Mass Personalized Reality
— A Case Study of Nokia Corporation

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Laurea University of Applied Sciences **Abstract**
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In this bachelor's thesis commissioned by Nokia Corporation, a conceptual solution for enhancing customer experience through an implementation of augmented reality in a stadium context was explored. The initial inspiration for the concept arose from a novel screen technology in which steerable multi-view pixels figuratively create an illusion of "parallel reality" by directing different images simultaneously to viewers in different locations.

The use of this technology enables new ways of tailoring the customer experience by means of customization and personalization, whether for entertainment, marketing, or accessibility purposes. This service provides added value for the customer and opens new revenue opportunities for the service provider.

Service design and design thinking principles along with research, survey, and benchmarking methods were utilized in the development task. The objective was to adopt a customer-oriented approach, prioritizing the user experience in this work. The iterative process also drew on feedback from the client. The thesis provides an overview of the project environment, the design sprint process, and team collaboration. It describes the technical aspects of the displays and the location tracking methods used and details the benefits of the concept for the customer and the ecosystem.

The outcome of the design sprint was a prototype of the concept developed into the form of a user story. The prototype provides solutions on a conceptual level to user pain points identified during research. As the concept took a futuristic approach, the thesis also considers the benefits and potential challenges of the technology. In addition, avenues for future development of the concept are also contributed.

Keywords: personalization, augmented reality, parallel reality, customer experience, design sprint

Contents

1 Introduction

The customer experience has seen significant changes over the past few decades, driven by digitalization and new technologies. Nowadays, customers expect to have personalized services more than ever before. (Bennett 2023.) The importance of this trend is expected to continue in the future, where new ways of creating captivating and engaging experiences tailored to customers will play a key role. Practical applications of innovations, such as augmented and virtual reality, could be ways to create these memorable experiences for customers. A positive customer experience creates customers for life. (Marr 2023.)

This thesis will introduce a service concept named *Mass Personalized Reality*, drawing inspiration from the concept and theory of personalization. Personalization aims to see all customers as individuals and consider each customer's needs whether they are explicit or implicit (Tseng, Jiao & Wang 2010). With the internet's interactivity and connectivity, personalization has been seen as a promising strategy to enable one-person marketing (Tseng, Jiao & Wang 2010). Mass personalization involves producing goods and services to meet the latent demands of individual customers in a way that the value outweighs the cost for both the producer and the customer (Zhou, Ji & Jiao 2012). Mass personalization is a combination of catering to a vast customer count and doing so at scale (Raitaluoto 2023).

Therefore, the potential for creating value-add will be explored in this functional thesis through a practical application of augmented reality and personalization as a concept. In other words, the objective will be to find a possible new solution to the challenge provided by the client company, Nokia Corporation: "What are the next-generation digital experiences and business opportunities in a stadium context?". The thesis utilizes the Design Sprint method and tools and was executed by a team in collaboration with Nokia Corporation ("Nokia") and Laurea University of Applied Sciences.

In Design Sprint, the goal is to innovate and develop an idea into a concept and present a viable result to the client within one week. In this project, the team draws inspiration from a new pixel technology and utilizes it in developing a concept for personalized customer experiences within an arena setting. The approach is customer-oriented and the methods of gathering a knowledge base, research, benchmarking, and survey are used to identify customer pain points.

The theoretical section of the thesis will cover the project background, description of the Design Sprint method, and the knowledge base of the proposed concept. The functional part of the report will describe the methods and tools used, the results obtained, the output, and the feedback-based evaluation. The final chapter will contain a summary of the results, the

proposed solution, and its relevance and benefits for the client and the customer. Finally, future development potential will be considered based on aspects found during the project.

ChatGPT has been utilized in this thesis, and all its applications are described in context.

2 Project Background

This thesis work commenced with a brief provided by Nokia. It served as a starting point for understanding their business landscape, next-generation experiences at Nokia Arena and other selected operators, and the Network as Code (NaC) model. Case examples were also included.

The aim was to seek a viable solution to answer the client's question, "What are the next-generation digital experiences and business opportunities in a stadium context?" The main focus in the development of the solution was a concept for use at Nokia Arena. The goals were to be achieved using the Design Sprint framework.

2.1 Nokia Corporation

Nokia is a public limited liability company with its head office in Finland. Its shares are listed on the Euronext Paris Stock Exchange, the New York Stock Exchange, and the Nasdaq Helsinki Stock Exchange. Nokia's net sales in 2022 were EUR 24.9 billion while operating in 130 countries and employing approximately 86 900 persons. (Nokia 2023.)

Nokia was founded as a single paper mill in 1865. Today, Nokia operates in four different business areas: cloud, network infrastructure, network services and mobile networks. All four share the common target of being the technology and market leader in their respective area. The strategy of Nokia is to be a pioneer and enabler of digitalization. The strategy is based on four values: expertise of networking, leadership of technology, pioneering innovation, and collaborative advantage. (Nokia 2023.)

Nokia's vision is that the metaverse will be a reality by 2030 and will open opportunities in industrial, business and consumer markets. Communication networks play an important role in making that vision a reality. The networks must change by embracing new trends like networks of networks, enriched Network-as-a-Service capabilities, and specialized sub-networks. (Nokia 2023.)

2.2 Nokia Arena

Nokia Arena is an experience center located in downtown Tampere, Finland. It has its own hotel, restaurants, casino, and event facilities that can be used for a variety of purposes. LähiTapiola, OP, Ilmarinen, SRV and the City of Tampere are the owners of Nokia Arena. Designed by architect Daniel Libeskind, it is 15 000 square meters in size and has 15 000 spectator seats. Nokia Arena holds 140 events and serves over one million visitors yearly. (Nokia Arena 2023a.)

Nokia Arena has won several awards, including TheStadiumBusiness Award 2022, the 2022 Visit Tampere Award, and the Project of the Year 2022 (Nokia Arena 2023a). Nokia Arena has been granted ISO 20121 certification, and all the events at the arena are arranged according to ISO standards (Nokia Arena 2023b). ISO 20121 offers guidelines to manage events so that the environmental, social, and economic impacts of these events can be reduced (International Organization for Standardization 2023). Nokia Arena was designed to be sustainable and to operate completely digitally. For instance, only digital payment methods are accepted, all energy used is renewable, and all waste is recycled. The arena was designed to enable visitors with restricted mobility or impaired vision to move easily. (Nokia Arena 2023b.)

2.3 Design Sprint Method

Design Sprint is a fast-paced creative process that addresses a design challenge in one week to efficiently innovate, test, and validate ideas. According to the Design Sprint creator, Jake Knapp, a team completes the sprint week by utilizing methods of ideation, prototyping, testing, and co-creation with the customer. It is a practical way of applying lean development and design thinking philosophies. (Knapp 2016, 9, 15–17.)

In Knapp's framework, each day is assigned a specific goal, as can be seen in Figure 1. The design sprint week begins on Monday to map and identify the target problem on which to focus. Tuesday is dedicated to generating ideas and sketching. On Wednesday, the team chooses the best idea with which to proceed to prototyping, which is then finalized by the end of Thursday. Friday is for testing the prototype and collecting customer reactions and feedback. (Knapp 2016, 16.)

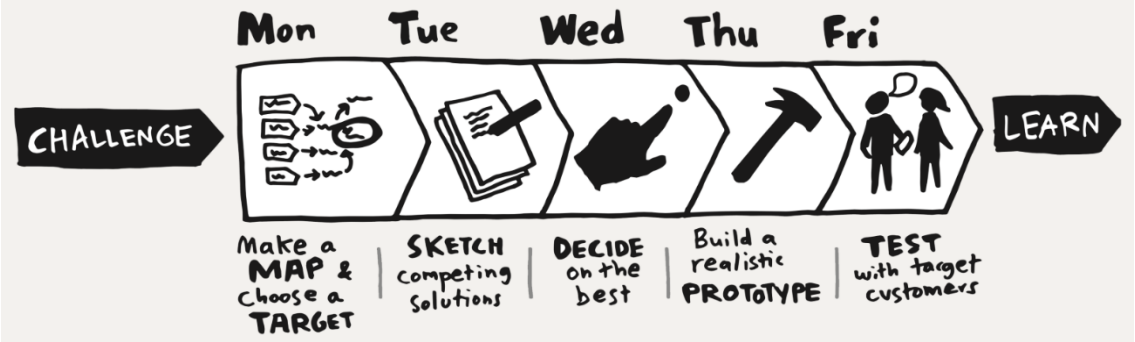

Figure 1: Design Sprint Framework (GV/Knapp)

In Design Sprint, the rapid process of prototyping and testing aims to gather valuable insights. By creating an engaging prototype, it is possible to get customer reactions without the need for a real product launch. These reactions serve as a return on investment. Whether an idea succeeds or fails, the customer reactions provide an opportunity to learn, identify opportunities, and pinpoint critical flaws. (Knapp 2016, 16, 169.)

Table 1: The Design Sprint Week

	Monday	Tuesday	Wednesday	Thursday	Friday
Goals	Make a map & choose a target	Sketch competing solutions	Decide on the best solution	Build a realistic prototype	Test with target customers
Methods	Analysing and defining the challenge Sparring Brainstorming & mind mapping	Brainstorming Benchmarking Sketching Customer Journey Map	Gathering customer understanding Interviews Creating a user story Sparring	Prototype construction Preparing for final pitch Sparring	Pitching Final presentation of the concept and prototype

Laurea's thesis sprint is based on a modified version of Knapp's framework (Table 1). A more detailed description of the sprint week and the tools used is provided in Chapter 5.

3 Key Technologies

The key technology that serves as the foundation and source of inspiration for this thesis was developed by a startup company based in the United States. Through this technology, personalized content can be delivered to each viewer on screens, such as a jumbotron in an arena – figuratively creating the illusion of parallel realities and likely serving as the inspiration for the given name.

The startup, Misapplied Sciences, was founded by a group of Walt Disney Imagineering and Microsoft veterans (Schlosser 2022). The company has developed an innovative technology

that allows large audiences to share screens, providing each viewer with a unique personal image without requiring special headsets (Parallel Reality 2023a, Dietz & Lathrop 2019).

3.1 Pixel Technology

The novel viewer experience is enabled by a new type of pixel that can simultaneously reflect even millions of light rays with different brightness and colors (Figure 2). Each of these rays can be directed to an individual viewer. (Parallel Reality 2023b, Dietz & Lathrop 2019.) This patented multi-view pixel technology is at the core of PARALLEL REALITY™ displays.

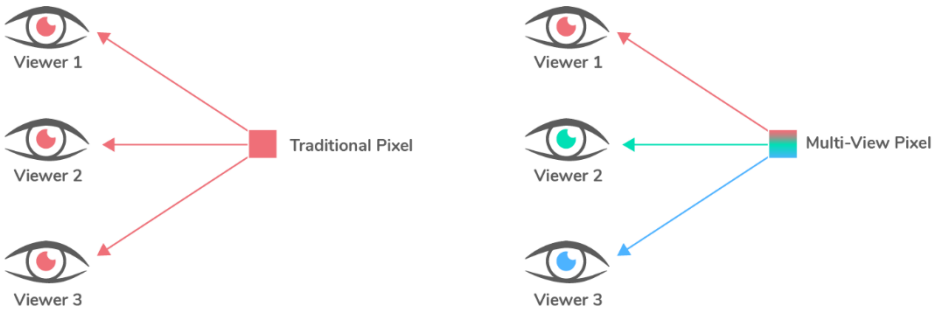

Figure 2: Traditional Pixel vs. Multi-View Pixel

Accurate spatial calibration calculates the destination of each light ray, and environmental modelling helps to target a specific person and place. Finally, optical design facilitates the sending of multiple, steerable light rays in real time. (Parallel Reality 2023b, Dietz & Lathrop 2019.)

Currently, PARALLEL REALITY™ displays can generate only 256 colors, which means that videos and photos are not very realistic. Also, viewers must stand nearly five meters from the screen to clearly see the effect of parallel reality. However, according to Ng from Misapplied Sciences, the visual quality is under constant improvement and the drive to achieve 24-bit (16.7 million colors) is under way. (McCracken 2020.)

3.2 Location Tracking Technology

Location services refer to tracking a user's location using a mobile phone network and form the technical basis for providing added value. Location services require customer consent to track and collect data. (Office of the Data Protection Ombudsman 2023a.) Legislation also defines how location data and user consent must be handled and regulates the sharing and retention of the collected data (Office of the Data Protection Ombudsman 2023b).

Location-based services (LBS), as defined by Raper et al. (2007), typically constitute mobile applications that utilize device location and context to personalize and distribute

information. LBS are already used in a very wide range of applications, such as social networking, gaming, fitness, healthcare, transport, assistive technologies, disaster and emergency, education, and entertainment. The development of reliable indoor positioning technologies has opened the gates to advances in innovation for indoor applications of LBS. (Huang, Gartner, Krisp, Raubal & Van de Weghe 2018, 63–68.)

Indoor Positioning Systems (IPS) consist of fixed beacons and Bluetooth Low Energy (BLE) enabled devices that determine positioning based on broadcast signals received from the beacons. In other words, an entity is tracking its location within an environment. A typical use case is using a smartphone for wayfinding indoors. Fingerprinting, a process in which signal strength is gauged and compared with beacon coordinates, may be used by the system to increase accuracy. (Spachos & Plataniotis 2021, 17.)

In a Real Time Locating System (RTLS), transmitting beacons are attached to a moving asset or person. Edge devices, such as Raspberry Pis, are employed to receive these BLE signals and calculate the position of the beacon. The position information is then relayed to a management system for further use. (Spachos & Plataniotis 2021, 17.) In other words, a system is tracking the location of an entity or asset within an environment.

3.3 Bluetooth Low Energy

BLE is a low power technology used to connect devices wirelessly in the 2.4 GHz ISM Band. Introduced as part of the Bluetooth 4.0 specification, it is used in Internet of Things (IoT) applications, where slower speeds and smaller data packets are characteristic. (Gomez, Oller & Paradells 2012, 11735–51.) Typical examples of IoT applications for BLE are wearables, indoor positioning, and home automation (Afaneh 2018, 85). BLE has a range of 50 meters (line of sight) or ten meters around obstacles, but a range of up to 800 meters (line of sight) can be achieved if utilizing Bluetooth 5.0. Device orientation, environment, and antenna design can all contribute to the range. (Ellisys 2018.)

The Bluetooth Core Specification 5.1 adds even greater granularity to positioning. To achieve this, the new specification adds angle of arrival (AoA) and angle of departure (AoD) as methods in addition to Received Signal Strength Indicator (RSSI) used in previous versions. AoA and AoD methods involve making calculations based on the phase of direction-finding signals transmitted to or received from multi-antenna arrays, respectively. (Woolley 2021, 10, 13.) With direction finding it is theoretically possible to obtain accuracy even within a centimeter, given the right circumstances (Bluetooth SIG, 2013). Practical studies have successfully shown that sub-meter precision (70 centimeters, on average) is attainable (Pau, Arena, Gebremariam & You 2021).

BLE offers more precise positioning especially indoors where the use of GPS is problematic (Kundoth, Karkar, Al–Maadeed & Al–Ali 2020). The technology can be used, for instance, for one-to-many data broadcasting by location beacons. The accurate location of these beacons can be established by BLE capable devices or access points. (AVSystem 2021.)

3.4 Beacons

In terms of hardware, tracking or positioning by beacons requires a transmitting device (beacon) and a Bluetooth-enabled receiving device. A beacon is generally used to refer to a stationary device, whereas a tag refers to a mobile beacon. Tag-based deployments require a relay device and an application to interpret the received data. Typically, these are an access point or gateway and an RTLS. (Kontakt.io 2023, 5–6.)

There are several different communication protocols available for how data in BLE transmissions are structured. The following is not an exhaustive review of the protocols as some are omitted due to the lack of adoption or relevance. Launched in 2013, Apple's proprietary iBeacon is the oldest option. Google's Eddystone, announced in 2015, was a strong contender until the end of 2018 when Google discontinued beacon notifications – both Eddystone and Physical Web – thereby hampering its potential for growth to some extent (Nayak 2018). AltBeacon is an option authored by Radius Networks in 2014. It is not yet nearly as pervasive as iBeacon, but due to its open-source nature and interoperability it has potential for strong growth for developers wishing to remain platform agnostic (AltBeacon 2023).

The iBeacon standard holds the dominant role in the current market (Straits Research 2023; PlotProjects 2023). According to market research, Eddystone and AltBeacon are both expected to see similar growth in market share through 2029, with iBeacon showing the greatest share increase (Maximize Market Research 2013). All protocols mentioned in this section are supported by multiple vendors and can operate on iOS or Android devices (Young 2018).

4 Development Methods

In this thesis, the team employed a diverse range of development methods. Along with reviewing existing literature, studies, and articles related to the topic, the key methods for laying the groundwork for the thesis were benchmarking and surveys. Both methods were essential for attaining valuable insights and data, aiding the research process, and deepening the team's understanding of the subject.

In the creative ideation process, the team utilized various brainstorming techniques. Additionally, a service design perspective and user-centered approach were important aspects to ensure that the developed concept would align effectively with the needs of end users.

4.1 Benchmarking

The target of benchmarking is to gather applicable knowledge and skills from other companies. The work is usually focused on a specific area of the business, such as customer value, the product, working practices, or quality. Benchmarking can also be used to solve a specific problem. The target is not to copy, but to apply what has been learned from others. (Vuorinen & Huikkola 2023, 188.)

Benchmarking can be divided into four different categories. Internal benchmarking looks at the company's activities from the inside. Competitor benchmarking looks at competitors in the same sector, and functional benchmarking looks at a company in a different sector to find new ideas for improvement. Industry benchmarking gathers a group of companies in the same industry to share their best practices with each other. (Vuorinen & Huikkola 2023, 188-189.)

In this thesis, the team attempted to use functional benchmarking. According to Vuorinen and Huikkola (2023, 193), functional benchmarking can be used to achieve new competitive advantages in the industry.

4.2 Survey

A survey is an effective way to collect and analyze data about human behavior, attitudes, and values. In a survey, the researcher asks questions using a questionnaire. The survey is a measurement tool suitable for behavioral and social science research, feedback, and street surveys, among other purposes. (Vehkalahti 2019, 11.)

Survey research is mostly quantitative research and uses statistical methods. The data consists mainly of measured numbers because the answers are expressed numerically, even though the questions are verbal. (Vehkalahti 2019, 13.)

Validity and Reliability are used to show the reliability of the survey measurement. Validity indicates whether the right thing was measured, and reliability indicates how accurately it was measured. (Vehkalahti 2019, 40–41.)

4.3 Preparatory Research and Ideation

Having heard the Nokia brief and their proposed design sprint thesis challenges, the team members took a day of individual assessment of the brief and preparation for a preliminary ideation workshop. The preparatory research included consulting articles, whitepapers, websites, AI (ChatGPT) and blogs to gain a deeper understanding of NaC (especially in terms of its application) and identify novel and burgeoning technologies, current digital experience offerings in large venue contexts, and customer journey pain points therein. The team opted to use Miro as their digital collaboration platform.

In the preliminary ideation workshop, the team discussed each member's thoughts on the available challenges to determine whether it was possible to select one immediately based on how inspiring, motivating, and viable it was in terms of the members' individual capabilities and strengths. However, as the discussion unearthed potential in not one but two of the challenge categories ("Next Generation Stadium" and "Network as Code Anywhere"), it was suggested that brainwriting be employed as a preliminary ideation method to further ascertain the development potential of these two options. Brainwriting was followed by expounding upon any unclear ideas, and, finally, voting to narrow down the most prospective ideas.

A combination of the Lotus Blossom Method and a variation of How-Might-We questions was then used to further develop the previously selected ideas showing most promise. Following this step of further development, the team voted on all the developed prospective ideas. Two ideas, both in the Network as Code Anywhere challenge category, received the most votes.

Brainwriting is an ideation method that involves participants writing down ideas, for instance, on sticky notes and posting them on a wall immediately for all to see. The work proceeds for a brief period with all participants working quietly and simultaneously. It is an inclusive way to facilitate divergent thinking and generate a varied pool of ideas. (Stickdorn 2018, 179.)

The Lotus Blossom Method, while similar to mind-mapping, is a brainstorming technique that challenges teams to explore a core concept more extensively before exploring additional related concepts or ideas (Visual Paradigm 2023). The technique, also called Lotus Diagram, promotes lateral thinking and defining of the key concept (CreativeSolvers 2023).

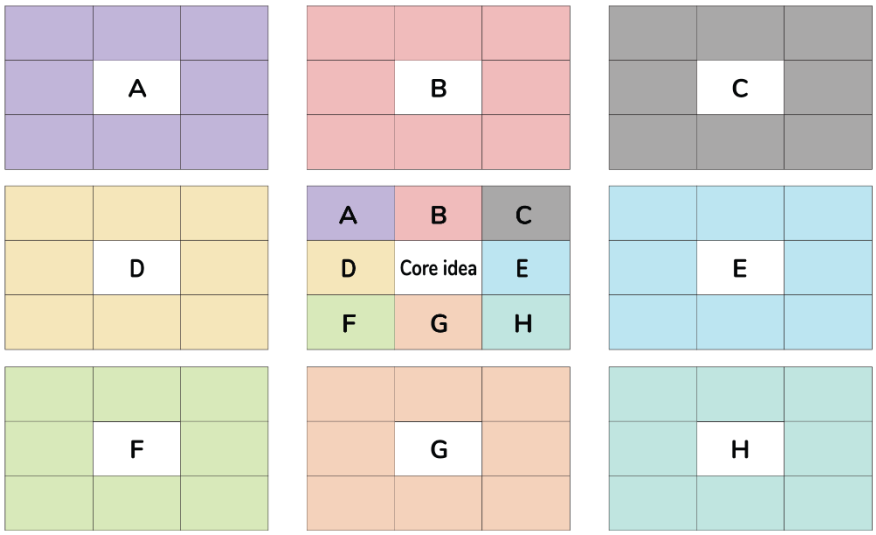

Figure 3: Lotus Blossom Diagram

As seen in Figure 3, the diagram evolves from a central three-by-tree grid (nine boxes) that is created first. The core idea or topic that needs developing is written into the box in the middle. The surrounding eight boxes are then filled with related ideas or topics by method of brainstorming. Each of the eight related ideas are then written as central topics on eight new grids surrounding the original central grid. These related ideas are further developed by brainstorming, resulting in a second level of related ideas or topics. In this fashion, a diagram consisting of nine individual three-by-three grids is formed. Visually resembling a lotus blossom, it is a quick and effective way to gain a broader and deeper understanding of a core concept and its relations in a structured manner.

The How-Might-We Method (HMW) is an effective and proven method in Design Thinking. It is useful for reframing problems and design challenges. It is typically implemented in several phases progressing from broad to precise questions, and the process is especially effective in determining the best scope and detail to a question. Beginning all questions with “How might we…” or the “HMW” acronym brings uniformity to the task. (Siemon, Becker & Robra-Bissantz 2018, 97–98.)

User stories and key insights commonly serve as the basis for formulating these open questions. The process starts with broader trigger questions, which can be drilled down further to unearth the extent of the available data. Arriving at the end of the data or understanding may reveal unorthodox ideas or demand more research. The plethora of HMW questions is subsequently clustered and prioritized. Some are chosen for further ideation in the final stage, for which it may be beneficial to include experts on the topic of each cluster. (Stickdorn 2018, 83–85.)

4.4 Primary and Secondary Research

One of the two ideas that gained significant votes in preliminary ideation involved using NaC to enable the provision of various automated processes to aid customers during air travel. Since the topic was quite broad, the team agreed to do some primary research by conducting two one-on-one interviews with aviation professionals to gain better insight into the nature and extent of various challenges and the processes that are typically in place (in the air or on the ground) to resolve them and mitigate their potentially negative impacts on the passenger experience.

The secondary research phase involved developing the knowledge base and identifying research sources from the internet, article databases, and AI (ChatGPT) for the two ideas on the table. Artificial Intelligence was used to find keywords, technologies, and headlines for consideration and further analysis, as well as to benchmark and understand the scope of systems and procedures in use within the field of aviation for managing people flow and the customer experience, in general. This trail of research led the team to the article about Delta Airlines testing PARALLEL REALITY™ screens in an airport context (Schlosser 2022).

The team convened a second meeting to discuss their findings for the two ideas and decide on the path forward. It quickly became apparent that the new pixel technology had sparked the team's joint interest. The team immediately identified multiple avenues for developing a use case for Nokia Arena. The initial knowledge base gathered for the prospective idea in the field of aviation was deemed, overall, relevant to a large venue context as well. The team therefore unanimously decided to pursue the "Next Generation Stadium" challenge and to apply the novel technology as the cornerstone of the thesis.

The team considered and discussed the implications of this decision for the next phase of research and the agenda of the first two days of the upcoming design sprint. The decision effectively concluded some of the work normally reserved for the beginning of a design sprint. The knowledge base themes were collated, restructured, and delegated amongst team members for further investigation. AI (ChatGPT and Perplexity) was again used as one tool in the groundwork.

5 Sprint Week Workshop

The first goal of the workshop week was to define the challenge and choose the target event on which to focus. To reiterate, the team's challenge (or long-term goal) was to recognize next-generation digital experiences and business opportunities in a stadium context. As such, the team promptly decided to concentrate on the customer experience at Nokia Arena. At this stage it was key to identify user pain points, narrow down the subject, and find the best area on which to focus.

Understanding the customer was essential to adopting a user-centered approach that extends beyond meeting obvious needs to addressing unconscious needs as well. Personalizing the customer experience is important, especially in the event industry, where it will have a high emphasis in the future, too (Alho 2023). To deepen customer understanding, the team decided to conduct a survey. Another method used for acquiring information involved examining past Google reviews of Nokia Arena.

As pointed out earlier, the team had started working on the thesis several weeks prior to the scheduled design sprint week. During this time, the knowledge base was gathered with the aim of being as prepared as possible for the actual sprint workshop. As the exact concept to be worked on had not yet been identified, the research topics were quite broad and included much information that eventually was not used for the final concept. However, the careful groundwork proved beneficial, as the group – inspired by augmented reality – found the final topic this way. Hence, the team was well prepared by the beginning of the design sprint week, and minimal additional research was required during the workshop itself.

The team did not assign explicit roles within it, but during the sprint week some roles formed naturally. Individual strengths, for example, graphic design or presentation skills, were exercised effectively. Reserving a meeting room for working in-person for the bulk of the sprint week proved to be an excellent choice. It allowed the team to focus solely on the sprint without any external distractions. Knapp (2016, 41) suggests that limiting device usage and using paper and pen in the design process can enhance creativity. Indeed, these proved beneficial for the team in the ideation phase, as this environment allowed the team to generate ideas, select the target, and develop the concept while maintaining a user-centric approach and storytelling at its core. Later in the week, it was necessary to switch to using computers to develop the prototype and prepare for the testing and the pitch presentation scheduled for Friday.

5.1 Survey Results

In the survey, the team wanted to find out about customers' experiences at various events in a stadium context. The survey was created with Google Forms, and each team member distributed the link to friends, acquaintances, and colleagues using instant messaging and social media. The survey was open for one day. The beginning of the survey detailed the purpose, duration, and authors of the survey, and informed that no personal data would be collected. Despite the brief time it was available, the team considered it valuable that 95 people participated in the survey. Nonetheless, the reliability of such a small sample size must be evaluated carefully.

The questionnaire (see Appendix 1) included four questions to find out what kind of events the respondents have attended, how satisfied they were with the organization of the events, what things could bring added value to the respondent, and whether they would be willing to pay for certain improvements.

Question 1: What types of events have you attended in arenas?

As indicated in Figure 4, respondents were able to select more than one option and add one of their own if it was not already on the list. Most of the respondents have visited concerts, sports events and exhibitions.

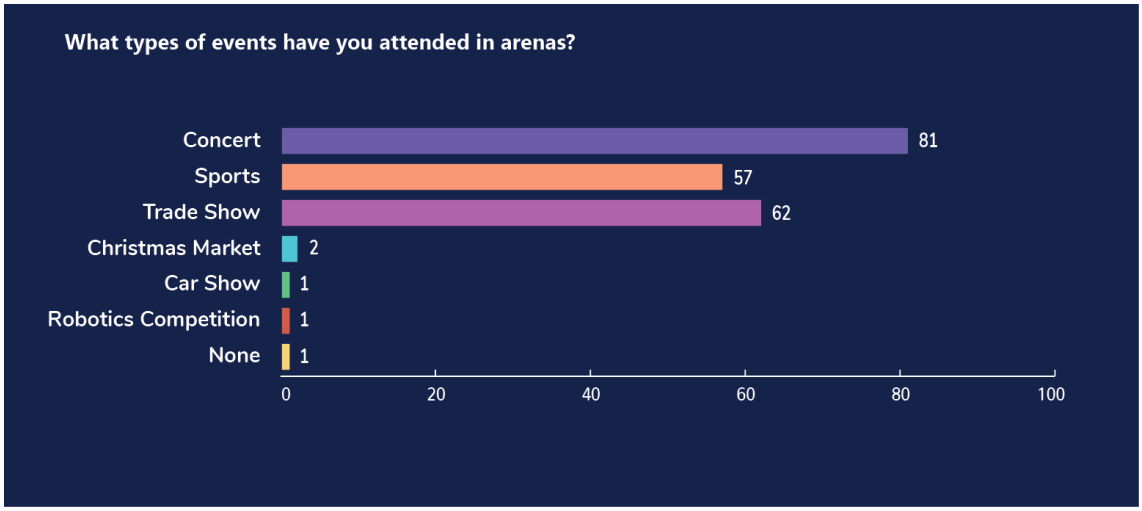

Figure 4: What types of events have you attended in arenas

Question 2: How satisfied have you been with the events and the venue from the following perspectives?

Overall, the respondents were satisfied with the events and the venues. However, there was no neutral option to select, which might have affected the responses (see Figure 5 below).

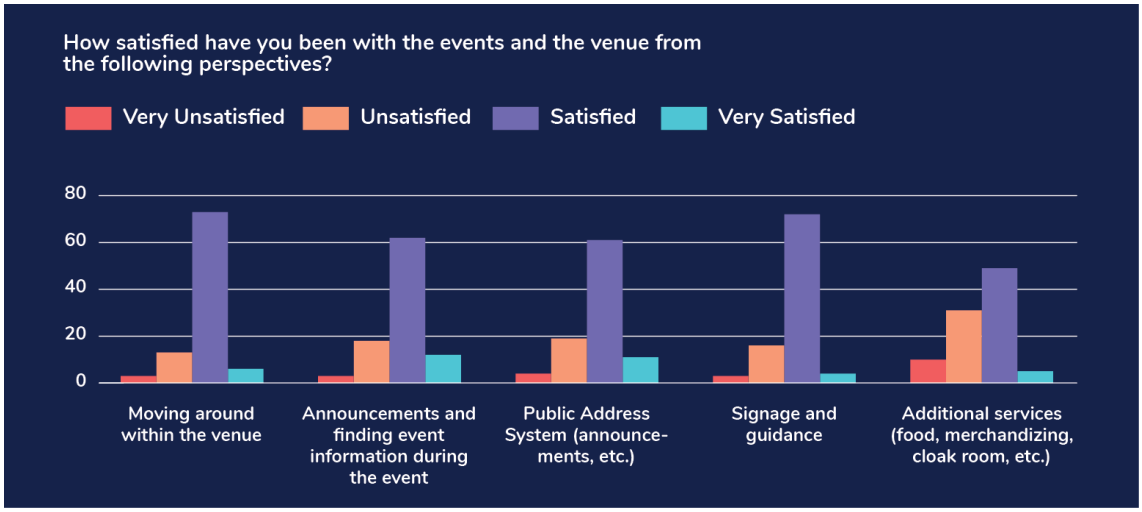

Figure 5: How satisfied have you been with the events and the venue from the following perspectives

Question 3: How much added value would the following services provide for you?

While respondents were generally satisfied with the events, they felt that clearer signs, information about public transport, and personalized offers would bring added value. Figure 6 also indicates that smooth arrival and departure from the event showed the greatest potential for value-add.

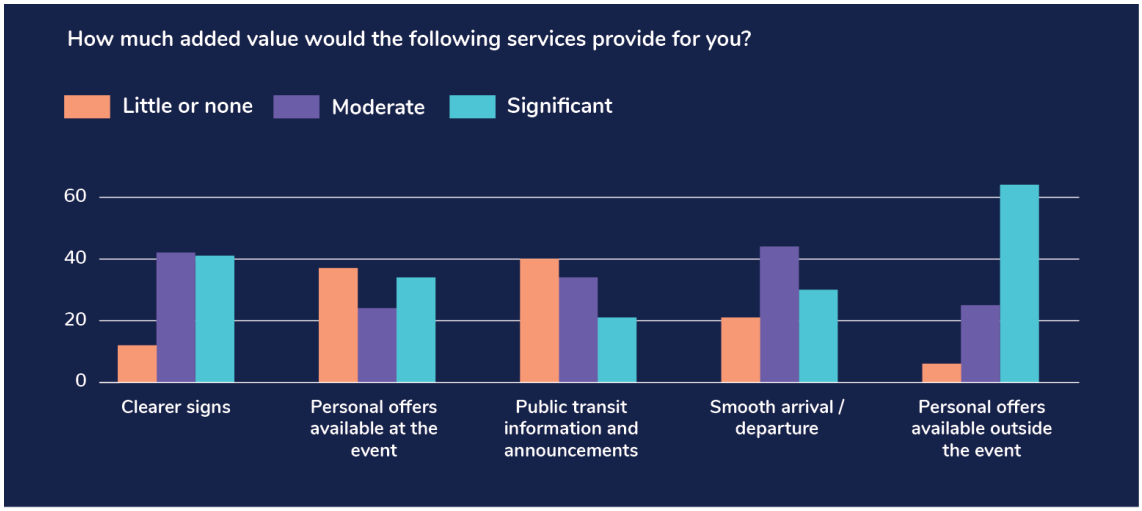

Figure 6: How much added value would the following services provide for you

Question 4: Would you be prepared to pay extra to...

Most of the respondents are not prepared to pay extra for the options offered in the survey. Only quicker arrival at the event and the ability to choose the content to be displayed on the screens were options that indicated a slight increase in a willingness to pay extra.

The options offered as the answers to question four could have been more descriptive, and there is doubt whether they were understood in the manner intended. Nonetheless, the team intentionally chose to keep the options general and somewhat vague in order not to influence the respondents with potential capabilities of previously unknown technologies. Interestingly, however, and as seen in the results of the previous question, the answers here also showed an emphasis on the speed of arrival at the event and the means to decide on the content to be displayed on the screens (Figure 7).

Figure 7: Would you be prepared to pay extra to

The result of the survey shows overall satisfaction with the events that respondents have attended. However, results show interest in receiving personalized offers and the possibility to choose what they can see on screens. Based on the responses, it could be argued that customer experience can be improved by smoother arrival, clearer signage, and easier departure.

AI (ChatGPT) was used for text translating purposes and to generate examples of short and catchy titles for the survey.

5.2 Benchmarking Results

PARALLEL REALITY™ display technology was found during the ideation process. The value of the screens was quickly understood, and the team decided to create ideas around the capabilities of this technology.

Delta Air Lines, an American airline company, has worked with Misapplied Sciences to further develop the technology and implement a use case with PARALLEL REALITY™ displays at Detroit Metropolitan Airport. The technology helps create a more personalized experience for travelling customers at the airport. (Delta News 2022.) The implementation allows personal

travel information about their current trip to be displayed for up to 100 customers at a time. This enables speeding up processes such as security checks, baggage drops, and boarding. (Schlosser 2022.)

Benchmarking first involved conducting a one-on-one interview with a representative of a well-known audiovisual systems integrator and services provider in the Nordics. The interview provided the team with considerations and specifications of real-world examples of LED screen technology in rental and large venue applications to compare with PARALLEL REALITY™ displays. Although a multitude of factors determine what is acceptable on a case-by-case basis, general guidance was received for topics such as pixel pitch, brightness in nits, viewing angle, contrast, IP classification, and serviceability.

The team then contacted Misapplied Sciences directly via email in hopes of procuring more precise technical specifications of their display technology for comparison. The lack of more accurate details especially of pixel pitch, brightness, and viewing angle make it difficult to assess possible limitations of the suitability of the current evolution of the technology to an arena application. The technology is unique; consequently, only comparisons between typical technological specifications might be made in the first place. Thus, although benchmarking proved impossible to complete sufficiently in the timeframe of the design sprint and thesis, the confirmation of the uniqueness of PARALLEL REALITY™ technology confirms its potential for achieving competitive advantage in the industry.

AI (Perplexity) was used during benchmarking to probe the existence of other technology like PARALLEL REALITY™.

5.3 User Journey Map

After utilizing brainstorming, lotus blossom technique and mind mapping as tools for ideation, visualization, and communication, the team mapped the customer's journey to identify potential pain points (see Figure 8). From purchasing the ticket to leaving the venue, problems like finding assigned seats, waiting in long lines, and general confusion in crowded environments can feel chaotic and degrade the customer experience. It is also important to consider underserved customer groups and their special needs.

The customer journey map is a Service Design tool that illustrates all the stages the customer experiences in the service, from the beginning (when the customer first recognizes a need) to the end (the achieved benefits). The map describes the customer's actions, needs, and emotions associated with the service. By modeling the journey, the customer's experience and the service touchpoints (the moments when the customer interacts with the service, including elements from both physical and virtual environments) are placed at the core of the development work. (Ojasalo, Moilanen & Ritalahti 2015, 73.)

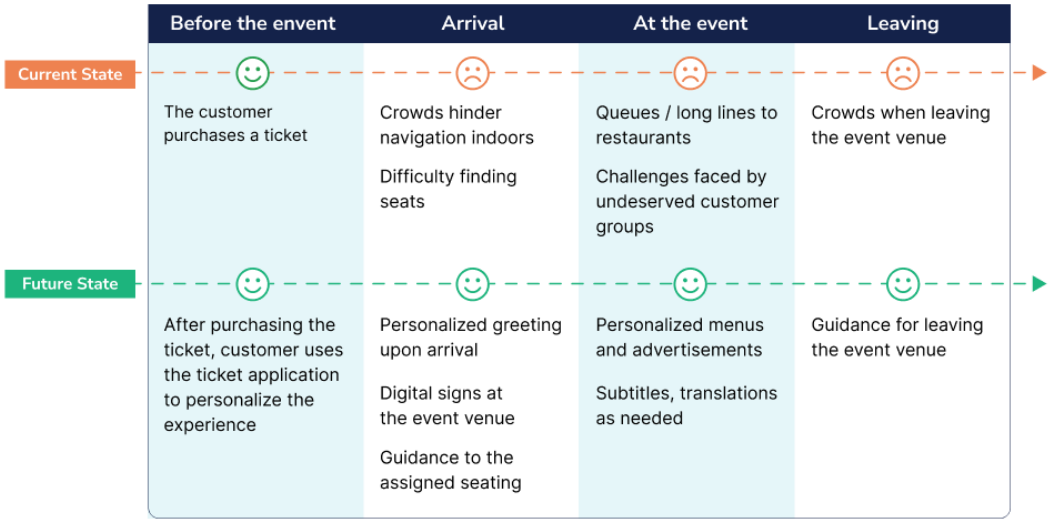

Figure 8: Current and Future State Customer Journey

In the customer journey map (Figure 8), the team defined the future state by outlining how to deliver a better customer experience by seamlessly integrating entertainment, guidance, and accessibility options using PARALLEL REALITY™ displays. Although the team considers the necessity of an app as vital and inevitable to fully capitalize on the proposed solution, it is not the focus in this thesis. The main goal is to improve the overall customer experience by creating a digital service which is not only user-friendly but also genuinely helpful and desirable. To achieve this equates to a value-add to all parties.

5.4 Customer Story and Persona

To concretize the acquired customer understanding, the team constructed a user persona. As described by Ojasalo, Moilanen & Ritalahti (2015, 77), personas are typically fictional characters based on gathered information. They present the customers' behavioral patterns, motivations, and needs. Personas are tools for enhancing empathy, making it simpler to design with a deep understanding of the customer's perspective. User personas also help in subsequent communication by establishing a shared understanding and vision.

In finalizing the concept, the team utilized the Crazy 8's sketch method, a Design Sprint tool recommended by Knapp (2016, 109) to enhance creativity and design thinking. This rapid sketching exercise brought the customer journey to life. The team was able to generate new and alternative ideas, perspectives, and emotional elements that transformed the customer journey map and user persona into a customer story. To showcase and simulate the customer story, the team presented it to Nokia in a sparring session as an animated slideshow accompanied by a script.

6 Development Results

The development result (or concept), which the team has titled Mass Personalized Reality, uses a combination of PARALLEL REALITY™ displays and a location tracking system to enable providing each visitor with personalized screen content steered to their 3D location. The content itself can be anything from wayfinding directions to advertisements or entertainment and selectable camera angles. Crucially, it does not require a headset or any other equipment to be used by the visitor.

The concept places a higher emphasis on the user experience, rather than on an explicitly defined technological solution. As such, the prototype is built around the customer story to simulate a large venue experience, and its main purpose is to explain how the Mass Personalized Reality experience is tailored to meet user needs and interests whether from the lens of personalization (by the provider) or customization (by the user).

Personalization, in the context of describing Mass Personalized Reality, is used in a general and over-arching capacity (a superordinate of sorts). Its underlying concepts are considered to include both personalization and customization. It is therefore important to consider their distinction, as the terms are often used with different meanings by scholars and businesses alike (Vesanen 2005, 5). According to Arora et al. (2008), whereas personalization is the tailoring of its products and services by a company based on customer insights, customization places the customer in the driver's seat to decide what and how to customize per their individual preferences (Chandra, Verma, Lim, Kumar & Donthu 2022, 1534).

Furthermore, customization of standard products takes various forms. Transparent customization implies unique offerings, whereas cosmetic customization is simply a different presentation of the standard product. Adaptive customization entails the customer choosing from any number of customizable options. Finally, collaborative customization is performed in concert with the firm and its customers. (Chandra, Verma, Lim, Kumar & Donthu 2022, 1534.) Mass Personalized Reality allows unprecedented levels of personalization and forms of customization as evidenced by the prototype and concept introduced in the next section.

The prototype was presented to Nokia in the form of an animated slideshow following a narrated script (see Figure 9). The story follows two main characters and their experience at an event in Nokia Arena and showcases various touchpoints with the Mass Personalized Reality technology.

6.1 Concept Prototype

The prototype introduces the audience to two characters, Alex and Nico, who arrive at a sports event at an arena. Alex presents their tickets at the door and simply agrees to position tracking on her mobile phone. This identifies and authenticates her for the VIP package she has purchased. In the lobby, she immediately sees a message on the screens: “Welcome Alex!” it says, followed by navigation directions specific to her and seen only by her.

Figure 9: Selected Image from the Prototype

After arriving at their seats, the game begins. At the first intermission to the game, the jumbotron displays a “Happy Birthday” message that only the two of them see. The customers at the table next to them are viewing a different image at the same time. It could be the game feed, personalized subtitles or other paid-for-by-customer messages for anniversaries, proposals, or team building.

When the period ends, Alex and Nico walk around to find something to eat. Alex sees targeted advertisements based on her preferences or location within the arena. These can be tailored menus from partner restaurants. They are both vegans, so they are presented with vegan options instead of a general menu that would include the meat section as well. The prototype slideshow then ends with the couple leaving the arena.

Prototype testing was used to gather feedback on the concept from two persons who confirmed having had experience with different types of stadium events in Finland and abroad. The test results closely align with the findings of the survey. Based on the feedback received, the personalized image from the displays would make it easier to arrive at the event and find the assigned seating. The birthday greeting displayed on the jumbotron was

considered particularly impressive and sparked new suggestions, like displaying a selected player card or hosting an interactive game during intermissions.

6.2 Technical Implementation of the Concept

The following concept description details an entry-level implementation of Mass Personalized Reality that works with the least amount of hardware and software from Nokia and minimum involvement from the visitor. It also lays the foundation upon which future developments will be easier to implement.

In this basic implementation, the visitors need only to authenticate themselves for the location tracking system when entering the venue to enjoy the benefits of Mass Personalized Reality. The authentication can be achieved in one of two ways: using a phone or a physical ticket. Each visitor already has a unique identifier based on the ticket they bought, as each ticket contains, for example, an ID number or QR code for the ticketing system. When arriving at the venue, the visitor can simply show the number or code from the phone or physical ticket to the location tracking system to allow it to start following their location.

The location tracking is performed on two levels: general location and head location. General location is implemented with Bluetooth Low Energy and iBeacons. When authenticating, the visitor either allows their phone to be tracked by the location tracking system or they must be fitted with a Bluetooth tag if using a phone for tracking is not an option. The tag is provided by the venue. General tracking follows the visitor in the venue for the duration of their visit.

For the displays to work effectively, merely knowing the location of the Bluetooth tag is not enough, as its location in relation to the visitor's eye height is unknown and varies. When the visitor enters an area where a PARALLEL REALITY™ display can show personalized content, camera tracking is used to find the location of the visitor's head. This tracking does not use facial recognition; it merely sees the shape of the visitor and calculates head position and eye height. The shape data is then combined with the general tracking data to link the shape to the authenticated visitor.

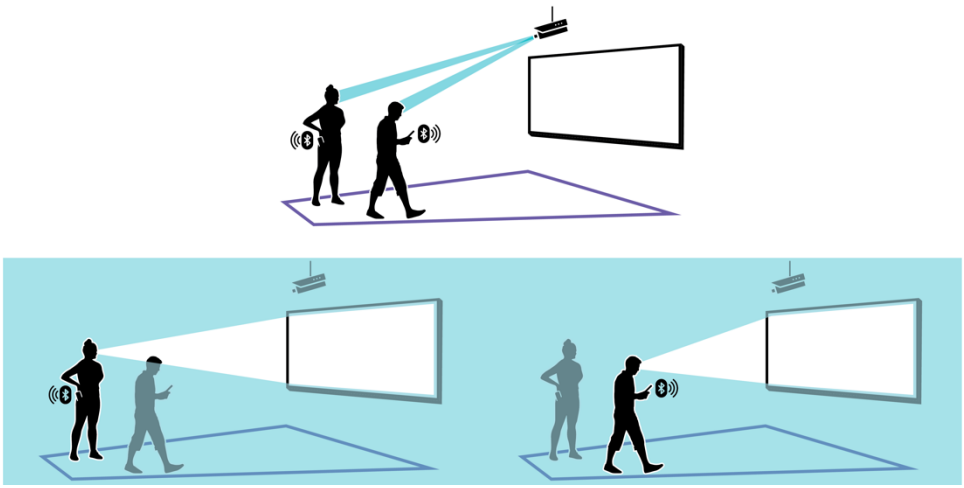

Figure 10: General and Head Location Tracking

Once the visitor's head position and eye height are calculated and confirmed, the PARALLEL REALITY™ display steers a precise beam of the visitor's personalized content to their position only, so that no-one else can see it (Figure 10). Everyone else in view of the same display sees either the default screen content or their personalized content instead. When the visitor exits the tracking area of the camera, they continue to be tracked only by general location tracking.

6.3 Personalized Content Enabled by the Concept

In Mass Personalized Reality, visitors not only receive directions to their assigned seating but can also have it in a language of their choosing (with high contrast text, if needed). The directions can also be adapted in real time to react to people flow requirements. For instance, if the toilets to the right are closer but currently behind a large crowd of people, the visitor could be directed to the toilets on the left for faster access.

Important announcements of a more personal nature can be delivered via the displays, too. If a car is parked incorrectly, the owner can be notified personally without the whole venue seeing the message. If even more discretion is needed, the display can simply draw the visitor's attention to a message sent to their phone.

The displays can also be used to provide personalized entertainment. Groups celebrating birthdays can broadcast congratulations via the jumbotron. In an entry-level version of the concept, the messages would need to be ordered online via a browser or before the event.

Advertisements can be completely personalized as well. Visitors can receive adverts pertaining to their personal interests or offers based on their location inside the venue. For instance, a restaurant can show vegan adverts and menus to vegan visitors. Age restricted

products and services can now also be advertised, as they are never shown to underage visitors.

When leaving the venue, the visitors again receive personal real-time directions to maximize efficiency of people flow. In addition, they can be shown relevant and personal public transit information instead of general timetables (a visitor living in Helsinki most likely does not need to know when a train to Oulu leaves).

6.4 Benefits

The survey results detailed earlier provide a glimpse into specific benefits of a mass personalized event experience, as perceived from the customer perspective. To reiterate, the benefits fall into the following types: exclusive screen content, special discounts, easier navigation, relevant travel information, and tailored services for the impaired.

Exclusive screen content unlocks a wealth of previously untappable screen time and surface area that can be simultaneously targeted to individuals and groups, whether based on customer choice, preferences, or segmentation. It enables both a novel way to better capitalize on existing content by increasing its distribution frequency, and a broadening of the scope of what content could or should be produced as an optional extra to the (paying) customer. Furthermore, upselling exclusive content now becomes equally applicable to standard and box seats, equating to a host of new VIP package offerings at different price points. All scenarios benefit from the customer being able to engage in the event experience with a greater visual awareness of the offerings.

For eco-system partners, benefits range from increased advertising opportunities in simultaneously targeted ads to exclusive product or service offerings. Upselling and cross-selling opportunities are improved. Concession stands can benefit from reduction of wastage, and even unique options for order management can be implemented with complementary technology.

For the venue operator, successful implementation of the technology can catapult them to be the forerunner in novel event technology and simplified mass personalization solutions. A higher utilization of installed technology and advertising surface area can create savings and increase revenues in one go. What is more, customer journeys in a large venue context can be orchestrated in entirely new ways to drive customer satisfaction, engagement, and loyalty.

Finally, the venue operator and its eco-system partners can reap reputational benefits with relation to CSR practices, whether from unparalleled quality of service to the impaired or the previously mentioned higher utilization of installed technology and reduction of food wastage – the latter two being key examples of sustainability in events. Moreover, the technology can

even be harnessed for sustainable development by diversifying the methods (i.e. personalization) through which event attendees are persuaded to retune their attitudes and behaviors, as Mair and Smith (2021, 1742) advocate.

6.5 Feedback

During the design sprint week, the team had a few sparring sessions with Nokia. Overall, the feedback was positive and was accounted for in the professional and self-confident way the sparring sessions and pitch were planned. The prototype was presented to Nokia in a pitch at the end of the sprint week, and feedback was implemented in changes to the final version of the prototype.

For the concept itself, Nokia commented that mass personalization is already a reality, and therefore the idea is very relevant and timely. Currently, this level of customization and personalization is only provided to VIP customers, but with the new displays it can be brought to the whole arena.

The use of AI was also mentioned in the feedback as a part of the personalization experience. Although it is not included in the concept per se, the use of AI as a feature is implicitly expected to be bundled with the displays – as is an app. The entry-level implementation of the concept functions without either of the two but using them both would enable reaping the full rewards.

7 Conclusions and Future Scope

The aim of the thesis was to innovate a solution to the challenge “What are the next-generation digital experiences and business opportunities in a stadium context?” The development was done in collaboration with the client company, Nokia, using the Design Sprint method.

The team was inspired by PARALLEL REALITY™ technology as a means of incorporating augmented reality into various environments. This fundamental idea was found prior to the sprint week and was validated in the sparring sessions with Nokia.

7.1 Conclusions

One of the challenges during the process was establishing contact with Misapplied Sciences about the PARALLEL REALITY™ displays. For example, the current state of the technical specifications of the displays could not be reliably and exhaustively determined. As a result, the development idea is not ready for implementation in all respects and requires further benchmarking and research. Although the technology is not yet widely used, the pilot case with screens in an airport context showing a personalized view to around two hundred people confirms some obvious benefits.

The survey helped the team identify the most common causes of unsatisfactory event experiences. This, in turn, helped narrow down the scope of the proposed solution. According to the results, the most common causes of poor experiences related to arriving and leaving the event and navigating to the assigned seating. Google reviews were also considered in assisting to validate the findings of the survey.

The Mass Personalized Reality concept uses new technology to provide a personalized and customized visitor experience in event venues. The PARALLEL REALITY™ displays have already been used, but at a limited scale. The proposed concept fully embraces the technology by expanding it to the whole venue, whether for entertainment and enhanced accessibility purposes, or novel marketing opportunities for ecosystem partners.

The displays combined with both camera and Bluetooth tracking give visitors a seamless experience of personalized directions, entertainment, information, and advertisements following them from start to finish. The visitor experience is enhanced all the more as people can put away their smartphones and focus on the event itself.

All visitors having access to the same on-site hardware results in the democratization of user benefits. Whereas different features and services may have been gated behind VIP access due to price, they can now be scaled to the entire venue instead of just a small VIP area. Now that all visitors effectively have their own exclusive screen, all previously VIP gated screen content can be provided to everyone.

In a real-life scenario, the cost of equipment acquisitions and the speed of implementation of technology in the arena/stadium ecosystem must be considered. Additionally, the environmental impacts of equipment acquisitions must be accounted for.

Be that as it may, visitors, ecosystem partners, and venue operators alike can – and should be encouraged to – reap the benefits on offer. Underlying the physical screens that serve as visual touchpoints is an incredibly powerful, flexible, and scalable solution for implementing novel services and experiences. As such, underutilization of its capabilities is a valid concern.

Although AI as a (key) component of the concept has not been explored in the thesis, it stands to reason that it is fundamental to driving a successful future implementation of the concept in its broadest scope.

7.2 Future Scope

The entry-level implementation of Mass Personalized Reality works with bare minimum involvement from the visitor. If a (web) application was developed and included in the concept, its potential could increase manifold (as suggested in the following examples). For instance, the visitor could then choose their destination via the app on their smartphone, and the displays would change to provide relevant directions. The displays could also be further leveraged for fun entertaining activities, such as hosting community games. For instance, one group could play the iconic Nokia Snake game on the arena jumbotron, while the people next to them could be answering a quiz. In a concert with a multi-camera setup, the app could enable users to choose which video feed appears on the screens. All these features could be ordered in real time via the app or service instead of having to navigate to a website. With the help of AI, further development can be extended even more; for example, to identify customer needs from different social media platforms to create even more specific offers and content for the screens.

Another slightly more comprehensive implementation of the concept could be enabled by capabilities added in the latest Bluetooth Core Specification version 5.4, which has introduced a much-anticipated wireless standard for electronic shelf label (ESL) applications (Dugand 2023). It could be used to enable a mid-level implementation that slots above the entry-level implementation of Mass Personalized Reality, yet still below the mature implementation involving a smartphone application. A small ESL incorporated into a wristband could serve as both a tag for location tracking and as the small screen for various announcements. These could be, for instance, the previously mentioned private announcements about incorrect car parking, navigation directions in areas not covered by screens, or even vouchers with QR codes for redeeming special discounts.

Once the Mass Personalized Reality concept has been piloted and verified to work, it can be productized and sold to other venues and operators. Virtually every venue is a potential use case for Mass Personalized Reality. The icing on the cake: no headset required.

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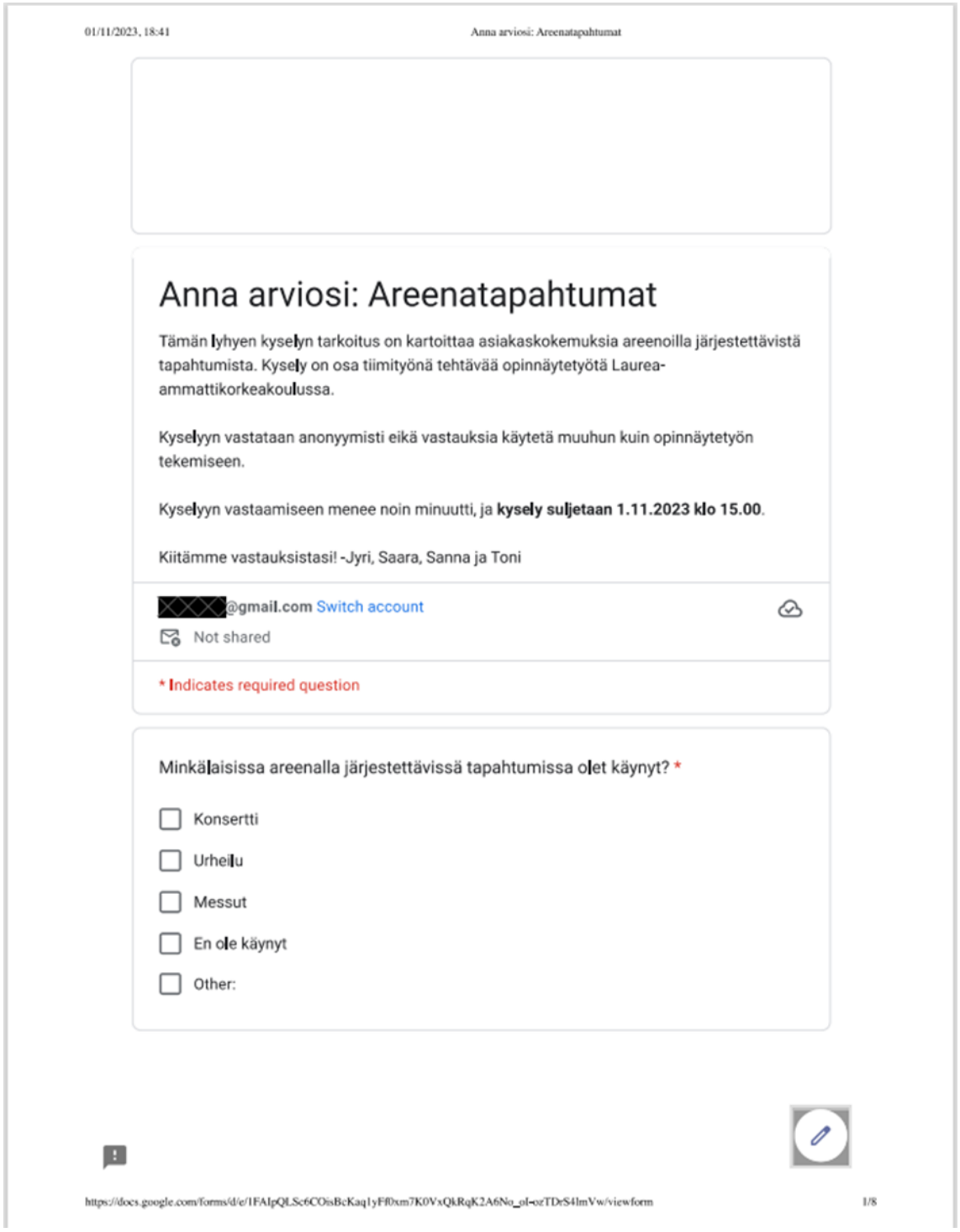
Figures

Tables

Appendices

Appendix 1: Survey



01/11/2023, 18:41 Anna arviosi: Areenatapahtumat

Anna arviosi: Areenatapahtumat

Tämän lyhyen kyselyn tarkoitus on kartoittaa asiakaskokemuksia areenoilla järjestettävistä tapahtumista. Kysely on osa tiimityönä tehtävää opinnäytetyötä Laurea-ammattikorkeakoulussa.

Kyselyyn vastataan anonyymisti eikä vastauksia käytetä muuhun kuin opinnäytetyön tekemiseen.

Kyselyyn vastaamiseen menee noin minuutti, ja **kysely suljetaan 1.11.2023 klo 15.00**.

Kiitämme vastauksistasi! -Jyri, Saara, Sanna ja Toni

[redacted]@gmail.com Switch account

Not shared

* Indicates required question

Minkälaisissa areenalla järjestettävissä tapahtumissa olet käynyt? *

- [ ] Konsertti
- [ ] Urheilu
- [ ] Messut
- [ ] En ole käynyt
- [ ] Other:

https://docs.google.com/forms/d/e/1FAIpQLSc6COisBcKaq1yFf0xm7K0VxQkRqK2A6No_oI-ozTDrS4lmVw/viewform 1/8

Kuinka tyytyväinen olet ollut seuraaviin asioihin tapahtumissa ja sen alueella? *

	Erittäin tyytymätön	Tyytymätön	Tyytyväinen	Erittäin tyytyväinen
Liikkuminen	○	○	○	○
Tiedotus ja tiedonhaku tapahtumasta sen aikana	○	○	○	○
Yleisäänentoisto (kuulutukset jne.)	○	○	○	○
Opasteet / opastus	○	○	○	○
Lisäpalvelut (ruoka, oheismyynti, narikka)	○	○	○	○

Miten paljon lisäarvoa oheiset palvelut toisivat sinulle? *

	Vähän tai ei ollenkaan	Kohtalaisesti	Erittäin paljon
Paremmat opasteet	○	○	○
Henkilökohtaiset tarjoukset tapahtumassa käytettäväksi	○	○	○
Henkilökohtaiset tarjoukset tapahtuman ulkopuolelle	○	○	○
Julkisen liikenteen tiedotteet	○	○	○
Sujuvampi saapuminen ja poistuminen tapahtumasta	○	○	○

Olisitko valmis maksamaan, että...

	Kyllä	En
...pääset nopeammin sisään tapahtumaan?	○	○
...pääset nopeammin omalle paikallesi?	○	○
...saisit valitsemallasi kielellä tekstitystä tai ohjeistusta?	○	○
...voisit itse päättää mitä kuvakulmaa tai muuta tietoa näet näytöiltä?	○	○