can significantly increase the business operations of companies.

Customer analytics making use of Big Data can significantly increase the business operations of companies. The N4S-program has also launched projects for studying this topic. They create pilot models for collecting and analysing in-depth customer data.

Using Big Data may become a central part of a company's operations and it can generate new business operations. On an international level, Big Data and analytics are used in banking, retail and entertainment. Also many other sectors, such as the health sector, contain vast possibilities. In Finland, VTT Technical Research Centre of Finland is involved in a European project that is developing tools for earlier diagnosis of memory illnesses and identifying people in the risk group. The tools being developed are based on processing



Tiina Autio

At what point do people quit and never acquire the products? This is what we can find out with collecting and analysing data, says Joonas Lyytinen, leader of the Deep Customer Insight work package of the N4S Program.

background information masses from different sources, and they are used in image analysis and machine learning methods.

“Data science is a new field that is very much talked about. The basic principle is that a large number of raw data can be used to build different models with the help of IT solutions and statistical methods in order to improve products and services,” says **Joonas Lyytinen** from Reaktor. Lyytinen is the leader of the N4S Program’s research area that aims to develop models for collecting and analysing in-depth customer data.

Big Data can be collected from mobile phones, internet browsers, customer databases and other digital sources.

“Nearly all business operations, and in the future also the Internet of Things (IoT), will produce data. These include even factory machines for industrial companies. Enormous production machines have a large amount of meters and sensors, providing indicators for how the machine operates. With the help of the Big Data produced by the machine, predictions about possible malfunctions, breakdowns and other problems can be made,” says Lyytinen.

Lyytinen started with Reaktor in 2004, which was a software development company at the time, engaged in coding for its clients’ software development projects. With the clients’ needs, the company service package quickly extended to designing user interfaces and graphic layout as well as concept and service design, and nowadays there are more than fifty Reaktor employees working in this sector. In the past few years, e.g. training services as well as data analysis and modelling have become parallel operations.

“There are approximately 300 people working at Reaktor, and we have our own department of experts who perform Big Data mining, statistical modelling and analysis. This is clearly an area with a lot of demand,” says Lyytinen.

Better Service for Customers

According to Lyytinen, the most visible services utilising Big Data are in retail and online services. Big Data is studied in terms of customer behaviour. “Which products do the customers look at, which products do they not look at? What do they place in the trash bin, what do they end up buying? What pages do they visit, what pages do they not visit? The intention is to collect data regarding customer behaviour and produce better service by analysing it, as well as information regarding what the customers want.”

“With in-depth customer data, we know how customers behave in a certain situation. Here we can generalise trends regarding what kinds of products they are most likely to buy and what kind of services they appreciate. Compared to traditional marketing studies, for example, this information in concrete, based on real customer behaviour. The aim is to be able to make nearly real-time product and service suggestions for customers through the data analysis,” says Lyytinen.

"With qualitative measures, it is possible to obtain information for why customers quit when faced with a certain function. We believe that cooperation with the research institutes in the N4S-program will bring new methods of analysis."



He elaborates that the customers are modelled based on certain variables, such as purchase history for products, and different segments are made of their profiles. New customers are placed in one of these segments, and products and services according to the customer group in question are offered to them.

"The movie and game rental company Netflix, for example, makes efficient use of this. The company suggests new products based on the customer's purchase history and recommendation rating. The company has been even more successful in getting the customers to buy new products when the people in the same customer segment have recommended similar products," says Lyytinen.

Results with the Right Questions

Raw data is generated in different sources with great speed, and the tools necessary for processing it depend on how automated or unique the model is supposed to be.

"You rarely have to code algorithms and tools yourself. You could divide the tools roughly into three categories: graphic interfaces, script writing, and software libraries. The tools for graphic interfaces are limited, and therefore, when conducting progressive or rare modelling, the properties run out in the very beginning. The best tools for analysis are e.g. the open source code analysis environment R and some Python libraries. However, they require some programming skills. Open source code software, such as Apache Hadoop, is useful if there are several terabytes of data," says Lyytinen.

Data collection and modelling are based on carefully set up questions. Lyytinen says that the correct questions are such where finding the answers helps the company in its business operations.



“The answer must be such that the person posing the question can understand it. All other questions are redundant, and therefore analysis is very much a question of the professional skills of the person posing the questions. The person performing the analysis, on the other hand, must know how to pose the question in a numeric form and make sure that the response is reliable in a statistical sense, and in general.”

Qualitative Methods to Support Analysis

According to Lyytinen, statistical analysis produces probabilities, based on which the phases of the customer’s shopping process can be detected.

“For example, at what point do people quit and never acquire the products. This is what we can find out with collecting and analysing data,” says Lyytinen.

He explains that the reasons for why customers quit buying at a certain phase remain somewhat unclear. Indeed, Reaktor is interested in combining research with a qualitative point of view.

“With qualitative measures, it is possible to obtain information for why customers quit when faced with a certain function. We believe that cooperation with the research institutes in the N4S-program will bring new methods of analysis.”

One of Reaktor’s cooperation partners is the Department of Computer Science and Engineering at the Aalto University School of Science, where research has been conducted for 15 years regarding how to gain in-depth insight on customer behaviour and needs, especially hidden needs, which can be accessed by observing the customers in their operating environment. This issue has been studied extensively e.g. in terms of the usability of services and products. Furthermore, long-term research in the field of requirement specification and recent research in the field of service design bring in-depth customer insight along with the statistical methods.

Reaktor
www.reaktor.fi

**Aalto University Department of Information and
Computer Science**
ics.aalto.fi/en

Deep Customer Insight work package
www.n4s.fi/en/work-packages/deep-customer-insight



Tiina Autio

The Objective: a Fast, Delivery Capability that Creates Value

The roaring success of the games company Supercell is partly a result of making use of customer feedback at all stages of game development. Medium-sized and large companies are also seeking a similar rapid product and service delivery capability, a feature of start-up businesses, by exploiting their benefits of scale. In the N4S-program, working methods that support this are being constructed.

The industrial leader of work package of "Paradigm Change – Delivering Value in Real-time", **Jari Partanen, Head of Quality and Environment**, from Elektrobit (EB), is at Helsinki-Vantaa airport early. Partanen is leading the work package in close collaboration with research heads Dr. Tommi Mikkonen from Tampere University of Technology and Dr. Markku Oivo and Dr. Pasi Kuvaja from University of Oulu. The morning includes virtual discussions German colleagues who work with car programs, amongst others, but before these there is still time to do some work and present the N4S-program. Its objective is to build a solid foundation for the success of Finland's software-intensive companies in the new digital economy.

Jari Partanen from Elektrobit (EB) is responsible for the Paradigm Change – Delivering Value in Real Time work package of the N4S-program. In it, operational models are developed with which companies build continuous delivery capability and the real-time production of added value.



“The new digital economy contains significant service and software business activity opportunities. The N4S-program is part of Finland’s ICT growth strategy and in it we are seeking to build up speed in finding new market gaps in different kinds of products and services,” says Partanen.

“This is also the objective of Elektrobit. We want to grow into new wireless application business activity areas,” adds Partanen.

EB is specialised in the integrated software and equipment solutions demanded by the automotive industry and wireless technologies. For example, EB makes automotive software that powers cool car technology such as AUTOSAR, FlexRay, infotainment, navigation, human-machine interfaces and driver assistance systems.

“We believe that different kinds of wireless connectivity services and product solutions, for example, such as special devices or connectivity solutions, will be used in the future in very varied applications. Through these, we can find global market areas in which the expertise of EB and its customers will be utilised.”

Value to Customers

EB’s wireless business segment in Oulu, Kajaani, Tampere and the USA, with some 500 employees, offers products and product platforms for defense and public safety markets as well as for industrial use. Further EB offers product development services and customized solutions for wireless communications markets and for companies needing wireless connectivity for their products. Partanen, who has worked for the company for more than 15 years, has previously worked in roles including the forestry industry and business consulting and seen the development arc of the working culture of the IT field over the course of his career.

“Attention began to be paid to agile software development in the latter half of the 2000s and during the last few years feedback chains have been incorporated into Lean operations. The objective has been to construct mechanisms with which feedback can be obtained constantly from the field,” says Partanen.

“At its best, this has led to the creation of operational models that are adapted to the company’s own activity, so-called ‘Way of Working’, which suit the company’s customers well and are motivating from the perspective of the personnel as well. In the N4S-program, use is made of the whole of this infrastructure and working model. Pilot models are built for the real-time collection and utilisation of customer feedback and the ability to carry out quick product and service trials in new business areas.”

Partanen is leading the first-stage research projects, the aim of which is a paradigm shift, i.e. a new kind of working practice based on real-time delivery of value. The objectives arise from the needs of today’s markets.

“In the N4S-program, it is predicted that business activity will be created in Finland’s software-intensive industry on the basis of the choices of the customers and the things that they consider to be of

value. It is believed that companies will develop products and services in the future which contain software and services that create a significant amount of added value to the customer, not only the devices that are associated with it.”

Feedback Guides in the Right Direction

Partanen believes that it is a risk in today’s markets to create a product following the old model so that feedback from customers or consumers is only obtained for a finished product or during intermediate stages. The needs of the customers may change in the interim.

“A more sure way of working is to ensure that sufficient feedback is received throughout the whole development of the product. Feedback can be sought, for example, with a prototype or demo, with which it is possible to check if the work is going in the right direction. Through feedback, some feature can be tested and taken forward for a moment.”

Partanen says that at EB the customers are linked in to the activity and to producing value.

“They see which stage of the work we are at. At the centre, there is a collaboration in the direction not only of the customers, partners and consumers but also our own staff, so that the features are found in the products and services that produce value for the customers,” says Partanen.

He adds that the Leaner the organisation in the company is, the more co-operation has been initiated, both inside the company and with customers and partners. There are not different levels in discussions, but instead everyone talks to each other so that projects succeed.



A Rapid Delivery Capability Requires an Operational Model

Doing things together, open discussion and rapid decision-making may well also be factors that originally led to the setting up of Supercell. The games company has organised its activity so that a small team consisting of programmers, graphic designers and producers can create a demo game in a short time, analyse the requirements of the market and ensure that its functionality matches that of the core product in the further development stage as well. With dispersed management, the makers of products and services have freedom and responsibility.

Speeding up the delivery capability of products and services is also a core objective of the N4S-program. Even though the products and services may also be physical, the objective of the programme is to create working models with which all factors relating to the develop-

"In the N4S-program, use is made of the whole of this infrastructure and working model. Pilot models are built for the real-time collection and utilisation of customer feedback and the ability to carry out quick product and service trials in new business areas."

ment of the services are accelerated, not only software development. The goal is to change the cycle in which products and services are only brought out from once to a few times a year to a faster one so that the latest version can be delivered at any time whatsoever.

Speed Must Be Seen As Bringing Value

So where does one begin in changing the operational model? Partanen replies that the company must itself want speed and see it as necessary and as bringing value. A new kind of organisation of activity is also required. The whole operational model from products to services, including the working practices of the organisation, must be developed to facilitate a rapid delivery capability that is adapted to the real-time economy.

"Each organisation has to build this in a company-specific way. To plan from its own starting positions how things should be organised and what operational models should be re-used from the existing processes. At the same time, thought is given to what this means technologically", says Partanen.

He raises as one key question the issue of how testing can be speeded up as a whole so that feedback is linked in more with development than before and the quality of product releases is improved. There should be a move from continuous integration development models towards even more continuous delivery models.

"How can the prototype testing of a product, which contains hardware, be carried out as quickly and in an agile a manner as possible? For example, EB has examples of teams in which the whole added-value chain has been built up holistically and in which it is possible to create even a very rapid delivery capability for a new product, but on the level of the whole company, we are not there yet."



Application examples for the EB Android-based Specialized Device Platform

The Defence and Security product group of Elektrobit's Wireless Segment includes products for tactical communication, such as the EB Tactical Wireless IP Network for creating flexible broadband networks for data transfer, and the EB Tough VoIP telephony products enabling IP-based voice communication in demanding conditions. Tactical communication means the communication of special groups such as the army or security sector professionals.

EB Specialized Device Platform is applied, for example, in customer-specific solutions based on the module, smart phone, tablet and smart watch segments.

Paradigm Change – Delivering Value in Real Time work package

www.n4s.fi/en/work-packages/paradigm-change-delivering-value-in-real-time



Ari Turunen

New Services and Products Through Flexibility

After the collapse of the Nokia-led ecosystem, the software industry in Finland has created new and agile ways of developing software. The N4S Mercury Business work package focuses on further improving business flexibility.

The software industry in Finland has changed radically after the collapse of the Nokia-led ecosystem. It has been replaced by new and agile ways of developing software – even in established companies. The work package of the N4S-program (Mercury Business) speeds up this development by creating methods that improve the flexibility of businesses.

The Internet has become the most important marketplace in the world. Even transactions with public administration take place primarily online. Therefore it is not surprising that software development has become the most important source of quick innovations. However, one of the problems of IT companies is the management of software products. It is often complicated, because it covers software development, publishing, marketing and support services. In addition, the companies' unnecessary focusing on processes slows down their adaptation to new circumstances, and may cause them to lose



Henrikki Mäkynen

Ilona Nevalainen's job at Ericsson involves coaching Ericsson employees in goal-orientated thinking.

new business opportunities. Time should also be spent on collecting new information about customers and the market.

Today, the success of companies requires software development to be done also in real time with the help of customer feedback. This is possible only by being flexible. The aim of the Mercury Business work package is to get companies to actively seek new ways of managing their current business operations, and to give them the ability to transform like mercury into entirely new business operations. This results in new products and services as well as start-ups that are created both inside and outside the companies.

"We can research, experiment with, and finally discover a very capable, flexible and cost-efficient product development concept that can be constantly customized for our business activities. What is particularly interesting about the Mercury Business work package is that the entire product development apparatus is adjusted towards a business that doesn't exist yet. This makes the work package challenging and multi-disciplinary in its approach", says **Ilona Nevalainen** from Ericsson. Nevalainen works for Ericsson as a coach, assisting Ericsson employees in directing their thinking towards goals. In the N4S-program, Nevalainen is responsible for the management of the Mercury Business work package.

Nevalainen lists the key themes of the work package: change, skill and business model.

"Change affects everyone and requires a permanent change of attitude. This allows one to recognize weak signals and accept surprises." Nevalainen believes that surprises are a part of everyday life and may contain information that has significant common ground with a company's business operations.

"The most important question after this realization is 'Why not? Let's turn that into our business!' The recognition of weak signals may therefore also happen through surprises. When they are studied with curiosity and seen as opportunities, the studying can also be fun!"

Skill must also be analyzed: What do the companies already have, and how can competences and learning be raised to a level that al-



lows the new business idea to be introduced to the organization? What is needed then is a business model.

"It is essential to create a cost-efficient (business) model that can be reused from one organization to the next and created according to the needs of the business idea, and to create new ecosystems."

Elastic companies

In 2012, the American researcher and entrepreneur **Nicholas Vitalari** and the Irish economist and sociologist **Haydn Shaughnessy** wrote an impressive manifesto about the business revolution they call elastic entrepreneurship. They believe that politicians usually do not understand the direction of change in the modern world. They use old-fashioned language of economics and are trapped by it. But we live in a world where business is run through complex global ecosystems. In these ecosystems, only versatile, flexible companies can succeed.

According to Vitalari and Shaughnessy, from 2007 onwards a small number of companies reached exceptional growth. Not only were the companies successful, they also managed it differently from other companies. Vitalari and Shaughnessy call such companies elastic. Elastic companies do not follow the same traditional working model as other companies. In these companies, there are no constant games or

Elastic companies buy know-how and services flexibly from outside the companies and create opportunities in large ecosystems of creative people.

distributions of tasks that eventually destroy all individual creativity. Elastic companies buy know-how and services flexibly from outside the companies and create opportunities in large ecosystems of creative people. At the same time, these companies create new markets.

The researchers of the universities participating in the N4S program support the companies' work by applying methods suitable for the situations the companies are in, such as business modeling and the building of ecosystems, as well as the mapping of new business opportunities and experimentation with new business operations.

"Through a survey for companies, we seek to find models of operation that allow companies to survive and grow in changing markets by finding new business opportunities. The indicators and models of operation discovered will be implemented as recommendations directing the companies' operations", says Professor *Pasi Tyrväinen* from the University of Jyväskylä.

The researchers' recommendations are aimed at ensuring the sustainability of the companies' operations.

"For example, with some companies, we study product development debt – in other words, when and why companies apply simplified solutions in software development to hasten their introduction

to the market. Such shortcuts may lead to increased workloads in the long term", Tyrväinen remarks.

A special section in the Software Industry Survey 2014 collected information about 500 Finnish software companies and studied their flexibility. The results were unambiguous: Companies experimenting with new businesses and constantly collect information about their customers were more flexible in adopting new customer needs and creating new products and services.

"Flexibility doesn't necessarily need to show in business models as a characteristic, but in the changing of models or the creation of new ones for new situations."

Software Industry Survey is a research project the Aalto University and the University of Jyväskylä have been working on since 1997. An annual survey produces statistical information about the current state of the Finnish software industry. The survey themes vary each year, but the main focus has always been on the study of growth and internationalization. Software Industry Survey is one of the most cited sources of information about the Finnish software industry.

One of the partners in the N4S-program, Avaus, also listed the 30 most elastic companies as a part of the Mercury Business work package. The "Smartest companies in Finland" study is a list of innovative, data-driven, forward-thinking, tech savvy and bravely experimenting companies in Finland. Avaus used seven building blocks, which – according to Avaus – are the ingredients of success in today's competition. These are smart vision, experimental culture, data-driven decision making, evolution in the value chain, the Internet of Things, using API's (application program interface), band connectivity and enterprise mobility.

The list includes both big Finnish companies operating globally, as well as small innovative startups to get a broad overall look at the landscape of Finnish companies utilizing smart methods. According to Avaus, some Finnish companies are taking the initiative to be the frontrunners in the new digital economy. The top five companies on the list are Supercell (mobile games), Kone (elevator technologies),





The “Smartest companies in Finland” study is a list of innovative, data-driven, forward-thinking, tech savvy and bravely experimenting companies in Finland.

Kemppi (welding technology and software), Rovio (mobile games), and Vaisala (environmental and industrial measurement).

According to Ilona Nevalainen, the N4S-program has understood well the additional value of research in creating new business activities.

“Building a new business platform outside the strategy is a challenge for researchers as well as IT companies, and one can’t do it without the other.”

Nevalainen wants to build an “ecosystem of thought” that would highlight the silent knowledge and weak signals of companies and research institutions.

“The charm of the ecosystem of thought could be the fact that it’s formed by a group of companies from different fields and a myriad of research institutions, which would allow the bouncing of ideas between different areas of business and academic fields. The strength of such an ecosystem is that by default, an idea is received with curious scrutiny. An ecosystem of thought could produce business ideas, and they could be experimented with on a rapid test schedule.”

A New Reference Model as a Tool for N4S Partners

According to Nevalainen, collaboration between companies and research institutions can be seen as a goal-oriented “hand-in-hand” approach to the companies’ business models and research themes. An example of this is experimentation with a new business model in a company, its analysis, discussions about change and new experiments.

“Our goal is to get a researched and tried model for the new businesses of Finnish IT companies. It can be created in collaboration by IT companies and research institutions. Together, we can bounce ideas and thoughts off each other, experiment and test, and at the same time, advance with determination towards our goal of creating new business outside our current strategies.”

Real-time action is one important goal of the N4S-program. The Mercury Business work package creates a reference model tool that allows the modeling of a company that is agile and capable of quickly moving into new areas of business.

“It is a frame of reference against which a company can study its own operations and make changes in the right places. The model offers three approaches: A concept, i.e. why the company needs to change its operations towards real-time business thinking; visualization that illustrates the critical variables analyzed; and tools for making and measuring changes.”

The aim of the model is to help companies in radical rethinking that allows them entry into new markets. The model allows them to discover things that set the company apart from others. The idea is to work transparently and in real-time within the N4S consortium, allowing the company to quickly receive information about the experiences of others. The result is a toolkit that describes the techniques used in different methods.

The reference model has been created by nine partners in the N4S-program: Ericsson, F-Secure, Elektrobit, Avaus, the University of Helsinki, the University of Jyväskylä, the Tampere University of Tech-

“We can research, experiment with, and finally discover a very capable, flexible and cost-efficient product development concept that can be constantly customized for our business activities.”

nology and the Technical Research Centre of Finland. The model can be used by the partners in the program and other companies.

Descom Seeks Growth through Flexibility

One of the software companies participating in the N4S program is Descom. It is a growing company specializing in omnichannel commerce solutions. Through flexibility, Descom has expanded its know-how and supply.

“We are heavily bound to the technologies of our partners, which is why networking is essential for us. We constantly monitor the development of our customers to be able to respond to changing needs. We can’t lull ourselves into thinking that only our current areas of expertise and currently available technologies will bring us growth”, says Descom development manager Outi Ihanainen-Rokio.

As part of the N4S program, Descom has studied analytics tools. For monitoring customer experiences, they use IBM’s Tealeaf software. “We can, for example, monitor the customer traffic of a web store in real time using Tealeaf. If a problem appears repeatedly, the software tells us at what stage of the process the problem appears. The reason could be, for instance, that a text on a button on the web site is misunderstood by the user.”

Typically, the challenges in the development of the know-how in Descom’s own software production are posed by tight schedule requirements. Therefore, the utilization of a testing community from the very beginning has been an important area of development.

“The basis of the N4S program has been good. The program has helped us change the different areas of our software production to better support our strategy of growth. There is still a long way to go and changing attitudes will take time, but flexibility and speed in the organization are key goals for us as well.”

Software Industry Survey
www.softwareindustrysurvey.org

The Elastic Enterprise
theelasticenterprise.com

Avaus
www.avaus.fi

A technology company with agile methods and innovative minds, it creates business models and services for the digital age.

Descom
www.descom.fi

Builds sales, marketing, and customer service solutions with their clients.

Ericsson
www.ericsson.com

The world’s leading provider of technology and services to telecom operators, the leader in 2G, 3G and 4G mobile technologies, and provides support for networks with over 2 billion subscribers and has the leading position in managed services.



Ari Turunen

Help from Design Thinking for the Creation of Digital Services

Professor of Applied Art and Design *Satu Miettinen* is leading the University of Lapland's research project in which service design methods are being developed to meet the needs of digital production for the companies of the N4S programme. With the aid of service design, customer understanding is increased in product development and the design of new products is speeded up.

The University of Lapland is on the Arctic Circle itself, but most of Lapland is to the north of the Arctic Circle. It's normal in winter that the temperature falls below -25°C. In Lapland, blizzards and frosts are no reason to stay at home instead of being at work or school. Society works in all conditions. The Arctic service design at the University of Lapland means a type of design that begins with understanding the Arctic environment and conditions and also takes into account the adaptation of people to the Arctic conditions.

"Arctic design means the development of northern well-being and sustainable development. For me, Arctic design is crystallised in the idea that design is no longer used just for aesthetics – nowadays it's used for staying alive," says *Hanna-Riina Vuontisjärvi*, a service



Henrikki Mäkinen

Professor Satu Miettinen and her group considers how and which service design tools help to speed up the service production of the company and how the service design process should be constructed

designer at the University of Lapland. Vuontisjärvi works in Satu Miettinen's group, which studies and applies service design in the requirements of different companies and public administration bodies.

Design thinking is an integral part of a new kind of management. The methods used in service design, such as scenarios, storytelling and prototyping, help decision-makers to see the changes in the operational environments of the future. It's a question of collecting the existing data and analysing it in a new way. Service design is of help in the IT field when it is necessary, for example, to familiarise oneself with a new technical ecosystem and begin to use its applications.

The Importance of Prototyping

According to Satu Miettinen, prototyping serves as a platform for co-creation, and it helps to convey the emotional components of service value. Prototyping and simulation methods are experiential learning and teaching tools that enable the emotional engagement of participants.

"Prototyping can provide emotional value to businesses through the conscious and subconscious information it can reveal and com-

municate to different stakeholders. A dedicated place and time for prototyping, a skilled facilitator, and the active participation of stakeholders are the practical requirements for co-creation sessions. Personal experimentation and collaboration is emphasised in eliciting emotional insight in co-creation. Prototyping sessions can support decision making, help in bridging functional silos in big companies and help in using tacit knowledge as a resource in these mutual learning sessions."

The research group of Miettinen considers how and which service design tools help to speed up the service production of the company and how the service design process should be constructed. The starting point is considering how the methods of service design support the birth of customer understanding and the development of the business idea.

"Design thinking is a solution-centred activity in which use is made of expertise from many fields with the aid of creative, visual and concretising methods," says Hanna-Riina Vuontisjärvi.

Finland, the UK, Denmark and Germany are all forerunners in service design. For example in the UK, Denmark and Finland, service design methods have already been used systematically to improve public services. In Finland, the Association of Local and Regional Authorities has used service design in forecasting and identifying coming changes in society and customer relationships.

Service design will be needed in the public administration of Finland because a part of the public service business activity has been transferred to different unincorporated state enterprises in the last few decades. At the same time, new models for ordering and producing services have been designed. In this way, service design creates possibilities to make use of and apply new working methods in the planning of services that connect the public and private sectors.

Service design works as a tool for the production, forecasting and development work of the municipality's or town's new content. It is part of decision-making. In municipal administration, new ideas



Arktikum in Rovaniemi is a museum, science centre and conference venue right on the Arctic Circle. The Arctic region is examined in light of the Arctic research of today and the future. The exhibitions provide a comprehensive section of the history and culture of Finnish Lapland as well as of Arctic knowledge.

come into use when the decision-makers are involved in the service design itself.

The satisfaction of municipality members can be increased by identifying their hidden needs and producing services for them as easy service paths. A service path means the progress of the service from the perspective of the client. It takes into account things which can be affected by planning and which the service user encounters.

Orientated towards the Future

Service design is orientated towards the future. Financial decisions are often made looking back into the past – with the aid of design methods, the view is directed towards the future instead.

According to Vuontisjärvi, a fundamental question is how to study something that does not exist yet.

“Research is done with the aid of artefacts, sketches, different environments and models. It focuses on everyday user problems, such as how to get used to new technical ecosystems and how to learn by doing.”

Miettinen’s group offers different kinds of visualisation tools for the use of companies.

“The tools can be, for example, visualisation in the form of photos, videos, scenarios and profiles – in a different way from using text or speech, images, i.e. visibility, make it easier to create mutual understanding between, say, the development team and the client,” says Vuontisjärvi.

An example of the efficiency of service design methods is making the product development process of a large company visible, recognising challenges and solving them together with the personnel of the organisation.

“Both time and money savings are created. In addition, we have brought customerships closer to the company by, amongst other things, identifying potential user groups and bringing their product/service experience closer to the development teams of companies through videos, interviews and workshops. Customerships could be brought even closer to the product development and testing processes of companies – not only by means of big data but through a real, face-to-face interaction,” comments Vuontisjärvi.

The Cardboard Hospital as a Prototype Brought Significant Savings

At the University Hospital of Tampere, there was a wish to design a patient-centred hospital environment. Service design was used to map out the treatment path of a sarcoma patient.

In the project carried out co-operatively by the hospital and service design researchers from Aalto University, the staff and patient

“Service design is of help in the IT field when it is necessary, for example, to familiarise oneself with a new technical ecosystem and begin to use its applications.”



took part in projects together. The methods employed included interviews, joint discussions and games. The core method in the development of the premises, service and experiences was prototyping. A large cardboard hospital was constructed in the large studio of Aalto University, in which patients, staff, researchers and architects together thought about and tested the features of good hospital premises.

As a result, new patient materials were created that describe the treatment in a better way from the perspective of the patient and a sarcoma nurse was taken on, whose job advertisement was drafted by the patients. The information and skills acquired in the project will be used from here on in the hospital for its own development work. The treatment path of the patient became shorter, processes became more rational and the hospital saved money.

Service Design in Companies

In northern Finland, the clients of the research group have been among others Danske Bank, Norrhydro, Santa Park and Lapland Safaris. Prototyping sessions were held in these companies, which helped to make the internal processes of the companies transparent.

“Ideally, the sessions helped the development management realise what is actually happening in the company regardless of formal guidelines or service manuals. On the other hand, the participants were able to identify and suggest good practices and successes worth spreading across the entire company. This was not limited to increasing customer satisfaction, but also includes potentially increasing job satisfaction and helping employees achieve personal sales goals,” says Miettinen.

According to Miettinen, prototyping sessions also serve as an internal benchmarking and platform for analysing and developing the customer experience of different existing business sites of the company (e.g. travel destinations).

“The use of prototyping methods was also identified as a new educational tool for training the actions of service staff during interactions with customers. This is important because the mood of the customer service person has an impact on the customer’s emotional experience.”

Miettinen’s group also did development projects, in addition to the ones for these four companies, for the lift manufacturer Kone Ltd. Furthermore, interview questionnaires were done for professionals who worked in service design in different companies in Germany, the United States, Italy and Finland. These were among others GE, Intuit, IDEO, Adaptive Path, LVL Studio, Volkswagen, Whitespace, BetterDoctor, Experientia and Diagonal. In these companies, service design is part of the company’s strategy or business activity. Volkswagen uses it in the development of its own products while IDEO sells service design, as do Experientia and Diagonal.



leviniglut.net

Arctic design. The glass-ceilinged Levi igloos are 10 kilometers from ski resort of Levi in Finnish Lapland. The constantly changing Arctic landscape is the roof. The triple-windows of the igloos are insulated and electrically heated to keep them from frosting.

The research created a case for understanding both the designer's role in value creation and the service design approach that enables this value creation. Research data were collected through thematic interviews and participatory observation and were analysed using theory-driven content analysis.

"These preliminary results indicated the absence of the field of co-design research in digital ecosystems: there is the necessary infrastructure and machinery in place in global corporations, but the tools and methods for thinking "in terms of programmes" are still lacking"

According to Miettinen, value co-creation models have changed. New models place the customers' needs at the focal point of the development process.

"There is more pressure to engage and involve the customer in the innovation process. This places the designer in a more central and strategic position in the company. This has also changed the role of the designer and added new skills and competences to their professional portfolio."

Currently, Miettinen's group is working in co-operation in the N4S project with F-Secure and Elektrobit in particular.

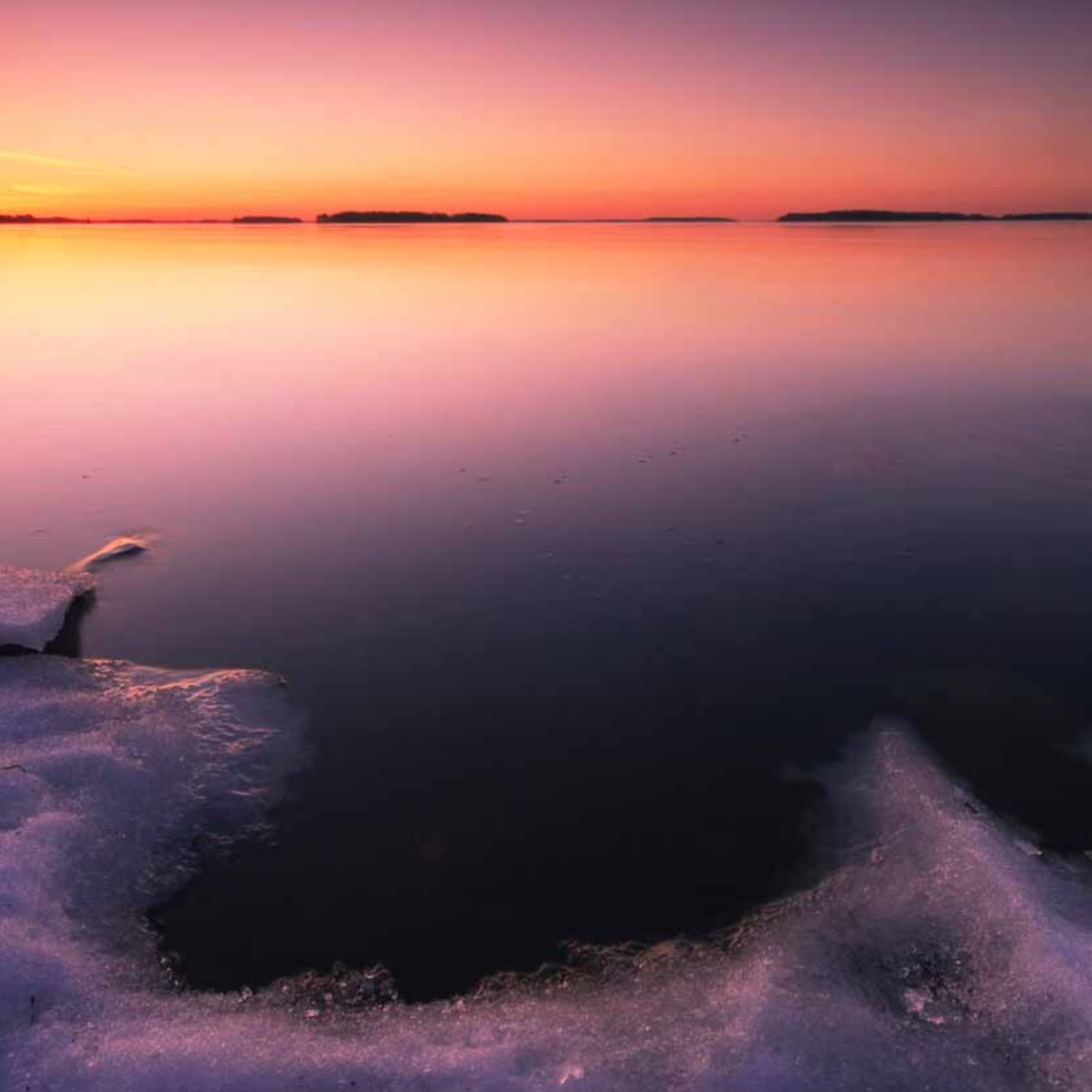
"Different prototyping techniques enable us to speed up the service development process. The service design approach gives us the tools to concretise the service offerings that are delivered through different digital channels and smart devices. The service design approach gives us the means in the project to look at how the service experience is formed both through the customer journey and at different touchpoints."

University of Lapland
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Juha Kronqvist, Heini Erving, Teemu Leinonen



Tiina Autio

When the Novelty Value Wears Off

Information about customer loyalty with new methods

Research group PREAGO from Aalto University and IT company Reaktor are looking for cooperation possibilities within the N4S program for processing in-depth customer data with the help of data science and qualitative research. Aalto University has conducted research into customer behaviour related to products and usability of services for 15 years. The group has been one of the first to examine how emotions affect customer loyalty, for example. According to the research, emotions, memories and long-term user experience has a significant impact on customer loyalty, in addition to the utility and usability of the product.

The PREAGO research group at Aalto University participates in the N4S-program in order to support companies in the new digital economy through the research. The University and the companies that participate in the programme have several cooperation projects where value is modeled, customer feedback is collected and the companies' practices in the software ecosystem are supported.

The aim of the cooperation with IT company Reaktor is to combine qualitative behavioural research and data science methods in collecting and processing in-depth customer data. Services based on pro-

cessing and analysing large data pools have been a part of Reaktor's supply since the start of the big data phenomenon, and currently the company has its own department for data science experts.

Postdoctoral Researcher Sari Kujala from the PREAGO research group believes that qualitative user research will expand on the results of data science regarding why customers use a particular product or service and what is good and worth keeping about it.

"Qualitative user research provides answers to questions of how and why. When we know that people behave in a contradictory way based on data analysis, and at which point in the user process there are problems, qualitative methods can be used to examine the reasons more carefully. With the help of data analysis, we can also identify critical moments – for example, at which point the customer loses their interest in the service. This is how we know that collecting qualitative feedback is worthwhile. When they are combined, these methods bring holistic, in-depth knowledge about customer behaviour," says Kujala.



One of the research areas of Professor Marjo Kauppinen's (right) PREAGO group is recognising customer and business value and supporting customer loyalty with the help of continuous feedback. Postdoctoral Researcher Sari Kujala (left) believes that product and service properties that appeal to emotions increase the user's customer loyalty.

Tiina Autio

Product Properties that Appeal to Emotions are the Most Important Ones

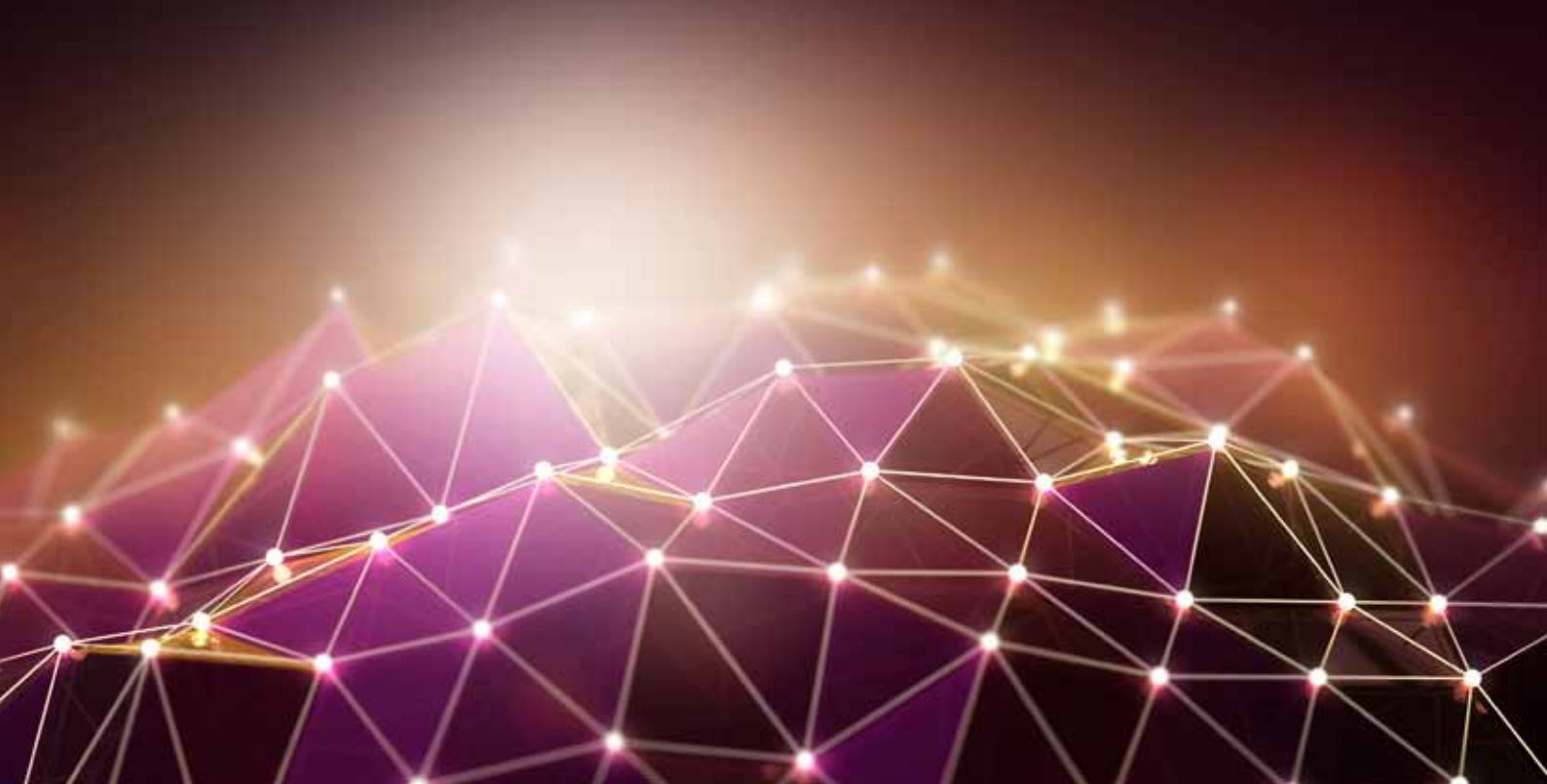
The data behind the numbers has been examined with the support of qualitative methods only recently. So far, companies have invested mainly in useful products and services and their value have been traditionally examined from an economic point of view. According to research, however, the value is not created in product development, but when using the product.

"The majority of companies do not have information about their customers' overall behaviour. It has been discovered that the customer's behaviour is guided not only by utility and usability but also enjoyment. Since enjoyment factors may, in practice, become more important than usability in the long run, we have focused our research on long-term user experience and the factors that create enjoyment – such as rewards, attraction and fun," Kujala says.

Curve-Drawing Method Takes Emotions and Memories into Consideration

Kujala, who examines product and service design from a human-centric viewpoint, conducts research into how the product or service feels for the customer and how product developers create products that can remain rewarding for a long time. Kujala's group has developed a curve-drawing method (UX Curve) that takes into consideration the user's memories, emotions and long-term user experience regarding the product or service.

"The method is based on the factors that the users themselves consider as important. The users look back on their feelings regard-



ing how it felt like to start using the product, and how their relationship with the product has changed with time. They evaluate their experiences from different perspectives, such as attractiveness, ease of use, usability, utilisation rate. Finally, the user draws a curve about how the experience has changed. Changes in the curve bring up the meaningful things that should be examined and taken into consideration in product design,” Kujala says.

Kujala, with a background in psychology and cognitive science, explains that the method is based on the user’s experiences that were particularly positive or negative.

“In long-term use, only the top experiences will be remembered. These memories correspond with the overall user experience, and this evaluation makes the user continue using the product and recommend it to others.”

Hidden Needs are Important

According to Kujala’s research, the hidden needs related to the use of the product are essential information for the designers of the product and service. “In a study regarding the needs of mobile phone users, we discovered that it is important for the users to own a phone that reflects their personality and to personalise the phone’s services to feel like their own. For example, the fact that the phone does not have a place to hang jewellery may be a more important reason in selecting the phone than usability. The phone is shown to friends and the user wants it to look good in the eyes of others. The fact that one’s own phone is better than those of others is a cause for pride,” Kujala says.

“In a study regarding Facebook users it was discovered that, in the long term, users are motivated by social factors, such as communication with friends and stimulations, such as social information, photos, games and applications and functions that the user has not yet used. Expressing one’s own thoughts and personality for example through liking different groups also increases the enjoyment obtained from the service,” Kujala says.

The Need for Self-Expression

Kujala’s research shows that in long-term use, the user’s interest is upheld by new properties and applications, and taking them into use and learning how to use them bring new possibilities for self-expression and social activities. The researcher believes that product design should focus on developing customer loyalty with new, interesting additional properties.

“A product or service, whose attractiveness grows with time, increases the users’ willingness to recommend the product to their

“With the help of data analysis, we can also identify critical moments—for example, at which point the customer loses their interest in the service”



friends. With services intended for consumers in particular, merely practical and useful properties are often not sufficient for forming an emotional bond,” Kujala states.

According to her, the product should have a positive effect on its user’s life and needs.

“Product designers should help people achieve their goals and support a positive self-image. If the product or service makes its user embarrassed or feel stupid, the initial excitement turns into disappointment, and the user will not necessarily be very interested in continuing its use,” adds Kujala.

“Our aim in the N4S-project is to develop meters for collecting customer feedback, in order to predict how loyal customers remain when the novelty wears off. At the same time, we are collecting feedback about how loyalty can be better supported,” Kujala says.

Further information

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The SPRG Research Group Supports Accelerating Product Development

Aalto University’s SPRG research group, lead by **Professor Casper Lassenius**, also participates in the N4S-program. The group’s research themes deal with especially the first work package of the N4S program, Delivering Product Value in Real-Time. The group has several co-operation projects with Ericsson and Nokia, for example. These projects examine the transfer of large companies towards agile and lean operational models and developing operations towards continuous deliveries.

The Project Manager, **Maria Paasivaara**, explains that the SPRG group examines changes within organisations and taking into use constant integration and continuous deliveries, with their challenges and solutions.

“We examine what kinds of changes have been done within companies and what are being done, and we provide feedback about what has worked well and where there is room for development,” Senior Researcher Paasivaara says.

According to Paasivaara, the challenge with change is how to organise the whole.

“We examine how good practices are scaled from one team to dozens of other, geographically dispersed teams, and how a large group of teams developing the same product could operate together efficiently. In addition to normal agile practices, scaling requires new practices. We examine which new working practices are functional and which are not,” Paasivaara says.

She says that, traditionally, there were new product versions every two years in the field of telecommunications just a little while ago.

“Instead of the previous waterfall model, we first collect customer requests, then analyse, code and then spend a long time testing the product. Now, the aim is a quick reaction time from the customer request to having the new property as a part of the product. For example, in terms of one product, new versions are published every eight weeks, and the aim is to move towards continuous deliveries,” Paasivaara explains.

Paasivaara says that the aim is to accelerate product development so that automation tests are conducted as the properties are developed, in which case the final testing period can be significantly reduced. In an optimal situation, the new property can be delivered immediately when the implementation is ready, without separate final testing.

“Small, agile and multi-skilled teams include both developers and testers. We also continuously aim to conduct a large number of tests automatically, so that when the developers have integrated their own products into the product package, they will receive testing feedback quickly and correct any errors immediately. The aim is to bring the product to customers immediately when the new functionality has been completed,” Paasivirta says.

The Product Requirements and Architecture Research Group (Preago)

cse.aalto.fi/en/research/empirical_software_engineering/product_requirements

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