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FAST WOW EFFECTS BOOSTING SME BUSINESS

Final Report

Centria
AMMATTIKORKEAKOULU

Centria. Raportteja ja selvityksiä, 27

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CONCEPT DEFINITIONS

AR	Augmented Reality, a technology which allows computer generated virtual imagery to exactly overlay physical objects in real time
Authentic	Genuine, real
ERP	Enterprise Resource Planning, the integrated management of core business processes, often in real-time and mediated by software and technology
Immersion	Perception of being physically present in a non-physical world
MR	Mixed Reality, a technology which connects the physical world to the virtual world, allowing the co-existence of physical and computer-generated elements in real-time construction of playful reality through experiences derived from experimental, hybrid reality game design
Stereoscopy	Illusion of depth to flat image
VR	Virtual Reality, the use of technology to create the illusion of presence in an environment that isn't really there

CONTENTS

1. INTRODUCTION

There is a growing need in companies to digitalize their businesses. The progress of digital technologies in combination with other key enabling technologies is changing the way we design, produce, commercialize and generate value from products and related services. The revolution in the people's behavior, new kind of value chains and networking create challenges form companies, even for SMEs (Prahalad and Krishnan 2008). No business areas are immune to these trends that cannot be reversed. Digitalization enables new kinds of scaling of company businesses and offers limitless opportunities for new value creation. However, this requires high agility from development teams and companies in order to accelerate their innovation processes (Morris, Moses and Wu 2014). In the revolution of value creation, companies need faster and cheaper innovation processes (Radjou and Prabhu 2015). They cannot use linear, pre-planned, time-consuming R&D processes. Rather, they must rely heavily on fast experimenting and rapid prototyping techniques — i.e., they collaborate intimately with customers and use their constant feedback to zero in on the most relevant product features.

The Wow effects are important in creating consumer experiences. However, there is no widely accepted scientific concept for Wow or Wow experiences, even if they belong to the domain of everyday experiences (Steen 2005; Desmet, Porcelijn and van Dijk 2007; Pieskä, Luimula and Suominen 2016; Reunanen, Penttinen and Borgmeier 2016). Rahman (2013) has examined the meaning of "coolness" in marketing in global consumer culture. "Cool" is a term heavily used by marketing practitioners, and Wow factors often play a key role in differentiating a product as "cool." To get a Wow experience to a customer, you should give them a pleasant surprise and exceed their expectations. You should address their needs thoughtfully and in unexpected ways. The Wow customer experience should be taken as a part of the product/service design and may help to uncover customer needs. Wow experiences as outstandingly positive user experience has often been cited as an important design target in industrial product development contexts. It will be increasingly important in global business-to-business relationships. There is always a need for customizing the level and types of Wow effects for serious application domains.

Virtual reality (VR) and augmented reality (AR) are examples of world changing technologies, even they are still in the early stages of development. Virtual reality immerses user in a virtual world. The immersion effect often gives a real Wow experience for the user. The 3D Cave Automatic Virtual Environment can also complete the immersion effect. In contrast, augmented reality overlays digital information onto the physical world so that the goal of AR is not to completely immerse the user in a virtual environment but to supplement and enhance reality. In the near future, even small and medium sized companies need to implement advanced technologies like VR and AR. In order to support and market their business using VR/AR requires that these technologies are more easily accessible by the businesses. This means understanding the potential applications and targets of use in their own business as well as decreasing the cost and required skills for starting a VR/AR implementation project. According to a recent Goldman and Sachs report (Bellini, Chen, Sugiyama, Shin, Alam & Takayama. 2016), virtual and augmented reality have the potential to become the next big computing platform. Most of the discussion today around virtual and augmented reality focuses on consumer-level solutions like gaming and entertainment. Nevertheless, they also hold great promise in boosting business and in speeding and improving product design. VR/AR technology has evolved and the prices are becoming much more affordable, which makes VR/AR as a truly usable technology even for SMEs. However, most of the reported industrial VR/AR experimentations are carried out

together with big companies (see e.g. DIMECC 2017). Virtual and game technologies provide huge potential also for SMEs to boost their business in an affordable cost level. However, companies working in small-scale manufacturing usually have limited resources for product development and marketing. Therefore, they need help in using co-creation principles (Kristensson, Matthing and Johansson 2008) in the network consisting of the company, their customers, and a research group.

The project Fast Wow Effects Boosting SME Business was carried out 1.1.2015 – 30.6.2016 as joint projects by Centria UAS and Turku UAS. The projects were financed by Tekes, companies, Centria UAS and Turku UAS. Total budget of the project was about 1 million euros, from which Centria sub-project was about 550 000 € and Turku UAS subproject about 450 000€.

The following companies / organizations participated in the project:

Bet-Ker Oy
Champion Door Oy
E.T. Listat Oy
JEDU
Joki ICT Oy (former PVP Oy)
Satavision Oy
Siipotec Oy
Takanen MR Oy
Taukokangas Oy
Topi-Kalustaja Oy
VAMA-product Oy
Zowell Oy
Turku Science Park Oy Ab
Turun Teknologiakiinteistöt Oy
Lingsoft Oy
Sun In Eye Productions osk
Turun Messukeskus Oy
Turun kaupunki

In the beginning of the project, the steering group consisted following participants:

Petri Kinnunen, PVP Oy (later Joki ICT Oy), chairman
Sakari Kinnunen, Jokilaaksojen koulutuskuntayhtymä (JEDU)
Juhani Reiman, Lingsoft Oy
Niko Kyynäräinen, City of Turku
Janne Roslöf, Turku UAS
Vesa Martinkauppi, Centria UAS

Marko Kivimäki, Tekes

During the project, the JEDU participant Sakari Kinnunen was substituted by Tuula Puoskari and later Ari Sarpola.

In Centria, the project manager was Sakari Pieskä and the responsible leader was Vesa Martinkauppi. In TUAS, the project manager was Taisto Suominen (Mika Luimula was substituting

him during Taisto's sick leave) and the responsible leader was Janne Roslöf. In Centria, the main persons who carried out incredible fine work in the development of Wow effects with VR/AR and game technologies were Ari Lehtiniemi and Anttoni Porri. They participated also in many use cases. The other persons who were implementing impressive solutions for the use cases were Juhana Jauhiainen (health care solutions), Jari Kaarela (virtual design of industrial robot solutions), and Veijo Hietamäki (ERP and info display analysis). Joni Jämsä was the responsible person for successfully implemented research exchange with Ochanomizu University.

The project concentrated on following research questions:

- How to develop and deploy innovative solutions which are supporting cost-effectively SME business?
- Which kind of methodology is needed to pre-define preferred digital content, to deliver this content to more suitable formats, and to lead this content to on-screen advertisement?
- Which kind of research methods (incl. user centric design and rapid prototyping) should be used boosting SME business
- Which kind of research, study and setup of 3D modelling process is needed to ensure interoperable solutions to be used with various hardware and software combinations?
- How to evaluate and enhance the commercial viability of the above mentioned features?
- How to test and further develop these solutions in various exhibition environments?
- Which kind of business models are needed to scale these solutions for wider use in SMEs?
- How to learn from the best practices of different cultural backgrounds? European (Finland), Arabic (Oman) and Asian (Japan) experiments and exhibitions.

The main focus of the project was to create Wow effect solutions, including software and hardware, feasible for large scale deployment in SME companies. Solutions had to be cost-effective but in the same time they should present state-of-the-art in the market. User centric fast experiments were found as the best way for agile innovation work with SMEs.

The work in the project was carried out in seven working packages:

WP1 Management
WP2 User centric design
WP3 Technology experiments
WP4 Business experiments
WP5 Company pilots
WP6 National and international cooperation
WP7 Dissemination

The *Management* work package included coordination of the work of research teams as well as overall coordination of national and international collaboration. It includes organizing steering group meetings and coordination of common meetings and workshops.

The *User centric design* work package started with general requirements definition for user centric design for Wow experiments. After that the common guidelines for company case specific requirements definitions were planned and companies were interviewed to find out their special requirements. Planning the common guidelines for usability evaluation was also included in this work package. The results of this WP2 are presented in Chapter 2.

In the *Technology experiments* work package the purpose was to create novel practical and theoretical solutions based on agile and experimental innovating. In technology experiments the competence required includes e.g. know-how from virtual and augmented reality design, VR/AR UIs (from mobile devices to caves), 3D scanning, point clouds, 3D modeling, game engines and graphics, 3D internet, and industrial internet. The results of this WP3 are presented in Chapter 3.

In the *Business experiments* work package the main research question was how to make new technologies (such as VR/AR) available and cost effective for SME business. Boosting SME business meant that we had to identify bottlenecks in marketing. Cutting the costs was one of the main challenges when creating new value with fast Wow effects. Experiments from the company cases were first analyzed inside the project. The wider evaluation of the business experiments was carried out together with an external consulting firm and the main results are presented in Chapter 4. Fast Wow project participated also with another Centria project in developing Digital Age Production Park, a consortium of companies, universities and different business developers that offers the best possible national and international competence for start-up and existing micro, small and medium-sized manufacturing companies to develop their operations. The main results of this WP4 are presented in Chapter 4.

The *Company pilots* work package started with definition of case specific requirements for company pilots. After that, technology-based development for each pilot was carried out. This included e.g. 3D scanning, game development / gamification, VR/AR modeling, programming and simulation, and integrating to 3D virtual spaces (caves). Experimenting, evaluating and further developing was part of the pilot cases. In many cases pilot results were integrated to business experiments, e.g. in marketing and exhibitions. The results of this WP5 are presented in Chapter 5.

In the *National and international cooperation* work package the goal was expanding collaboration between Centria, TUAS, participating companies and national and international partners. By networking with external parties the participants in the project could achieve synergy between research, industry and public authorities. In national cooperation Centria and TUAS had collaboration with both universities other projects and external cooperation especially with Haaga-Helia UAS and their Tekes-project The Box. The international co-operation was carried out with Arabic Countries (Oman / Sohar University College, Dubai and Arab Emirates) and Japan (Ochanomizu University). Research exchange was carried out as planned and it brought concrete results for the project and company pilots. The results of this WP6 are presented in Chapter 6.

The *Dissemination* work package included planning dissemination, choosing the exhibitions and seminars and preparations for dissemination. The results were disseminated in about twenty national and international events, exhibitions, workshop, seminars and conference publication. The results of this WP7 are presented in Chapter 7 and in Appendix 1.

2. USER CENTRIC DESIGN

2.1 Experience Economy Expanding to All Industries

Creative industries have influence on other industries not only because their organizations and modes of operation provide models that have certain advantages, but also because the relationship they develop with customers suggest new patterns of consumption (Lampel & Germain 2016). In 1998, just after Apple launched the iMac, Pine and Gilmore introduced the term *Experience Economy* in their Harvard Business Review article (Pine & Gilmore 1998). They argued that our economy has entered a stage of economic development where experience increasingly dominates consumption. This means that a product plays a decreasing role in competition, and creating experience is becoming progressively more important. After that time, the experience economy has changed many traditional ideas of how consumers evaluate products. Pine & Gilmore's experience economy has been regarded as a predominant concept in experience area (Jung, tom Dieck, Lee & Chung 2016). Pine & Gilmore (1998) spoke about staged experience and classified into four realms of experience economy by two spectrums of participation (passive and active participation) and connection (absorption and immersion): entertainment, education, esthetic, and escape experience. The paradigm of tourism business is an example of business areas which have been shifted from focusing the product or service itself to enhancing tourists' experience and making it memorable. With technology advance, numerous ICT solutions used in tourism destinations (e.g. VR & AR) have increasingly provided tourists with more real and immersive virtual environments (Jung et al. 2016).

This development is expanding now in all business areas. The experience economy has shifted from services to all business areas including even design and manufacturing of products. One of the leading industrial 3D software and PLM software vendors Dassault Systèmes has lately updated its brand to be a 3DEXPERIENCE Company which offers a 3DExperience platform to its customers (Dassault Systèmes 2017). Dassault Systèmes claims that it provides businesses and people with virtual universes to imagine sustainable innovations. They are speaking in their vision about The Age of Customer Experience and telling that that their 3DEXPERIENCE Platform leverages 3D software applications to transform the way products are designed, produced, and supported, enabling businesses to craft delightful customer experiences. These expressions have lot in common with the thoughts Pine and Gilmore introduced in their Harvard Business Review article in year 1998. Dassault Systèmes offers also 3DEXCITE development solutions for permit instant and continuous visual and functional analysis, simulation and review of engineering work. VR and AR are part of this platform to give Wow effects e.g. in design, development, marketing and sales.

2.2 Requirement Analysis for Use Cases

This work package started with general requirements definition for user centric design for Wow experiments. This requirements definition guided also work packages 3 and 4. In addition, in every case in WP 5, a detailed requirements definition was carried out together with companies. The requirement analysis was carried out by interviewing the participating companies. The main results were collected by using the matrix frame presented in FIGURE 1. In Centria matrix 12 companies were analyzed, in TUAS matrix was 7 companies involved.

FIGURE 1. The matrix frame used in the collection of requirement analysis for the use cases of companies.

The use case matrix indicated that the companies in the sub-projects of Centria and TUAS differed considerably. Typical company in the sub-project of Centria was a manufacturer whose role in the project was the user and adapter of digital solutions. The use case needs typically focused on digital models and media in boosting business, ERP integration and development, reliable remote connections for monitoring, control and maintenance and development of mobile user interfaces. The answers for the future role question showed that companies in the future aim to deliver more efficient and larger systems which will utilize digitalization in versatile ways, including digital business models, scalable digital services and mobile digital user interfaces. Many of the companies wanted to be in their business forerunners in utilization of 3D models and digital data.

Typical company in the sub-project of TUAS was a company providing media or linguistic services or facilities and support for companies and exhibitions. The roles of these companies were either provider or user and adapter of gamified solutions. The use case needs typically focused on digital platforms, AR solutions or innovations for boosting business. Many of the companies wanted to be in their business forerunners in utilizing AR and gamification solutions e.g. in learning solutions, tourist applications or nosiness promotion

2.3 Virtual Technology Create Fast Wow Effects in User Centric Design

Digitalization enables scaling of company businesses and offers limitless opportunities for new value creation. The fast growing IoT and industrial internet business is based on the implementation of digitalization. Digitalization enables Wow experiences for customers. As discussed in the Introduction, there is no widely accepted scientific concept for Wow or Wow experiences, even if they belong to the domain of everyday experiences. Wow experience can be also divided into two category, Wow effect and Wow factor (Reunanen et al. 2016). The Wow-effect is a result of something that provided wave of sensation for what the user was not prepared (Pizam 2004). Wow-factor is not a feeling but it is more like an attribute that the product, company or service have (Slevitch, Mathe, Karpova and Scott-Halsell 2013). Wow experiences as outstandingly positive user experience has often been cited as an important design target in industrial product development contexts. The Wow customer experience should be taken as a part of the product/service design and may help to uncover customer needs. It will be increasingly important in global business-to-business relationships. There is always a need for customizing the level and types of Wow effects for serious application domains. Wow can be considered as the factor that already exists in companies' business and affects to people in many cases (Reunanen et al. 2016). It just needs to be found consciously, to be defined clearly and utilized

better in order to enhance business and profits. When manufacturing companies in the future are transforming their business more and more from selling products to providing services, the innovative Wow experience design will be important for them as well (Pieskä et al. 2016).

Digitalization has resulted in a whole new global era, bringing with it yet unrecognized opportunities that will impact every aspect of life. Virtual and augmented reality technologies together with game technologies are important enablers in this progress. These technologies are based on digital 3D models, and their utilization has become possible because industrial design has transferred to utilize 3D CAD. Buildings, ships, infrastructure etc. are currently all in digital format. The digital product process covers the entire product life cycle, from the design phase until maintenance and after sales. One promising area is marketing, which has not yet been widely utilized to boost SME business. Only big companies have been able to utilize digitalization effectively until now. New technologies such as 3D scanning, VR/AR glasses, and game engines will enable the use of digital content to boost SME business, especially for marketing purposes. In the future VR/AR technologies will be often integrated to mixed reality, the examples and relation between them is presented in FIGURE 2, where it is linked with the definition by Milgram and Kishino (1994).

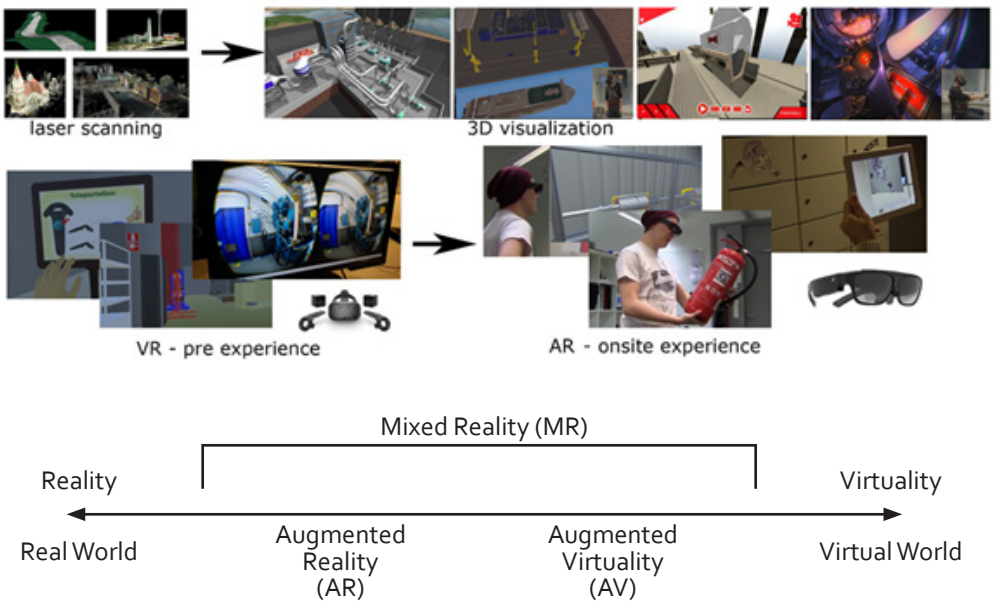

FIGURE 2. The relation between Virtual, Augmented and Mixed Reality

Interaction with the customer is becoming increasingly important in marketing. Virtual technology often play key role in the development process. We carried out number of case studies during the project in versatile application fields—from manufacturing to interior design, health care, tourism, cultural heritage, and exhibition. Language management tools, virtual and augmented reality technologies, game development tools, 3D scanning and virtual design technologies, and socially interactive robot technology were utilized to create Wow effects in versatile application fields.

2.4 Usability Evaluation

There are many ways to carry out usability evaluation which vary from unstructured interview-based qualitative analysis to highly structured quantitative surveys. As an example of qualitative analysis, Hassenzahl (2011) has proposed for user experience design a simple conceptual model. He distinguishes three different levels, when designing an experience through the interaction with an object: The Why, What and How level. Experience Design is a remedy to this. It starts from the Why, tries to clarify the needs and emotions involved in an activity, the meaning, the experience. Only then, it determines functionality that is able to provide the experience (the What) and an appropriate way of putting the functionality to action (the How). Experience Design wants the Why, What and How to chime together, but with the Why, the needs and emotions, setting the tone. This leads to products which are sensitive to the particularities of human experience. It leads to products able to tell enjoyable stories through their use or consumption.

Jung et al. (2016) have presented an example of structured quantitative analysis. Their study investigated the impact of Virtual Reality (VR) and Augmented Reality (AR) on the overall visitor experience in the context of museum. They used a partial least squares (PLS) regression analysis, using PLS-Graph version 3.0. With PLS-Graph, the analyses were implemented by taking two steps: measurement model analysis and structural equation modelling (SEM). Questionnaires administered to 163 museum visitors revealed that social presence in mixed (VR & AR) environments is a strong predictor of 4 realms of experience economy (entertainment, education, esthetic, and escape experience, see Chapter 2.1). They presented their results by quantitative tables and a structural model where path estimates were carried out with PLS analysis.

The common guidelines for usability evaluation were planned before the first user experiences were collected. Due to the various nature of use cases, an unstructured interview-based qualitative analysis was chosen to be used in the project. The experiences of the users who were visiting Centria's VR laboratory or Turku Game Lab were collected by informal interviews. This included many different demonstrations in 3D CAVEs or VR/AR environments, and gamification solutions for interactive product or production presentations, rehabilitation games, museum visits, entertainment etc. One important part of user experience collection was carried out in events and exhibitions were hundreds of people were testing the results developed in the project.

3. TECHNOLOGY EXPERIMENTS

3.1 Quick CAD Modeling or Point Cloud Handling for Fast Experimentation

Industrial design has transformed to utilize 3D Computer-Aided Design (CAD). Data concerning products, manufacturing, building, infrastructure, etc., are currently all in digital format. The digital product process covers the entire product life cycle, from the design phase to maintenance and after-sales. Marketing is a promising area that has not yet widely utilized digitalization to boost business for SMEs. Until now, mainly large companies have been able to utilize digitalization effectively. New technologies such as low-cost 3D scanning, VR/AR glasses, and game engines will enable the use of digital content to boost SME business, especially for marketing purposes. We carried out the digitization process in several use cases with the same procedure: starting with 3D scanning, then from point cloud to 3D model, and finalizing the process into animations and simulations based on that accurate 3D model. We described earlier the phases of the entire digitization process, from 3D scanning to implementation software development (Jämsä, Luimula, Pieskä, Brax, Saukko & Verronen 2010; Luimula, Suominen and Pieskä 2015).

The biggest problems when using the conventional point cloud handling is that it is too time-consuming and expensive for SMEs, During Fast Wow project, we found that using game development tools results in a much faster development cycle than using industrial 3D CAD-based software. It also allows quick transfer of digital models to VR/AR devices or to the 3D CAVE. We have found game technology very useful for fast experimentation. It also provides a cost-effective and quick way to transform the results from one platform to another, e.g. from desktops to 3D CAVEs, smart phones, tablets, VR headsets, and game programming software (e.g. Unity and Blender). FIGURE 3 presents the alternative ways how quick virtual modeling was carried out in the use cases of our project.

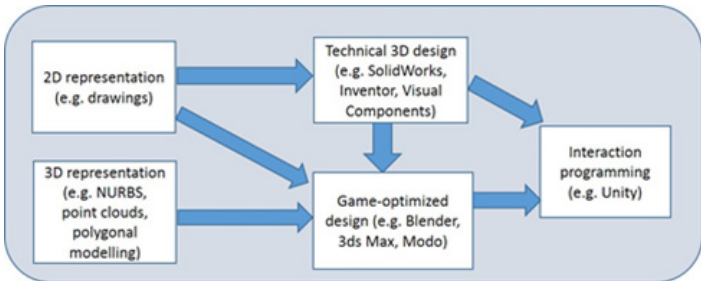

FIGURE 3. Alternative ways of using virtual and game technologies in quick modeling

The first wider experiment where game development tools were successfully used in point cloud handling was carried out in a factory hall in Varkaus (FIGURE 4). The factory hall was planned to be taken for a new kind of production and a virtual model was needed in this planning process. The work was carried out in collaboration with Centria and TUAS. The laser scanning was carried out in May 2015 with Centria's Leica Scan Station 2 scanner and the quick modeling was made with Blender and Meshlab softwares. This technology experiment gave useful information about quick modeling with game development tools and this information was utilized later in the use cases of partner companies.

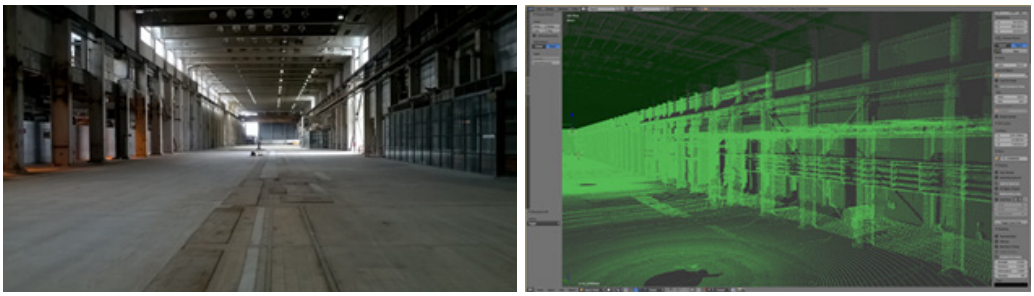

FIGURE 4. The factory in Varkaus and the point cloud after laser scanning

Another technology experiment using quick point cloud handling with game development tools was carried out when creating a CAVE-compatible 3D model of the Ylivieska church (FIGURE 5) after it was completely destroyed in an arson fire in Easter Saturday 2016. Fortunately, the church had been 3D-scanned three years earlier, and the scan file was located in Centria's archives. Many people got a Wow experience when they could still visit in Centria's CAVE a church that no longer exists. Later this virtual model was further developed and transferred to mobile and HTC Vive virtual glass applications which were successfully presented in a shopping center before Easter 2017. The main game development software which were used were Blender and Unity.

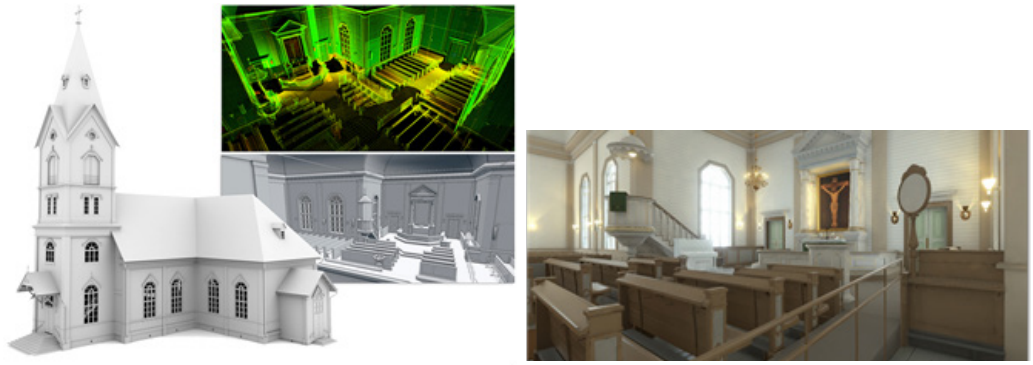

FIGURE 5. Ylivieska church as a point cloud, 3D model and virtual model for VR and mobile devices

A holiday house Raikas (owned by the project partner JEDU, a local vocational school) was 3D-modeled for the 3D CAVE environment starting from the drawing and photos. Game development software was again was used in the quick modeling process and adding various interactions for the virtual model. In this application, it is possible for users to change the colors and textures of the surfaces (see FIGURE 6). The result was tested as an educational interior design tool in JEDU .The educators in the vocational school reported having genuine Wow experiences when they first tested it in the CAVE environment.

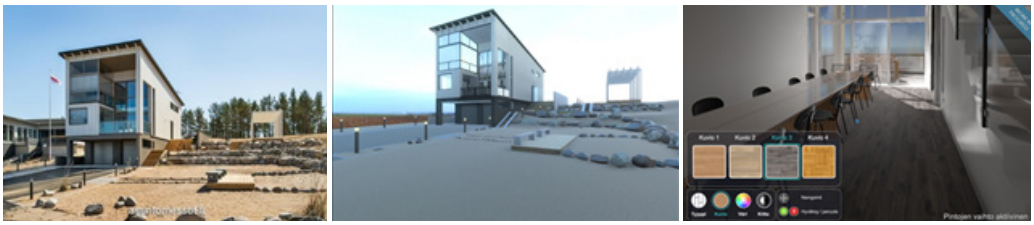

FIGURE 6. 3D-modeled holiday house with educational interior design tool compatible for CAVEs

Centria had also technology experiments how quick modeling can be carried out starting from technical 3D design files (e.g. Solid Works, Autodesk Inventor, Visual Components). Often the biggest problem is that these technical 3D design files are too detailed and their use in VR/AR, CAVE or smart phone solutions requires lot of work in simplifying the model so that they can run in the CAVE, VR, AR or even in mobile applications e.g. in smart phones. FIGURE 7 presents some examples of the technology experiments which were developed and tested starting from the technical 3D design files. These applications were developed further in other Centria's projects.

FIGURE 7. Some examples of the cases where technical 3D design file conversions were experimented

3.2 Technology Experiments in Virtual Spaces

Virtual spaces or Collaborative Automatic Virtual Environments (CAVE) are immersive virtual reality environments where projectors are directed to the walls, floor or ceiling of a room-sized cube. They allows user to experience and visualize e.g. architects and engineers 3D models in a stereoscopic view. In Fast Wow project, CAVE applications and demonstrations were developed and demonstrated in several virtual spaces. In the Centria's use cases during the project, the main virtual space for development was the 3D CAVEs at Centria Ylivieska (FIGURE 8, left) which was taken into use in the first project year in cooperation with Satavision. During the project, hundreds of people were testing the demonstrations developed in the Fast Wow project. One of the project partners, JEDU Kalajoki has also a 3D CAVE supplied by Satavision. Therefore in their use case it was easy to test there the applications developed at Centria's CAVE. Collaboration with Satavision included also a comparison visit to the CAVE at UKI-Arkkitehdit, Oulu, which makes close cooperation with Satavision. Satavision presented their virtual space solutions in a workshop May 2016 at Centria. Collaprime is a spin-off from Satavision and they have a virtual space environment in the city center of Helsinki. The project made a collaboration visit to that environment in February 2017 with participants from Centria, TUAS and Haaga-Helia UAS. In addition to Turku Game Lab equipment, TUAS used also the CAVE situated in the TUAS campus area (FIGURE 8, right). That CAVE was also visited in the workshop of one steering group meeting.

Virtual spaces can be used during the lifecycle of a product, production, building, a plant or an infrastructure. Our technolgy experiments showed that it is a useful tool for involving design and gathering the feedback and views of the users and other stakeholders. Its main benefits come in the design / engineering phase with the development team and customer. It is also a useful tool in marketing. The main drawback is that many people feel uncomfortable in CAVE with virtual glasses, especially if the demonstration is led by an operator who makes too fast movements.

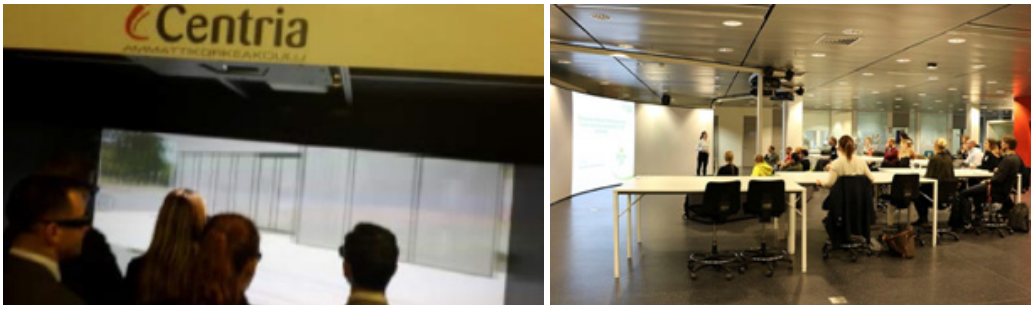

FIGURE 8. CAVEs at Centria Ylivieska and at Turku Science Park

3.3 Technology Experiments Based on Virtual and Augmented Reality

The main working method in the Fast Wow project is based on fast experimentation. The purpose was to create novel practical and theoretical solutions based on agile and experimental innovating, see e.g. (Radjou et al. 2015, Morris et al. 2014, Prahalad et al. 2008). In technology experiments the competence required included e.g. know-how from virtual and augmented reality design, VR/AR UIs (from mobile devices to caves), 3D scanning, point clouds, 3D modeling, game engines and graphics, 3D internet, and industrial internet. Some of the use cases presented in Chapters 3.1 and 3.2. were also transferred to HTC Vive or mobile environments (FIGURE 9)

FIGURE 9. VR / AR environment in Centria's CAVE

In cooperation with Haaga-Helia University of Applied Sciences, TUAS conducted various experiments where Haaga's the Box concept was tested and extended with new interaction methods (FIGURE 10). Our first demonstration called Medieval Gastro Box is named based on Haaga's concept. In this demonstration, we utilized "escape room" game design with theme of Erik's dungeon. This "escape room" game will be presented in details later in this document. Our Medieval Gastro Box was presented in IEEE CogInfoCom 2016 conference in Wroclaw, Poland, and in the Working with Museum Audiences – Towards Active and Inspiring Customer Experience 2017 conference in Turku (organized by the Association of the Castles and Museums

around the Baltic Sea). These demonstration proved that we are able to provide a new level of sensory and cognitive experiences and elements to elevate the level of immersion for tourism and hospitality industries. This proof-of-concept solution involves an immersive dining experience set in the virtual representation of the medieval Turku Castle.

FIGURE 10. The concept picture of Medieval Gastro Box (left) and a screenshot from VR Erik's dungeon escape room minigame (right)

We have also shown that this concept can be extended and further developed to be suited for nearly any kind of tourism based activity, event or a venue. Moreover, as the Medieval Gastro Box is located within two containers and a mobile unit, it can bring tourism related activities as a pop-up VR experience into various real-world locations, providing a new concept for many fields of tourism and hospitality industries, e.g. marketing, promotion, trade fairs and expositions. The second version of this concept was demonstrated at the end of this project in our final seminar organized in Haaga Campus in Helsinki. In this demonstration, we created a Finnish forest environment for the seminar audience with various interactions (FIGURE 11).

FIGURE 11. Finnish forest environment as the second version of GastroBox concept was demonstrated in the final seminar in August 2017

One another VR technology experiment has been conducted for Forum Marinum which is Turku based sea museum. This technology experiment called VR Ships gives for the museum visitor an experience of boarding the famous Finnish ships and airplanes from wartime Finland in a realistic environment by utilizing VR glasses like Oculus Rift and HTC Vive with Unreal Engine. In this experiment, we have focused on 3D modelling in order to provide historically accurate ships and other relevant content. In addition, also audio and sounds were designed based on the location of the player (submarine, airplane etc). These results have been demonstrated in ICT Showroom 2017 (FIGURE 12) and based on this valuable feedback further cooperation with Forum Marinum will be considered later 2017 or early 2018.

FIGURE 12. VR Ships demonstration presented in ICT Showroom 2017

3.4Technology Experiments Based on Speech Recognition in Healthcare and Therapy

TUAS has studied digital rehabilitation and exercise gaming in various RDI projects. As a result, TUAS had wide range of exergames available for Wow experiments in a cooperation with Centria. During this project, these two research organizations decided to test TUAS exergames with Centria Kompai service robot. This robot (see FIGURE 13) was tested in this work package its ability to speak and understand something in Finnish language together with rehabilitation games created by TUAS. One of the main experiments was a technology demonstration in Games for Health annual seminar in Turku, 2016. In this event, researchers got a lot of valuable feedback from the audience and from the local media. Based on this promising feedback we decided to further develop and test this Wow concept later in a health care and a rehabilitation center.

FIGURE 13. TUAS exergames demonstrated in Games for Health seminar (Yle 2016)

One example of a therapy related application developed during this project is Sanalanka (FIGURE 14), which is aimed for children with speech and language therapy needs in the age group of 3-4 year old. During the initial assessment for the needs and benefits for an application for a specific therapy requirements, we found out that in many cases the speech therapy aids and tools in use are picture cards, with imagery originating from the 1960's. The visual quality of the cards may be questionable, and the associative qualities of the images may be not adequate enough. For example verbs are not easily expressed with non-animated images, presenting one advantage of a digital application. Verbs can be presented with short animations and the speech therapy tools are thus easily accessible via mobile devices or home computers. The game will also employ speech recognition features by Lingsoft Ltd. allowing the end user to experience controlling the game with their own voice. This voice recognition feature is significant from the speech therapy point of view, and also encourages the child to speak and use their voice. We have aimed to make a special contribution on the player's own motivations in speech development, since the player should not be at all times aware that the therapy and controlled learning environment are taking place. The final application will have a large variety of different minigames through which the therapy methods will be fully implemented, and furthermore during the progress of this project, the application will be tested by speech therapy groups. This technology experiment was introduced with Lingsoft Ltd. for the big audience in EU Thematic University Business Forum in Haaga-Helia University of Applied Sciences in Helsinki, 2-3 June 2016.

FIGURE 14. Sanalanka speech and language therapy game aimed for young children

3.5 Other Technology Demonstrations and Experiments

The other technology demonstrations and experiments included various application areas, some of them are introduced in FIGURE 15. The upper and middle line show results of the demonstration demonstrations which were carried out together with Centria's IIBE-project (Industrial Internet as Business Enabler). The monitoring mobile robot with sensors was connected

to internet by wlan. It could monitor changes in factory environment, e.g. with thermal sensor information it could make warnings about possible fires. More information about technology experiments can be found from the conference paper (Heikkilä, Pieskä, de Jong & Elsinga, 2015). The second line presents results from industrial internet based wlan performance measurements which were carried out both in Centria's laboratories and in the factory area of one participating company. In the two lowermost line demonstrations of quick 3D scanning, visual display and virtual robot control are introduced.

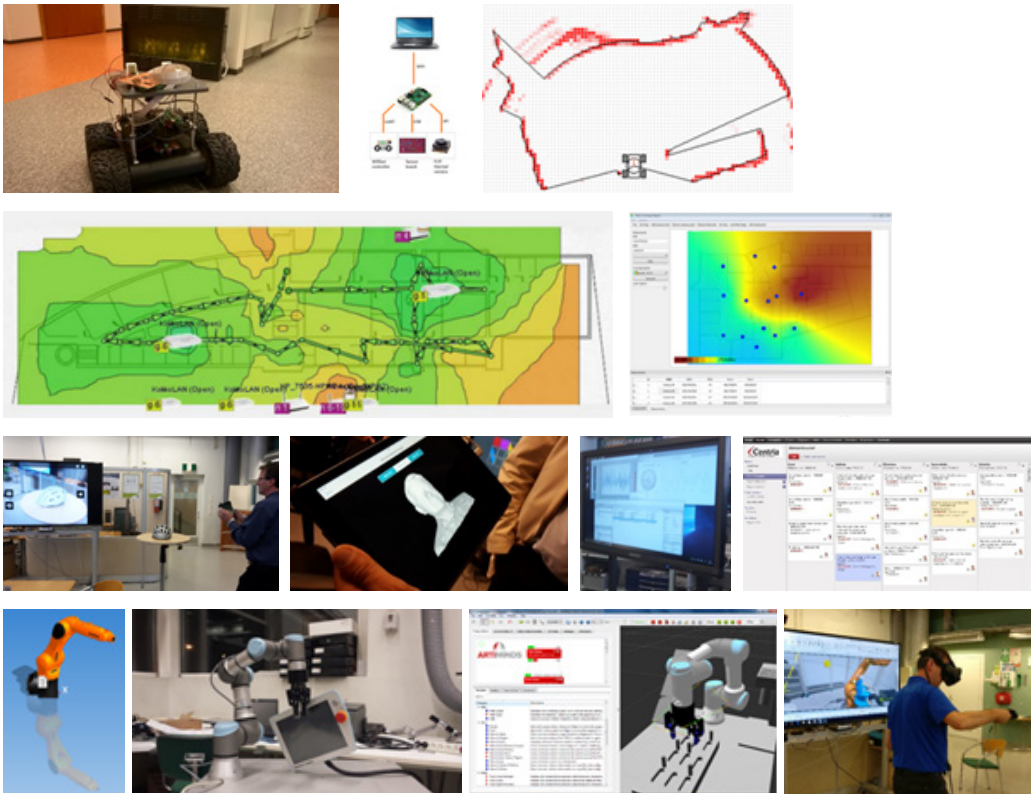

FIGURE 15. Examples of various technology demonstrations and experiments from the project

The technology demonstrations presented in Chapters 3.1 – 3.5 gave participating companies not only many Wow experiences about new technology, but they also gave more realistic information about the applicability of these technologies in their own business.

4. BUSINESS EXPERIMENTS

The wider analysis of business models and business experiments were carried out in the project together with Virike Consulting, Centria and TUAS. This wider analysis was collected by Dr. Kari Hakkarainen from Virike Consulting and it was presented in the internal project report (Hakkarainen 2017). The other business experiments carried out in the Fast Wow project were based on Wow-Canvas and Digital Age Production Park concepts. The main findings from these experiments are presented in this chapter.

4.1 Experimental and Iterative Business Innovation

At a general level, the business model has been referred to as: a statement, a description, a representation, an architecture, a conceptual tool or model, a structural template, a method, a framework, a pattern, and a set (Zott, Amit and Massa 2011). Morris (2009) has made a wide definition for a business model:

> "A business model is a description of a whole system, a combination of products and services delivered to the market in a particular way, or ways, supported by an organization, positioned according to a particular branding that, most importantly, provides experiences to customers that yield a particular set of strong relationships with them. Further, a business model describes how the experiences of creating and delivering experiences and value may evolve along with the changing needs and preferences of customers. And it says how you make money, what people are willing to pay you for."

In our project, the target was in the wide definition of the business model. However, our approach was to start with small steps with experimentations as presented in the Morris-Sääskilahti model in FIGURE 16.

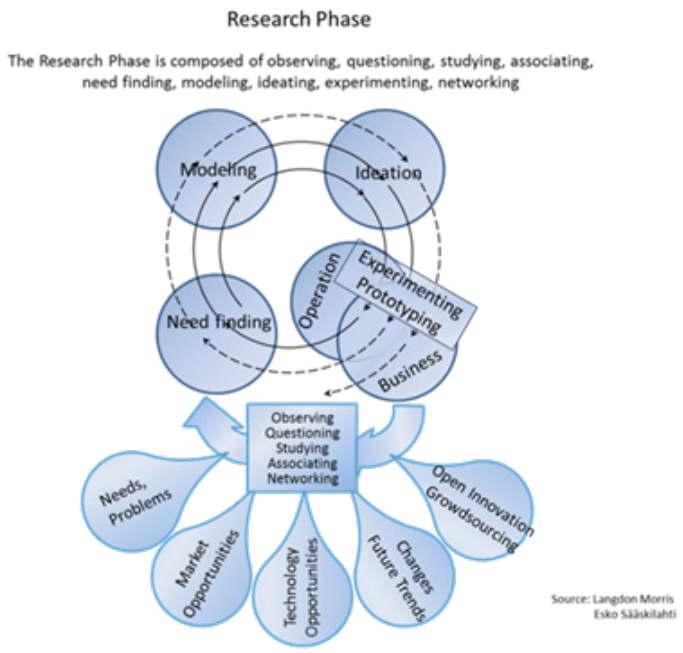

FIGURE 16. Experimental and iterative business innovation

4.2 Modeling and Ideating Business Experiments

There are methods, like brainstorming, that are good concepts in theory but have proven inefficient in practice (Evangella 2014). Brainstorming and similar forms of teamwork are, in fact, claimed to be actually less effective than individuals working independently (12manage 2014). Participants' behavior is affected by group dynamics, alertness varies, and there are distractions, and so on. Scott claims that when brainstorming is conducted the right way, as intended, it is effective (Bercun 2007). Unfortunately, real-life sessions seldom consist of more than organizing sticky notes. Bercun (2007) presents several tools that might help to reduce obstacles to idea hunting. De Bono, known for his classic treatise on "lateral thinking" (De Bono 1970), has written several books on the subject. Various other well-known methods, such as TRIZ (Etria 2014), are occasionally mistaken for idea generation. They may nurture creativity, but by definition they are actually intended for problem-solving or for classifying and organizing ideas. The Internet can provide a bunch of tools, and it does no harm to give some of them a try.

Only a very small fraction of ideas turn out to be productive (Stevens and Burley 1997). In the literature there are lot of idea screening and funneling techniques but they are often too slow and expensive methods for SMEs to be implemented in their projects. Morris et al. (2014) presented the Agile Innovation approach as an alternative way for innovation process. They show how agility and innovation can be combined and made happen in practice. Other methods which were analyzed during the Fast Wow project were Frugal Innovation by Radjou et al. (2015), Kissing Technological Frogs by Matthews (1990) and omni-channel business models (e.g. Leslie 2015).

Frugal innovating often includes recombining existing solutions and further customizing them. Frugal innovators use to innovate faster and cheaper because they don't use linear, pre-planned, time-consuming R&D processes. Fast experimenting is often related to frugal innovations.

Matthews calls strategic positioning "kissing technological frogs", referring to a fairy tale. Frogs in a pond represent ideas, i.e. potential strategic options. One picks up one frog at a time and kisses it, in order to determine whether it is actually an enchanted prince. If it is, one schools it to become a king. If not, the frog is released to leap back into the pond to mature.

Omnichannel is a cross-channel business model that companies use to improve their customer experience. More information can be found from Leslie (2015). The analysis of modeling and ideating business experiments and models were more widely discussed in the internal project report (Hakkarainen 2017).

4.3 Experimenting and Evaluating Business Models

Every company has a business model, whether it is deliberately defined and clearly articulated, or shaped by itself over the course of time. However, in reality only few have documented it as such. There are different definitions for the concept. Usually they stem from, or focus on, attributes specifying financial or business targets such as new value proposition or value generation. Morris (2009, 2014) has made a wide definition for a business model which was already presented in Chapter 4.1.

Business model cannot be dedicated to a particular organizational unit or function. It is the entire organization together as one thing that brings it to life, as Morris has stated. This means

that every individual in a company is in direct or indirect relationship with the customer. It is important to understand that every individual thus contributes to the business model.

The main research question in this working package of the project was how to make VR/AR technologies available and cost effective for SMEs. Boosting SME business means that we have to identify bottlenecks in marketing. Cutting the costs will be one of the main challenges when creating new value with fast Wow effects. The costs should stay still within reach to SMEs working on limited resources. That is e.g. to say we have to find new innovative ways to build exhibition stands and permanent showrooms by utilizing as much as possible digital contents (for example one physical example which will be modified by using VR/AR technologies).

Our main method in business model issues was fast experimenting which utilized the main principles of frugal innovations (Radjou et al. 2015) and agile innovation (Morris et al. 2014). Frugal innovating included recombining existing solutions and further customizing them. Some of our expertise areas were key enablers in this process. Fast reverse engineering with 3D scanners could speed up 3D modeling, game engines did the same software development speeding effects to 3D modeling. 3D modeling technologies were also used as marketing tools, e.g. in a testing phase in exhibition stands.

In the project, we utilized our own business experts as well as external information and experts in recognizing, modelling and co-creating new business opportunities. This process will need various competence areas namely: business modelling, fast experimentation, 3D scanning, point clouds, 3D modeling, game engines and graphics, VR/AR UIs (from mobile devices to caves), industrial internet, 3D internet, and sustainability. User centric design (WP2) will have an important effect to this process because utility issues and user feedback are essential when creating successful business.

The developed innovations were taken into iterative real-life tests in companies' design or marketing processes. Based on the results achieved in the tests the next versions were further developed and tested in the next round e.g. in exhibitions. New innovative approaches for business were searched while participating national and international collaboration, seminars and exhibitions.

There was two special business model experimenting approaches used during the project; Wow-Canvas and Digital Age Production Park.

Wow-Canvas is developed on the base of business model canvas. The purpose of the Wow-Canvas is to be the method to track how the companies´ Wow-factors flow through company. Also there was a need for surveying how the Wow-factors are reached, what kind of challenges there are and where does the benefits come from. In addition, the Wow-Canvas is a tool for examination of the understanding of the Wow-factor in company personnel. The understanding and pursue for the Wow-factors should be common, just like in case of company strategy.

As seen from the FIGURE 17 there are nine different components in Wow-Canvas, dived to two categories, internal and external.

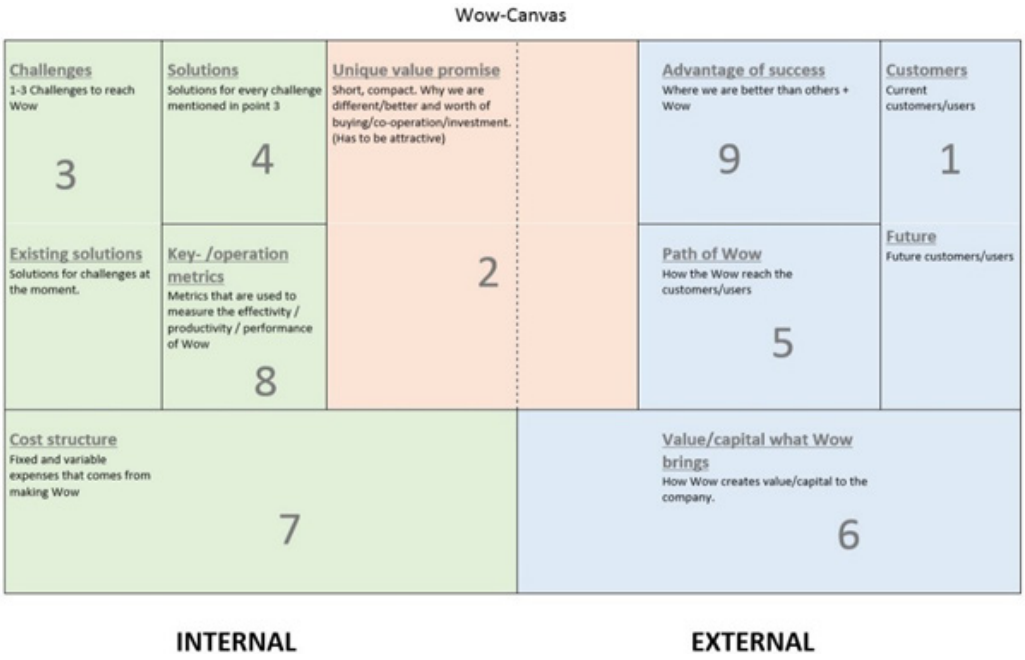

FIGURE 17. Wow-Canvas

Purpose of the Wow-Canvas is to get the company's management concretely make clear how the Wow-factor flows through company from every aspect. In addition, when figuring out how the company's Wow-factor flows through the company, people also automatically starts to think if there is new kind of Wow-factors in the company which are still to be discovered. When using the Wow-Canvas, the company should have information and knowledge which are the unique Wow-factors of the company. The Wow-gap model together with e.g. company strategy, product or service promises, information from production and marketing and other information related to the Wow-gaps are used to finding this information. Nine different components of the Wow-Canvas are explained below.

1. **Current and future customers:** Who are the customers and the customer groups the company has now. To this component also includes what are the future customers and customer groups that the company is focusing.
2. **Unique value promise:** Why is the company and its products better / different from others and that why they are worth of buying / co-operating / investing? This area has to be short, compact, simple and attractive and feed "hearts and minds".
3. **Challenges and existing solutions:** What are the 1-3 challenges that the company is facing trying to reach the concept of Wow? Also this component includes figuring out which kind of solutions the company already have for those challenges.
4. **New solutions for challenges:** This component is the place where to think new kind of solutions for all of the challenges founded in point 3.
5. **Path of Wow:** How the Wow reach the company's customers and the end users of the product or service?

6. **Value / Capital what Wow brings:** How and how much the Wow brings value / capital to the company. It is also important to figure out the vicinity of the value / capital increase what the Wow brings. It is important when deciding which new solutions from point 4 are feasible.
7. **Cost structure:** Calculate the fixed and variable costs that are generated from pursuing and making the Wow.
8. **Key- / Operation metrics:** Define the metrics that are used to measure the effectivity / productivity / performance of Wow.
9. **Advantage of success:** In this point, target is to found out the outcome from combining the Wow with those facts where the company is better than its competitors

Fast Wow project participated in developing Digital Age Production Park concept which was led by another Centria project. Digital Age Production Park is a new kind of environment for developing manufacturing industries in the digital era. It is a consortium of companies, universities and different business developers that offers the best possible national and international competence for start-up and existing micro, small and medium-sized manufacturing companies to develop their operations. Four universities (Aalto University, Tampere University of Technology, Lappeenranta University of Technology and University of Oulu) were collaborating with Centria, Sievi municipality and Ylivieska Region in the concept development. Digital Age Production Park operations aim at the success of the companies. Key operators are the companies. New jobs will be created along with their development and growth. The key element of the approach is the forge concept which has been designed to implement the operations model in the production park. The six forges include future, innovation, experiment, competitiveness, business, and start forges. Each forge has its own focus area that is vital for developing manufacturing industries. FIGURE 18 depicts the main operators and the forges of the concept. The first successful trial of the concept was carried out in May 2017 in the Digitalization 2017 event in Centria Ylivieska. More detailed description of the concept is presented in the Digital Age Production Park report (Sääskilahti, Pieskä and Kiema 2017).

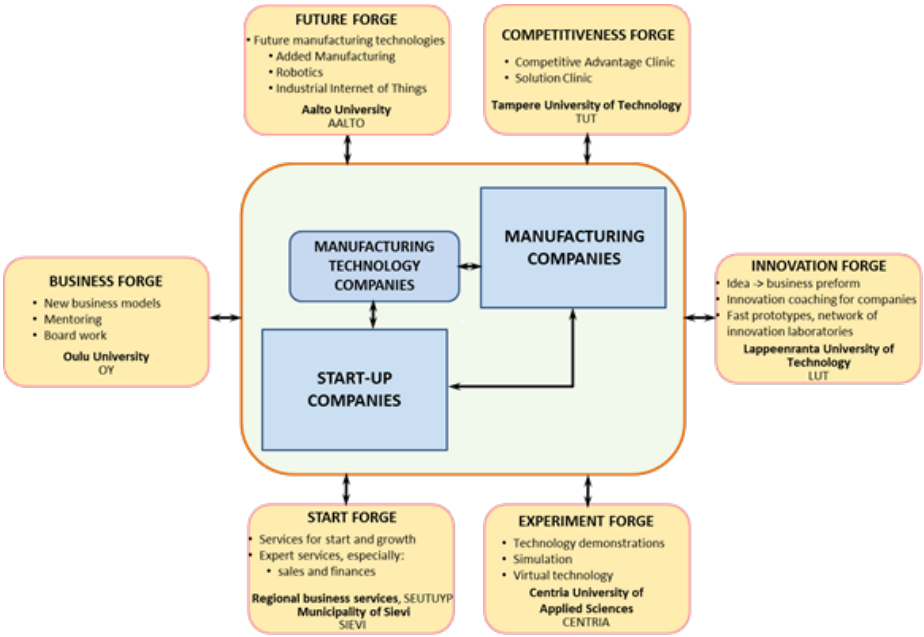

FIGURE 18. The main operators and the six forges in the Digital Age Production Park concept

4.4 Networking for Boosting Business

Nowadays, networking is an essential element for the success in business. That includes not only the network of companies but also the public actors should be involved e.g., in a form of PPP (a public–private partnership) or the Triple Helix concept of university-industry-government relationships. During the project, some of the participating companies found new cooperation ways with each other, and some of the companies found new cooperation with the research groups. The collaboration with Centria, TUAS, Haaga-Helia UAS and companies during the project is a good example of successful networking. Digital Age Production Park concept (Sääskilahti et al. 2017) is another concrete example how this networking could be arranged (see FIGURE 18).

5. COMPANY PILOTS

5.1 Company Case Specific Requirements and Technology Development for Use Cases

In every company case, a detailed requirements definition was carried out together with companies. As discussed in the Chapter 2.2, the requirement analysis was carried out by interviewing the participating companies and the main results were collected by using the matrix frame (see FIGURE 1). This analysis continued and deepened during the technology development of use cases. It was found that some of the companies had clear comprehension about the goal of their use case. However, some companies needed technology demonstrations before they could properly understand the possibilities how new technology might boost their business. That was the case e.g. with virtual reality applications which were quite new for many production oriented companies. Another example where companies needed technology demonstrations to deepen their insight was how lean visual process management (see FIGURE 19) or visual factory (Ortiz and Park 2011) in their case could be implemented using various digital forms and devices. Applying lean visual process management needs versatile information about suitable visual tools, devices (e.g. visual displays, mobile user interfaces) and software (e.g. ERP and project management software) and their integration aspects. ERP systems include typically information which companies do not want to share publicly. Therefore, detailed information of visual presentation experiments in company cases are not presented in this report.

FIGURE 19. Applying visual process management needs versatile information about visual tools available

The use cases were typically based on digital models, tools, platforms and media in boosting business, ERP integration and development, reliable remote connections for monitoring, control and maintenance and development of mobile user interfaces.

5.2 Experimenting, Evaluating and Iterative Developing in Use Cases

In the project, we examined the possibility of boosting business for SMEs through Wow experiences. Our innovation generation approach (Luimula, Suominen, Roslöf, Pieskä & Lehtiniemi 2016) relies on fast experimentation, which includes both technological and business model experimenting, as presented in FIGURE 20. The iterative innovation process starts with open innovating and continues clockwise from conceive to design, implement, and operate. During the development cycle, we try to utilize our students' capabilities as much as possible.

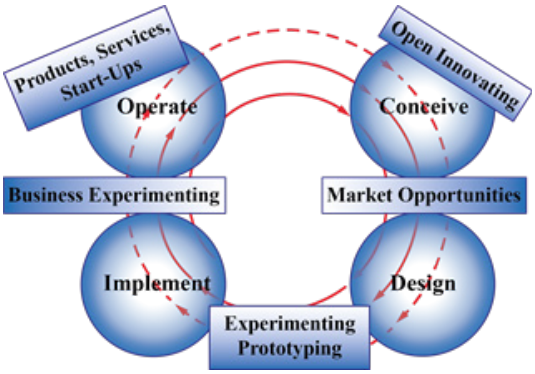

FIGURE 20. Our fast experimentation-based innovation generation model

Our case experiments have been used into the following areas: virtual design of automation equipment, robot work cells or production processes, interactive virtual environment for training maintenance or assembly operations, interactive product or production presentations for marketing, events and fairs, and utilizing 3D CAVE and VR/AR environments in education, training and rehabilitation. TUAS earlier studied how complicated CAD drawings can be utilized in game development. These results were utilized in the game development of IndustrySim demonstration (Luimula et al 2015), which contains massive CAD drawings of a coal-fired power plant.

In the virtual design of automation equipment or manufacturing processes we have utilized both technical 3D CAD software and game programming tools. The basic idea in both alternatives is the effective re-use of the original 3D design when moving from one platform to another. In robotic work cells this can cover all the way from work cell layout design to the off-line programming, remote monitoring and maintenance and updating operations. Game programming tools proved to be very useful in situations where a team is carrying out design in a busy scheduled automation project. With game programming the process and interactions can be quickly demonstrated and utilized in various platforms: 3D CAVE, virtual glasses, PC and smartphone environments. Virtual design and simulation can give Wow experiences also in marketing.

Virtual design and simulation were utilized in versatile ways in in Siipotec use case (FIGURE 21). Simulation models were utilized in machine design, layout design of work cell, predictive analysis of work sequences, collisions and safety. In addition, it was also used for marketing and off-line programming of robots. Technical 3D design data was also transformed to 3D CAVE environment with game developing tools in the development of a linear servo technology based wood processing equipment. The possibilities of using digital twins in the future were also introduced; they enable location independent remote commissioning, monitoring and maintenance. For marketing purposes, also a video (a cutout presented in FIGURE 21, right) about the ready solution was created and first time presented in LIGNA 2017 Fair in Hannover (93 000 visitors).

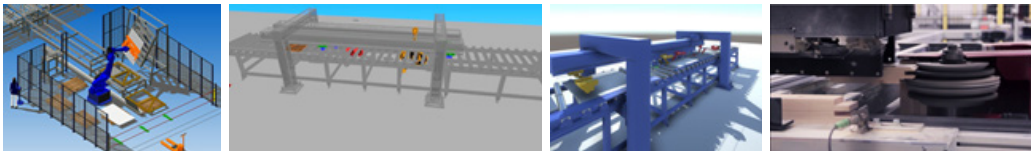

FIGURE 21. Examples of virtual design applications carried out in co-creation with a SME

We have found that virtual and game technologies can create Wow-effects in marketing, especially in events and fairs. Interactive product presentations with game technology can even provide ways to get important feedback for user interface design. FIGURE 22 presents cuts of interactive product presentations for SMEs working in different areas. In the left, a view of the interactive product guide for a heavy metal industry product is presented from the Bet-Ker use case. In the right, a large hangar door product presentation from the Champion Door use case is shown.

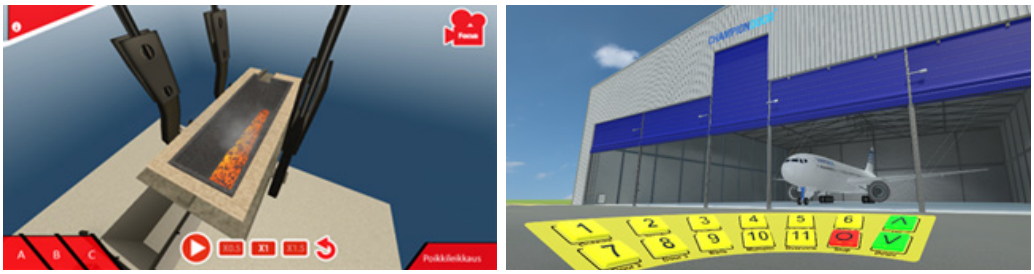

FIGURE 22. Views from interactive product presentation carried out in our projects

With game programming tools the technical 3D design can be extended to include interactive virtual environment for training maintenance or assembly operations. This is extremely beneficial if the assembly or maintenance process is far away, such as the case is often with hangar and large industrial doors. We have later applied the same technology to other areas as we presented earlier in FIGURE 7. During the project, both of the solutions presented in FIGURE 7 were taken in companies into marketing use to boost their business.

In VAMA-Product use case (FIGURE 23), programmable logic control and its integration to the location aware control system of a gritter were developed in in co-creation process with the company. Location aware towable gritter with GPS tracking gives the customer a Wow experience with a new option; reporting tool allows reports based on routes, driving time and material usage. The system has s vehicle speed and drum rotation speed sensors which are connected via CAN Fieldbus to the controller, HMI (Human-Machine Interface) and the GPS radio modem. The system utilizes cloud services. The company launched this tracking-based reporting tool as an option in their web page during the project.

FIGURE 23. Location Aware towable gritter with GPS tracking and cloud services

In Zowell use case (FIGURE 24), the goal was to develop in co-creation with the company an ERP system for property management. The first step was to develop an online available integrated property management system which included property and infra management together with maintenance and contractor management. Secondly, customized views were provided for property managers, contractors, maintenance personnel and residents. To increase flexibility, different versions were made for mobile user interfaces such as tablets or smart phones. The experiences from customers expressed that they had real Wow experiences how easily they could get the essential up-to-date information. The company launched the FaciPro product in their web page during the project.

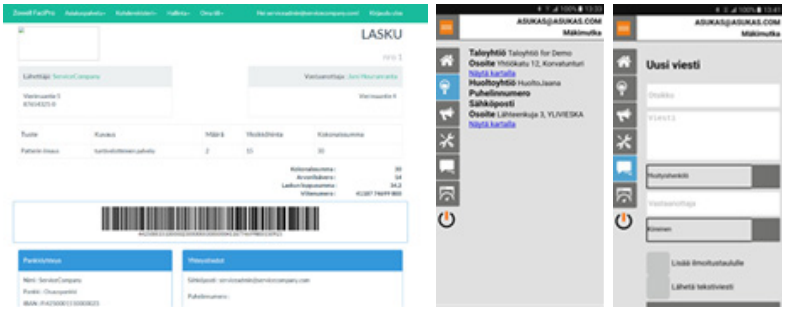

FIGURE 24. Mobile user interface gives flexibility for the property management information system

Our experiences show that virtual and game technologies can be used as business boosting enablers especially for SME companies. Our approach has not been to focus on entertaining but immersion or enhancement of reality. However, entertaining can also be one of the enablers. Because SMEs typically don't have virtual environments themselves, the collaboration and co-creation with research groups is important.

A holiday house Raikas owned by JEDU was presented as a quick 3D modeling example in Chapter 3.1. Game development software was used both in the quick modeling process and for adding various interactions for the virtual model. In this application, it was possible for users to change the colors and textures of the surfaces (see FIGURE 25 left). The result was successfully tested as an educational interior design tool. The experiments from JEDU described that users got real Wow experiences when they tested the application in the CAVE environment. The kitchen of the holiday house was also utilized with Topi-Keittiöt use case. Users can also change the company's various kitchen furniture models (e.g. door colors and models of the kitchen cabinets) in the same way they can change the colors and textures of the surfaces (FIGURE

25 right). The immersive CAVE environment brought Wow experiences for the kitchen design which could be utilized in marketing.

FIGURE 25. Interior design tool with possibility to change the models of kitchen cabinets

One application area where we have applied virtual and game technologies is healthcare solutions /9/, where we have tested rehabilitation games (e.g. skiing game) developed by Turku Game Lab in our collaborating SME's (Taukokangas) premises. The test included a demonstration day in summer 2016 (FIGURE 26) with the service robot and rehabilitation games, and a larger test period of these applications at the end of 2016. The results were presented in a thesis (Turpeinen 2017) which was awarded as a best social science thesis of the year in Centria University of Applied Sciences. The results showed that the personnel had more suspicious and disbelieving attitudes than the customers for using this kind of new technology.

FIGURE 26. Game technologies and the service robot were tested in rehabilitation applications

The Wow experiences aimed for events and fairs include the Fair Game that was firstly developed for Turku Fair and Congress center, aiming to activate the event visitors via digital gamification. The target audience included children, teenagers and other age groups enjoying mobile games. The first version of the Fair Game was presented during Turku General Fair 2015, and allowed the visitors to play the game by visiting seven different locations involving minigames throughout the fair. Each location featured augmented reality content as presented in FIGURE 27 leading to the minigames, rewarding the player with collectible cards, which in turn unlocked more content within the game.

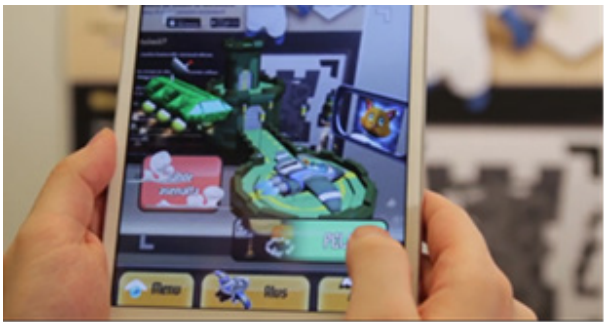

FIGURE 27. Augmented reality content displayed on top of a real-world camera view in the Fair Game

The Fair Game at Turku Fair 2015 was extraordinary and first time in our region when someone combined classic playing or collectible cards, modern features of smartphones and exhibition. The goal of this application was to provide the visitors with a new, innovative and different fair experience. The application also aimed to create a viable business platform for the fair exhibitors to market their content with both the digital game and the collectible cards. Furthermore, the Fair Game has been under development since the first prototype version, and a second version of the game presenting Mikael Agricola character were launched during Turku Book Fair 2016, and this version presents the scalability of the application where the general event and fair game platform can be extended in agile manner to cover different themes for a variety of events, trade shows and fairs (FIGURE 28). Based on these two fair game experiments we have seen that it is challenging to advertise as much as needed, to promote downloading the application beforehand, to emphasize the added value, to develop an application which will not steal the main focus from the fair experience itself, to offer significant information, and to package all in one application (no needs for extra applications). As more and more exhibitions have dedicated applications the visitors will expect them to provide more interactive content thus create a market and a need for application providers.

FIGURE 28. Mikael Agricola fair game was presented in Turku Book Fair 2016

Another example of a game designed to provide Wow experiences for a variety of events is a motion-controlled game designed around the cartoon character little bird Pikkuli by Sun in Eye Productions animation studio. The goal within this project was to create a prototype of the motion-controlled game, consisting of several minigames with the target audience being children of ages 4-8. The games were designed to include both educational and physical activity themes, and the digital hardware was designed to be placed in Pikkuli-themed playgrounds at such venues as airports and shopping malls. The games include a minimum amount of written

content, since the youngest players of the target audience might not yet have fluent literacy skills. Furthermore minimizing the textual content would allow the game to be localized for the global market with minimum extra effort.

During the development in the autumn 2015 the focus was even more shifted towards games of physical activities with entertaining content, which would be employed within the Pikkuli Play Area concept (FIGURE 29). The application employs Microsoft Kinect technology, allowing the motion detecting to have high enough fidelity for a variety of venues and settings, and the sensors to be able to separate the player even in situations where several people are located within the field of view of the cameras. During the project the game was playtested by a group of 6-8 year old children from Wäinö Aaltonen elementary school in Turku. The game received positive feedback and the children enjoyed playing the game. The game was furthermore tested also in Middle East by children of the target age group, also receiving positive feedback. During spring 2016 the games were further tested by an eye-tracking test setup, and all the test cases have provided material to allow fine-tuning the minigames e.g. regarding the difficulty levels of the games. The latest tests have been conducted in Luolavuori elementary school in February 2017. The results from this experiment have not yet been published.

FIGURE 29. Pikkuli Play Area has been one of the eye tracking test setups in this project

One of the Wow applications designed for tourists is so called Turku Castle in Your Hands. This application is designed to engage a physical visit to Turku Castle museum, allowing the visitor to experience the architecture and exhibited items as interactive elements in pursuing historical facts. User starts the tour by choosing between a tourist-mode or a game-mode. These two modes have carefully designed methods by which the content is presented to the visitor according to their expectations. Learning is based on the actual environment and the information presented in terms of relevance. For example, in game mode, the information will be given by solving a variety of tasks and mini-games. Children could easily be entertained for an hour (the length of the tour) and receive the information in a pedagogically adapted level for the younger visitors. Additionally, virtual reality system (VR in brief) is integrated for users of smart-phones, meaning certain content is available for discovery only in the VR environment.

As a result we have been testing the application in various occasions and variety of age groups, main experiences are gathered from random visitors of Turku Castle. During the project development, the challenges were faced with unstable internet connection in the castle, exhibition light-setup conditions and functionality of the Vuforia augmented reality platform one of the key technologies utilized in this application. As a summary, the promising results lay in creating new type of visual markers that function with the tracking device. We have created novelty in game concepts and possibility to implement the platform to any other facility or event, which was one of the main research questions in our work. "Turku Castle in Your Hand" (Fig, 30) has been a valuable case study that has joint multidisciplinary skills both from Turku University of Applied Sciences, University of Turku, industrial partners and international cooperation partners. The first usability tests have given positive results in user interface design and general design of application. Users especially enjoyed the VR minigame and quality of work

in 3D representation of the room. As a result of this project, we have created a platform that can be adopted to any other event or institution that may need this type of services for their customers. This application will be tested by several different cultural institutions especially in Finland and Middle East, with intention to integrate the platform with local business partners in commercializing the product in the future.

FIGURE 30. Turku Castle in Your Hands application designed for tourism and cultural heritage

5.3 Analyzing the Experiments for Boosting Businesses of Companies

Whole concept of Wow, or even the term, isn´t unambiguously defined. Since whole research of business side, was going to rely on this clear vision of what Wow is, it was important that first thing what TUAS´s business research personnel did was to find out what Wow really is. Therefore, literature research was conducted and ontology regarding Wow was created. TUAS´s business research personnel also created a model which is further developed from Zeithaml, Parasuraman & Berry´s SERVQUAL model to WOW-Gap model. Results of this research was published by Springer (Reunanen, Penttinen and Borgmeier 2016). The third author, prof. Dr. Arndt Borgmeier is a professor in Leadership Industrial Sales and Technology in University of Applied Sciences in Aalen Germany and he was asked to provide outsiders view to Wow research.

Our research showed that the whole concept of Wow wasn't very familiar to people. Many have heard the word Wow from somewhere and could connect it to something really great or amazing. But no one could tell more of what the Wow really is. To create value with something it is important first to understand with what the value is supposed to create and after that start to think how to do it.

5.3.1 Business experimenting

After the whole concept of Wow has been defined, it was possible to start to figure out how to find the specific Wow of every company. For that we developed a questionary based model where we interviewed the few person from each company and after analyzing the answers we could form a clear picture of the Wow what the company is doing. Combining this (the company based Wow) with the fast Wow effects created digitally (AR/VR) it was possible to start to figure out how the value creation through those establish. Results of this questionary was company based Wow-analyses where the company based Wow-factor or -factors raises up.

Business experiments were conducted from company cases by making an inclusive business plan from every of the different application or implementation. Also from the base of those business plans, there was made five different case where the idea of the true business experiments where applied on a different kind of business idea (for example using AR technology for technical parts and service manual idea). From those cases were also made inclusive business plans (FIGURE 31, FIGURE 32).

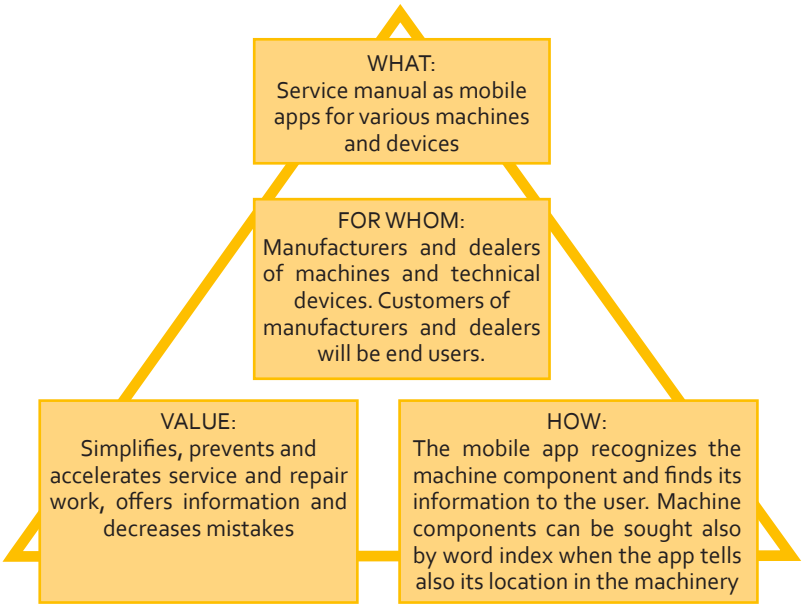

FIGURE 31. Opened business plan from business case idea: Service manual

Evaluation of different business experiments was done by using book "The Business Model Navigator" (Gassmann, Frankenberger and Csik 2014). The book presents 55 different business models that revolutionize business. For every business experiment there was chosen few different models from the book that reflects the best way of creating profit on every business plan.

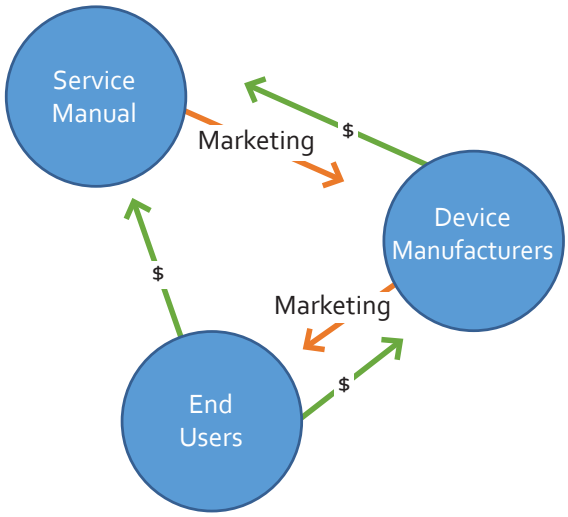

FIGURE 32. Cash flow on business case idea: Service manual

Result of these was business plans from all of the company cases and also business plans from the idea cases developed from the base of those original company cases.

Also a combined article "Wow-tekijä liiketoiminnan kehittämisessä" will be published by Turku university of Applied Sciences. In that combined article will be presented the base idea of Wow-factor and Wow-effect, the principals of business planning, how to use Wow-factor and Wow-effect on business planning and development and also using Wow on those case idea applications from the business view.

5.3.2 Developing business experimenting

Iterative development of business models was done by continuing development. Business experiments were further developed by two ways. Business cases were developed further by innovating different possibilities of utilization of Wow projects technical achievements and pilots. Second way was to further develop Wow concept in business. TUAS´s business research personnel conducted two articles for how to use Wow to develop business. Results of this research is published in two articles published by Springer (Penttinen, Reunanen & Borgmeier. 2017a, Penttinen, Reunanen & Borgmeier. 2017b). Prof. Borgmeier was again giving outsiders view to the research.

Wow gaps model is illustrated in FIGURE 33 which shows a simplified system dynamic model from how Wow-effect can be examined. Customer expectations are consisting of needs, the words of mouth, past experiences and expectations made by marketing and sales. Signals from the markets to management are typically delivered by marketing and sales by market researches and sales representatives' reports. But interests, personal biases and expectations of management, not to mention that management too, have their words of mouths, needs and past experiences influencing their perceptions.

Wow-effect can also be pursued by marketing, advertising and sales, but in this research this Wow-effect is combined more to promises about products or services than claiming this promise. When claiming the promise, Wow-factors can be seen as determinants with extreme satisfaction. If the factor is not giving Wow-effect, this doesn't mean that factor is not good or unpleasant, it is just not exceeding expectations enough for Wow.

As seen from the FIGURE 33 there are 7 distinctive gaps between different stakeholders:

1. Gap between Markets and Management,
2. Gap between Management and Marketing & Sales,
3. Gap between business definition and Company Existence,
4. Gap between Existence and Specification,
5. Gap between Production output (includes product/service delivery),
6. Gap between Production output and Perceived Experience, and
7. Gap between Customer's Expectations and Perceived Experience.

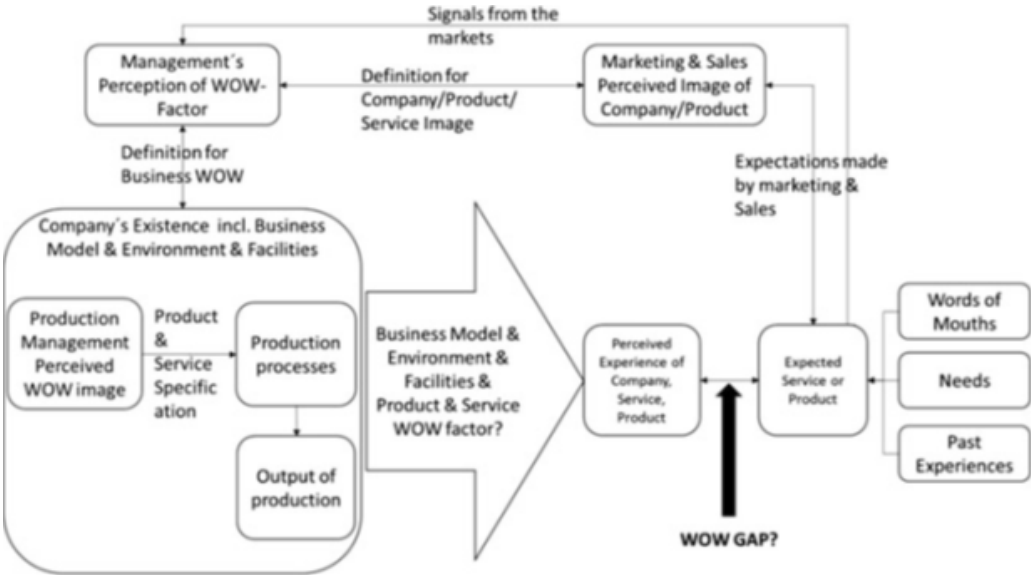

FIGURE 33. Wow Gap model (Reunanen et al. 2016)

5.4 Planning the Future Steps for Creating Value with Digitalization

Rapidly changing business environments, increasing numbers of competitors and transformation in value creation are forcing the companies to find new ways of develop business faster and more innovative ways. Customers are more and more enlightened of different possibilities and they have more information to use when deciding the product or service provider. For these reasons, it will be even more important to realize and take into account the customers´ feelings. The product or service what the company is providing need to give kind of a memorable moment, i.e. Wow experience for the customer.

The future will bring digital solution ways of creating Wow experience for customers and consumers even faster. Combining companies' products or services with digital solutions and people feelings forces the companies more closely to focus on what is that really amazing thing they are doing. It just needs to be found consciously, to be defined clearly and utilized better in order to enhance business and profits.

The very promising connections between the Wow concept and business, management and human aspects still have to be researched more deeply. In addition, one of the future research topics should be how can the Wow be connected to the profitability of the company, how remarkable the impact of Wow-factors and Wow-effects are to the companies´ profitability, and can the Wow-factors be negative in some cases i.e. are there also anti-Wow?

6. NATIONAL AND INTERNATIONAL COOPERATION

6.1 National Collaboration with Haaga-Helia UAS, Virike Consulting and Other Partners

The consortium with wide areas of expertise is important in developing know-how and methods suitable in new value creation. This project consortium was networking with many external parties to achieve a synergy between research, industry and public authorities. The most intensive collaboration was carried out with Haaga-Helia UAS and Virike Consulting.

During the consultation and collaboration with Haaga-Helia UAS Vesa A. Heikkinen and Pasi Tuominen participated in ideation of contents, demonstrations, workshops and meetings of Fast Wow project (Heikkinen 2017). The best result was to utilize The Box to demonstrate and experiment the applications created in Turku Game Lab and Centria. One of the future vision is to build a new generation learning environment where Lingsoft's linguistic know-how is integrated to Turku UAS, Centria UAS, Haaga-Helia UAS and Perho Culinary, Tourism and Business College knowledge and applications.

The consultation work of Haaga-Helia UAS summarized that the technology know-how in the focus area is in Turku UAS and Centria UAS at the highest level in Finland. However, they need larger service infrastructures for test and development environments for tourism, hospitality and experience business. They need also bigger partners who are willing to carry out new business experiments and can afford them.

The wider analysis of business models and business experiments were carried out in the project together with Virike Consulting, Centria and TUAS. The analysis was carried out with face-to-face meetings, online meetings and with email exchange. This analysis was collected by Dr. Kari Hakkarainen from Virike Consulting and it is presented in the internal project report. The main results of this analysis were introduced earlier in Chapter 4. In the future, the most interesting parts of the analysis will be presented in scientific articles which are currently under preparation.

6.2 TUAS and Collaboration with Arabic Countries

On December 2015 Taisto Suominen and Balsam Abdulghani visited to Dubai where the Fast Wow project and the Fair Game was introduced to Riju George, Director of Sales at Dubai WTC.

The emphasis was on the customization on the game - the content, the mini games, treasure hunts, memory games, maps, markers. Riju George was from the exhibition events management and he was very interested and he liked the concept. They were interested to cooperate and have a tailormade solution but mostly target group for them is adults not kids. In Dubai, digital services are evolving really fast. In two years, they've already developed and Riju predicted that in Dubai the use of social media and smart devices is rising all the time. We learned that everyone has a modern smart device which is late model so there are lots of possibilities for interactive applications. After Dubai, the researchers travelled to Sohar, Oman where Hazem AL-Bermanei joined them.

Balsam and Hazem tested Pikkuli Motion games already in Finland during November and the idea was to repeat a similar test in Oman. The aim of the test was to find out does the cultural differences affect the players behavior and is the Pikkuli content attractive to Arabic children. The tested games were Pikkuli Flying game and Traffic control game. We filmed and photo-

graphed the test for further analysis which Balsam Adbulghani conducted in Finland. We took notes about the behavior of the test subjects. The age of the test subjects was 4 to 10-year-old. We arranged totally three different test sessions is Sohar in two different private schools. Mostly there weren't any issues with game content and the difficulties with the motion detection was similar as in Finland. As the players saw each other play the next player knew how to play. (FIGURE 34)

FIGURE 34. Test conditions in the private school at Sohar, Oman

We also started co-operation and working in Sohar College of Applied Sciences. We were hosted by Dr. Tariq M.S. Abdullah Altaye, Dr. Hilal Al Maqbali. We discussed also the future steps with Dr

Qasim Al-Mamari, The Ministry of Higher Education. Hazem met the dean of Sohar Dr. Ali and Dr. Sultan Al Ruzaiqi The President of The General Authority for Information Technology in Oman. Hazem explained the summary of the research exchange and the objectives of Fast WOW project to them. Hazem answered the questions of the Dr. Sultan Al Ruzaiqi and the local newspaper documented Hazem's visit to the opening ceremony of the new department of Open Source Software Lab.

During the research exchange, we visited also to the Nizwa College of Applied Sciences. The college building was exactly the same structure as the college in Sohar. The Dean Dr. Said Alnabhani met us with head of the design department Dr. Amr M. Abdel Kader. We discussed about our research exchange and our experiences in Oman and explained the purpose of the Fast WOW project. We showed a video presentation of the Turku Castle application and demonstrated the application and the scanning of the paintings with an iPad. We discussed about the research exchange possibilities to TUAS.

After the visit, the college we went to a historical Omani icon and a famous touristic point of attraction, which was Nizwa Castle. The visit to Nizwa Castle gave us understanding of the tourist attractions in Oman and need of guidance if you want to learn something about the history of the castle. We decided that the Nizwa Castle would be perfect example for the scaling of Turku Castle application.

In 2016 TUAS invited three researchers from Oman (Dr. Tariq M.S. Abdullah Altaye, Dr. Hilal Al Maqbali ja Dr. Amr M. Abdel Kader) as exchange researchers from Sohar and Nizwa to work in Turku Game Lab together with game developer experts. This exchange aimed to make concept

design and the prototype for Nizwa Castle based on Turku Castle in Your Hands. The challenge was to meet requirements in Arabic countries cultural and technical context and requirements and to use multilingual content. The research was done in a close cooperation with Turku Game Lab specialists. We managed to develop a game application for one of the rooms of the castle using VR technology, as well as AR (Augmented Reality) that supplied information about the castle in a very modern and attractive way to the tourists.

Prototype application was built for the local and the international tourists but also for pupils to be engaged their learning process. Dr Amr continued working with the interactive map of Nizwa Castle with the students of Nizwa College of Applied Sciences. One of the objectives in this cooperation was to get local partners (e.g. new startup) skills and ability to utilize Finnish Wow platform efficiently in Arabic contexts. We learned on our last visit to Oman on January 2017 that there are already a few game developers in Oman that utilize the same game development tools and are interested on utilizing them on cultural heritage projects. Continuing the discussion with Omani Ministry of Tourism, Sohar and Nizwa Colleges of Applied Sciences and local developers will be our approach to continue business and research activities between Finland and Arabic countries. (FIGURE 35)

FIGURE 35. Game Development Workshop at Private University SAS Virtual Reality Center, Muscat

The results were presented in Oman TV General in September, 2016 (FIGURE 36)

FIGURE 36. Nizwa Castle technology demonstration was presented in Oma TV General in autumn 2016

On January 2017 Tero Reunanen, Marcus Penttinen, Mika Luimula and Taisto Suominen travelled to Dubai to research the business potential of AR and VR technologies in Middle East. The purpose of the trip was to introduce the WOW theory and the WOW canvas which were pro-

duced during the project. We visited Intersec 2017 fair and the Arab Health 2017. In Arab Health, we had a stand in Finpro's Team Finland common stand area for Finnish industry. During the Arab Health we had many visitors who were impressed about our technology demonstrations.

During the visit, the team visited various locations and had various meetings with Gulf area representatives e.g. from King Khalid University, Saudi Arabia. In the meetings, the Fast WOW project results were introduced and further cooperation was discussed. Taisto and Mika also visited to Oman where they visited various locations in Muscat, Sohar and Nizwa including Sohar Aluminiun and Ministry of Tourism of Oman. With the representative from the Ministry of Oman they visited a guided tour in the Mutrah Castle and the Nizwa Castle and discussed further cooperation with cultural heritage applications.

6.3 Centria and Japan Collaboration

Centria collaborated with Ochanomizu University in Tokyo and especially with Siio lab (http://lab.siio.jp) which is specialized at ubiquitous computing and human computer interactions. User experience is the main part of the group's interest topics. At Siio lab Centria people got familiar with FastWow applications created by Japanese hosts. They utilize the most recent technologies and solve out company need basis challenges. Joni Jämsä had earlier visited lab several times and had three visits there during the project. Project manager Sakari Pieskä joined the visit in March 2016 and digitalization manager Marjo Heikkilä in November 2016. The aim of the research visits were to get information of the latest Japanese solutions and to learn their objectives in improvements of human machine interactions. Co-operation covers also studying Siio lab practices especially mobile environments and smart phones. November 2016 visit included also participation to MUSICAL 2016 conference and a joint paper in that conference. There were seven research exchange visits from Ochanomizu to Centria (altogether 12 months) and three visits vice versa (altogether 2 months). Ochanomizu participated into financing the cooperation by paying the salaries and travel costs of their researchers. The summary of the research exchange is presented in FIGURE 37.

FIGURE 37. The summary of Ochanomizu - Centria research exchange during the Fast Wow project

The topics for Wow experiences in Japanese culture often differ from European ones. However, some of the project cases could in the future find business opportunities also in Europe. In the following, we present some interesting case examples found in Ochanomizu University.

Use of virtual technology

Virtual technology is a good way to create an image of product functionality which would otherwise be difficult to understand. Oculus Rift glasses uses to simulate the experience of vehicle safety solutions. When the video starts up, a virtual driver runs through the city and the various situations that come in to situations where the functionality of the vehicle safety equipment is tested. In one situation, a pedestrian jumps to the front of the car, causing the automatic braking system to start.

Augmented Reality application

The AR Mirror application works like a mirror, adding different effects to the image. The program recognized face and added Japanese-style clothes to the user. This could be used for entertainment applications as well as in sales promotion (web applications for clothing trade). In industrial use the installation site will be described and added to the product sold by AR the environment.

Information presentation system using the entrance space

FIGURE 38 presents a system for information presentation using the entrance space. The smart door with camera outside can give many kind of useful information for residents inside.

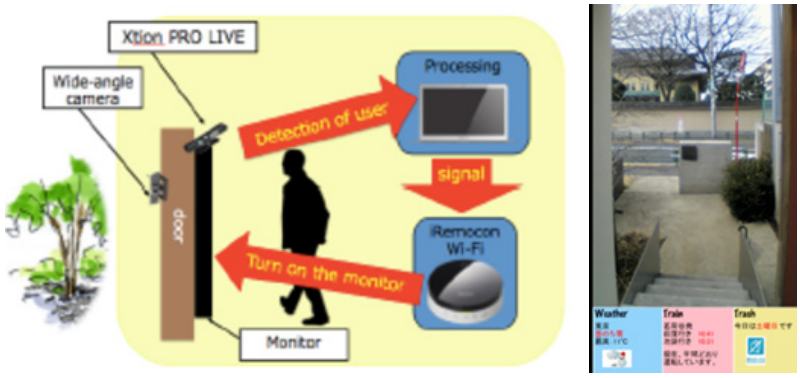

FIGURE 38. Information presentation system using the entrance space

Teaching Cellular Network

In the application, the glass table was constructed with infrared mimetics describing the cellular network, with its terminals and switchboards. In the application, the connection lines describing signaling were projected. The application presented how the signaling proceeds in different phases of the call in network structures.

Information display for guest guidance

We visited the lobby for a screened guest guide. From the info screen, you could find trails and places for places. The information display was carried out on a touch screen that was tilted to an angle of about 25 degrees. This would be well suited to the company or even to the Centria purposes. For example, an information screen could tell about daily events, inform news, and guide to meeting rooms.

Projection technology

This was combination of Japanese culture and display technology. In the dressing room, projection technology was used to choose kimono's color and design. The idea was to present the different shapes of the season at the actual kimono surface. An application of the same type could be used, for example, in the selection of furniture or clothing.

Motion sensor for senior citizen fitness

The big challenge identified in Japan as well as Finland is the aging of the population. The purpose of the application was activate the elderly to move. The application utilized the Kinect sensor, TV and computer. The help of the TV was directed to the player and the background music. The Kinect sensor was utilized to identify movements. Based on the gestures of the hand gestures, it was possible to conclude the user fitness. The application collected information on the number of movements performed.

Heart rate and motion detection on sleep problems recognition

Polysomnography research method was developed to identify sleeping disorders version implemented with sensors. Information was collected through the heart rate sensor and motion sensors falling asleep. The pulse sensor used was the Fitbit charge HR sensor and was collected smartphone application. The extension of the extension was also meant to be added to the application breath sensing sensor.

Bone ear bug

The bones lead to the vibration of the voice (through jaw and cheekbones) to the inner ear, skip the outer and middle ear structures, such as the eardrum. The method has been used for persons, with hearing impairment. The method has also been applied to military use on the battlefield for messaging, so the headset does not dampen the sounds of the environment. Similarly, the cufflinks are suitable for industrial or physical activity when desired communicate with headphones but retain the ability to track the environment, including traffic sounds.

Sony MESH

When IoT is in an easy-to-access format, it can be used, for example, in different home applications. The MESH tag is a brick-shaped product with many features that can be combined with the MESH application. It is not necessary to exploit MESH products programming or knowledge of the electronics. The tags can be found with LED light, button, motion sensor, temperature, motion detection, lighting intensity, temperature and humidity sensor and general purpose IO tag.

Robot indoor control

Improved indoor accuracy can be achieved by using Bluetooth receivers. Modern technology offers precision a few meters, but autonomous moving robots need more accurate location information. The pilot had light beams dense, so direct, line of sight connection was possible from at least one device. The radio image produced by the beacons will change according to the direction of travel and the shooting area can record a picture to teach the route to the robot very accurately. Increasing fixed beacons will improve the positioning accuracy even further.

Bluetooth Low Energy

In a large showroom, it is possible to store the unique Bluetooth field (MAC) of the tracks. This will help you find out about a business trip, visiting places, and even connect to the visitor's background information through registration information. In this case, the lighthouse is a user (cell phone or guest card) that moves in the space. The readers are fixed and placed in a sufficiently dense area to be located. When using a visitor card, the Bluetooth tag is integrated on it and no special application is required for the mobile phone. In the pilot, Raspberry PI was reader with simple Bluetooth dongle. These were installed on walls, but especially on doorways. The tag sends eventually once a second of its own ID that the environment recognizes and is able to perceive the location.

6.4 Co-operation with other International Partners

The whole Wow-concept and its use in business development and future developing it has interested people in Mexico (Dra. Mariana Alfaro Cendejas Directora de Departamento Regional de Mercadotecnia y Análisis de Datos Región Centro Tecnológico de Monterrey), Dubai (Assistant Professor Carrie Amani Annabi, Heriot Watt University) Germany (Prof. Dr. Arndt Borgmeier, Hochschule Aalen) Poland (Assistant Professor remigiusz gawlik at Cracow University of Economics) Israel (Ph.D. Eyal Eckhaus, The department of economics and business administration, Ariel university)

Fast Wow project had close cooperation with Centria's two international EU projects: Interreg Nord project "I3: Innovations & Industrial Internet" (www.innoarctic.com).and NPA project "TARGET" (http://www.targetproject.eu/). The partner universities of these projects came from Sweden (LTU Luleå), Norway (UiT Narvik), North Ireland (SWC Enniskillen and Cavan) and Ireland (Local Enterprise Office Sligo). Centria with its collaborating universities also participated in networking with about 20 European organizations which led to two Horizon 2020 Factory of the Future applications in winter / spring 2017. Networking will continue even if these first applications succeeded not to be financed despite from good evaluations.

7. DISSEMINATION

7.1 National Dissemination Events and Publicity in Finland

Fast Wow project participated in numerous dissemination events in 2015 – 2017. Many of the following events were full or partly organized by the project:

- Centria Open event, Centria, Ylivieska,November 2015

- 3D-printing seminar and workshop, Centria, Ylivieska, December 2015

- Games for Health, Turku UAS, Turku, December 2015
  - In media: Turun Sanomat, YLE
    - http://hyvinvointi.ts.fi/terveys/robotit-vanhusten-jumppaohjaajiksi/
    - http://svenska.yle.fi/artikel/2015/12/11/roboten-manniskans-basta-van
    - https://www.facebook.com/yleturku/videos/10153657119535837/

- The Potential of Industrial Internet in Business - workshop (Teollisen internetin mahdollisuudet liiketoiminnassa), Centria, Ylivieska, March 2016
  - In media: Kalajokilaakso 16.3.16, Kymppisanomat 17.3.16

- On the Way to the Future – seminar (Matkalla Tulevaisuuteen seminaari), Akustiikka, Ylivieska April 2016
  - In media: Kalajokilaakso 13.4.16, Kymppisanomat 14.4.16

- The Potential of Virtual and Game Technologies in Business - workshop (Virtuaali- ja peliteknologian mahdollisuudet liiketoiminnassa), Centria, Ylivieska, May 2016
  - In media: Kalajokilaakso 1.6.16, Kymppisanomat 2.6.16

- Rehabilitation Games and Service Robotics demo day (Kuntoutuspelit ja palvelurobotiikka esittelypäivä), Taukokangas, Oulainen, June 2016
  - in media Keskipohjanmaa 17.6.16, Kalajokilaakso 17.6.16, Pyhäjokiseutu 17.6.16

- Workshop FastWow & The Box, Kalajoki, September 2016
  - in media: Keskipohjanmaa 3.9.16

- Workshop FastWow & The Box, Subcontracting 2016 (Alihankintamessut 2016), Tampere, September 2016

- Workshop FastWow & The Box, Haaga-Helia, Helsinki, December 2016

- Automation Days 22 in Vaasa, March 2017 (http://www.automaatioseura.fi/automaatiopaivat22/)

- Virtual Church Demonstration, Prisma shopping Center, Ylivieska, April 2017
  - in media Keskipohjanmaa 11.4.17, Kaleva 11.4. 17, Kalajokilaakso 12.4.17

- Digitalization 2017 workshop (Digitalisaatio 2017), Centria, Ylivieska, May 2017
  - in media Keskipohjanmaa 11.5.17, Kalajokilaakso 12.5.17

- Profitable Idea, Regional Final (Tuottava idea -aluefinaali), Kankaanpää, May 2017
- HSL Demonstration Day for Personnel and Partners, Helsinki, June 2017
- Fast Wow miniseminar for Industry and Tourism actors, Helsinki, August 2017

FIGURE 39. Fast Wow workshops and seminars attracted large audience

7.2 International Dissemination of Project Results

The results were disseminated in various events, exhibitions, workshop, seminars and conference publication. The project results were disseminated in the following events, either by project personnel or by participating company people:

- 6th IEEE International Conference on Cognitive Infocommunications, October 2015, Győr, Hungary
- EU Thematic University Business Forum, Haaga-Helia University of Applied Sciences, Helsinki, June 2016
- 12th International CDIO Conference, Turku, June 2016
- IEEE SIMS2016, Narvik, March 2016
- 2016 International Conference on Human Factors, Business Management and Society, Florida, USA, July 2016
- 7th IEEE International Conference on Cognitive Infocommunications, October 2016, Wroclaw, Poland
- International Workshop On Mobile Ubiquitous Systems, Infrastructures, Communications, and Applications, MUSICAL 2016, (presentation by A. Shimada), Hiroshima, Japan, November 2016
- Arab Health 2017 (http://www.dwtc.com/en/events/Pages/2017/Arab-Health-Exhibition-and-Congress), Dubai, January – February 2017
- TINN seminar in UiT Narvik, March 2017 (http://www.teknologifestival.no/)
- MRO Americas 2017, Orlando, USA (next one http://mroamericas.aviationweek.com/am18/Public/Enter.aspx)
- LIGNA 2017 Fair (http://www.ligna.de/en/exhibition/after-show/) , Hannover, Germany, May 2017

- Paris Air Show, Paris, France, June 2017 (https://www.siae.fr/en/)

- AHFE 2017 International Conferences on Human Factors in Management and Leadership, and Business Management and Society, Los Angeles, California, USA, July 2017

FIGURE 40. Project results were demonstrated also in the Champion Door stand at Paris Air show

8. CONCLUSION AND DISCUSSION

We presented in this report our experiences for boosting SMEs business with fast Wow effects. The goal with our fast experimentation and co-creation based approach was to bring new technology, such as virtual and game technologies, in use in SMEs e.g. in virtual design, training, maintenance and assembly operations. We introduced many interactive product presentations for marketing, events and fairs utilizing virtual and game technologies. We presented also examples how new technology can be utilized in education, training and rehabilitation and bring wow experiences there. Based on our experiences, virtual and game technologies provide effective tools for fast experimentation and co-creation with SMEs. Our collaborating SMEs have found the case implementations very beneficial and some of them have already invested themselves in the latest virtual technology. However, in the future these single case implementations are not enough for successful business. Even SMEs have to have a strategy how to use these technologies as an added value service in their product life cycle management, including design, sales, production, and maintenance. SMEs need co-creation with research groups in this task.

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APPENDICES

APPENDIX 1

PROJECT PUBLICATIONS

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FAST WOW EFFECTS BOOSTING SME BUSINESS

Final Report

The project Fast Wow Effects Boosting SME Business was carried out in collaboration with Centria and Turku Universities of Applied Sciences. The other partners in the project included about 20 Finnish companies, Ochanomizu University from Tokyo Japan and Arabic partner from Oman and Dubai. The ultimate goal in this project was to focus on digital transformation of value creation. Digitalization can offer new possibilities to synergic combination of different fields, such as game programming, art and new technology. The project was carrying out fast experimentations in versatile applications to study how synergic digital wow effects can be utilized e.g. in product presentations, in marketing and in engineering applications. Virtual and augmented reality together with game programming played key role in many use cases. The idea was to give customers a pleasant surprise and exceed their expectations. Based on our experiences, virtual and game technologies provided effective tools for fast experimentation and co-creation with SMEs. Our collaborating SMEs found the case implementations very beneficial and some of them have already invested themselves in the latest technology, e.g. virtual technology. The extensive collaboration in the project increased the knowledge level and it will progress co-operation with universities and SMEs.

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