

**UNIVERSITY
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MASTER THESIS

**Designing an Engaging
Marathon Track Experience
for Runners and Spectators**

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STUDY PROGRAM

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INTRODUCTION

Long-distance running events (LDRE) have increased in popularity thanks to the recent awareness of the importance of physical activity, attracting an increasing number of amateur runners and spectators over the last decade. Despite this, these events have seen a drop in runner participation since 2016 (Andersen, 2019). To tackle this, the Enschede Marathon (EM) organizers mentioned that they wanted to enhance the running experience and make the event more interesting for both participants and spectators. This event is the oldest of its kind in the Netherlands and Western Europe and hosts almost 11,000 runners and 80,000 spectators along its 42KM track every year (Enschede Marathon, 2021). As the event is growing in participation, organizers are interested in developing innovative experiences to improve engagement by applying technology to connect runners and spectators participating in the event.

1.1 Problem statement

Prior studies on Sport Experience Design (SX) have shown that using technology to provide sports services improves engagement by targeting specific consumer needs (Griffiths, 2014). However, researchers studying particular technological innovations frequently concentrate either on the company or customer perspective (Funk, 2027). This has led to a theoretical gap at the intersection of consumer and organizational complex interactions. More in-depth theoretical understanding is necessary to fully comprehend the cognitive, organizational, physical, and social factors influencing customer satisfaction with the sports experience (Funk, 2017). Sports organizations worldwide make efforts to provide real-time interactions between runners and supporters by utilizing event apps, tracking, and social media during the event (Abbot World Marathon Majors, 2022). As these organizations fail to meet their specific user and technological needs, there is a mismatch between the organizational and user perspectives, resulting in sport user dissatisfaction.

1.2 Aim of the thesis

The Enschede Marathon must improve customer perceptions of the service experience to keep up with new technological developments and stay competitive in the marathon market. The current analysis aims to reflect on the current service experience of the EM environment, service providers, and the perceived benefits of designing a new technological experience. With a qualitative approach using service design tools, this study will gather an in-depth understanding of the sports user's underlying values, needs, and concerns. Following the Diamond Design framework, this study maps the design process from a broad perspective to a narrowed solution in line with the Enschede Marathon objectives.

1.3 Research questions

The present study explores how technology can mediate an engaging experience for runners and spectators participating in a small scale long-distance running event like the Enschede Marathon. For this, I will attempt to answer the main research question and the following sub-questions:

RQ: How should we design an engaging technological marathon track experience for runners and spectators?

SQ1: How can a long-distance running event technological intervention shape the motivational components?

SQ2: How can sports organizations use service design to engage runners and spectators through technology?

This thesis seeks to develop a concept of an engaging sports technology experience for the EM by answering these questions. This project planning is based on an adaptation of the double diamond design framework to achieve this goal.

1.3 Plan of approach

This study approach addresses the practical challenges confronting the Enschede Marathon organization and the theoretical limitations of existing research on real-time interaction technologies, which have traditionally been observed in isolation. To discover how technological innovations might improve service experiences in the long-distance running event industry, the SX and DyPECs frameworks were explored as a practical theoretical lens to understand management and user perceptions of the EM experience.

To answer the research questions and develop a new service, this project planning is based on an adaptation of the double diamond design framework, which is divided into four stages: Discover, Define, Develop and Deliver (Design Council, 2015). This design methodology allows the researcher to map the design process from a broad perspective to a narrowed solution, focused on creating a new service following the Enschede Marathon objectives, user, and context needs. Additionally, a 'Reflection' stage was added at the end of the process to analyze the final project results and observe the impact and scalability of the concept, providing improvement possibilities for future work. In this section, the different steps and tools of this method are described, and they are illustrated in Figure 1:

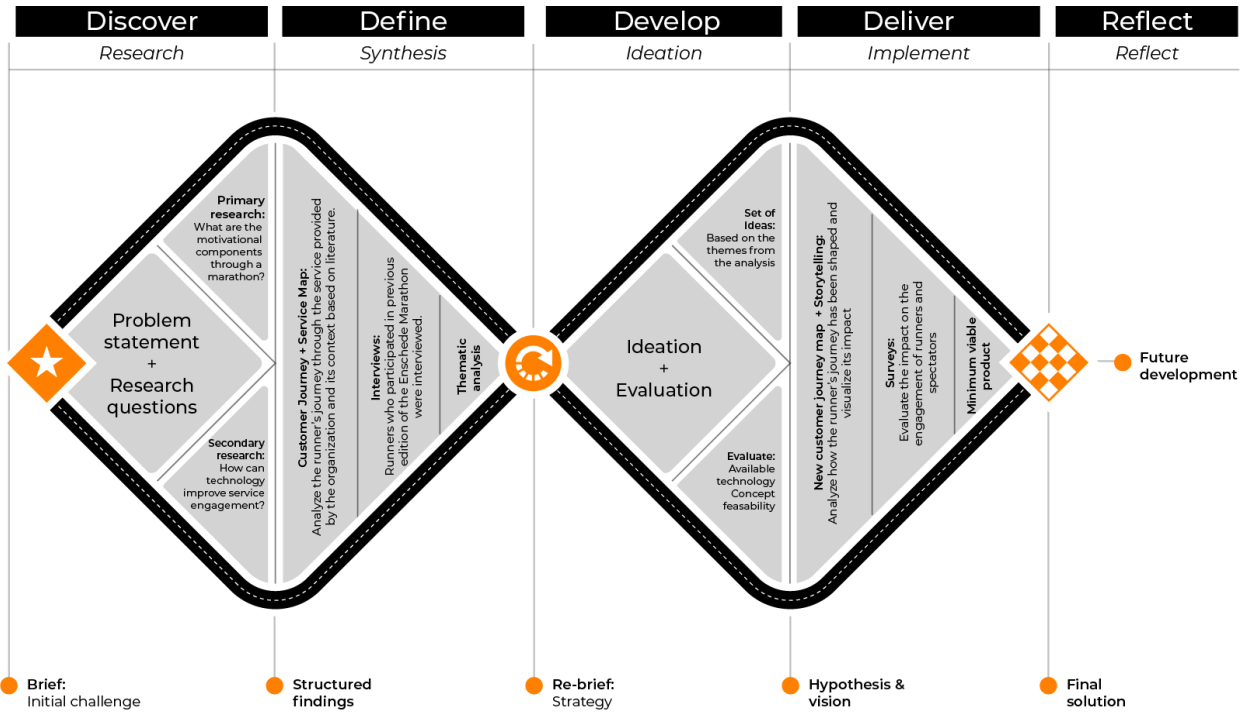


Figure 1. Double diamond design framework as a base for this project planning.
Adapted from Design Council, 2015.

Phase I: Discover

The Discovery phase gathers sports experience design literature to identify the main actors, perspectives, and their unique needs. This literature research will explore the runner and spectator experience, broken down into components (according to the ... framework): Emotional, physical, social, and cognitive components. Additionally, it addresses literature on how to design technology as an experience, providing this study with a set of guidelines and tools to answer our research question. Finally, attention will be given to learning about specific technology used in marathon events worldwide, depending on the findings.

Method: Literature review.

Phase II: Define

The Define phase uses an exploratory research approach to narrow down the scope of the assignment and establish the requirements for developing the unique marathon track experience. This phase aims to redefine the challenge from a user perspective, situated in the EM sport context. Service design tools synthesize the collected data and provide an in-depth understanding of the technology marathon market and user experience.

Method: Market Analysis, Customer journey map, Interviews, Thematic Analysis

Phase III: Develop

A new technology marathon experience will be designed in the Develop phase while considering the runner's particular needs. An idea will be selected and developed based on the available technology, feasibility, and scalability. The main focus will be on enhancing social interaction between runners and spectators through technology. This phase represents the implementation process of technology into the EM runner's experience.

Method: Design thinking, Ideation, Conceptualization

Phase IV: Deliver

The Deliver phase focuses on validating and evaluating the final concept. A trial version of the technological experience to enhance social interaction between runners and spectators will be implemented during an event to test how the concept shapes the runner's experience.

Method: Prototyping,

Phase V: Reflect

While the conclusive parts of the previous chapter discussed the insights and recommendations for the final design of a unique technological marathon intervention, this phase will summarize the project and its outcomes while reflecting on the design process. The knowledge contributions towards society, design, and the field of Sports science are discussed, and opportunities for future work are given. A personal reflection on my learnings during this project will complete this *Method*.



LITERATURE REVIEW

Sports organizations create an environment where sports consumers experience a wide range of interactions through touchpoints during a live sporting event from beginning to end (Funk, 2017). In the marathon context, interactions range from searching for information about the event, signing up, traveling to the race location, enjoying pre-race activities, the use of technology to listen to music and updates, watching the race and digital content on the screens next to the finish line, cheering, using mobile devices to post pictures, interacting with other runners and spectators, purchasing running equipment and merchandise, using restroom facilities, participating in ceremonies, and finally leaving the venue (Enschede Marathon, 2021). As a result, runners and spectators interact with the organization's website, employees, volunteers, vendors, other participants, sound and visual systems, mobile technology platforms, facilities, and service elements. To enhance customer satisfaction, organizations must study their experience as a variety of two-way interactions between customers and products, including tangible and intangible services. These services are encountered during the entirety of the sports consumer journey, taking into account the start and conclusion of this journey beyond the time constraints of the day of the event (Funk, 2017).

2.1 Use of Technology in Running Events

Large LDRE organizations are increasingly interested in improving the runner's experience using commercial technologies to enhance their event experience. Janssen (2017) showed that 87.9% of participants used a monitoring system during the Eindhoven marathon to monitor distance, time, and speed. The London Marathon 2018 edition incorporated a smartphone app that tracked the runners' progress, allowing spectators to arrive at viewing areas in time to cheer their athletes (Tata Consultancy Services, 2018). The EM offers a tracking app for runners to get important information about the event and track their performance. The app allows following other runners and getting a final ranking based on time and position at the end of the race (Enschede Marathon, 2021). However applicable, this information is still limited to basic performance statistics, leaving spectators out of the equation.

Different applications have been explored by studies to support runner-spectator interactions in real-time. Interactions through social media and other apps for tracking runners during the event have been examined by different sports organizations throughout the world (Andersen, 2019). For example, HeartLink shares heart rate data with spectators so they can send cheering vibrations to support runners (Curmi et al., 2013). Based on the runners' need for external motivation, a runner can actively request or decline cheers from spectators using the RUFUS system (Woźniak et al., 2015). These interactive technologies can make runners feel supported and motivated while engaging spectators. However, spectators have expressed a desire for a more profound sense of connectedness by having closer access to the runners' experience and having real-time interactions as on-site spectators.

One of the increasing issues the Enschede Marathon faces is the growing usage of technology and its effect on the sports user experience. When designing sports experiences, marathon organizers fail to meet personalized consumer needs and business goals. Knaving et al. (2015) emphasize the importance of generating a sense of community (togetherness) and connection with spectators by including them as part of the event. Funk (2017) suggests that organizations need to focus on their unique micro-encounter needs during runner-spectator interactions during the event to use the right technology as part of their services. Research demonstrates the importance of integrating engaged spectators as part of the marathon's event context since they are using the facilities and services provided by the organization while cheering a particular runner (Bouchet et al., 2011). By enhancing sports consumer satisfaction and engagement with technology, the EM organization can generate retailing opportunities while assessing perceived use and pleasure for future event editions.

2.2 Designing technology as an experience

User experience (UX) design is the process used to create interactive products and services that provide meaningful experiences to users. It improves usability and accessibility while ensuring a meaningful and relevant experience (Interaction Design Foundation, 2017). Funk (2017) asks a fundamental question that has developed from his research: how organizations may better manage service experiences to promote organizational outcomes such as future patronage, profitability, and stability. According to Hassenzahl (2010) in his book *Technology for all the right reasons*, experience is *subjective* since it is a consequence of the psychological processes of perceiving an object. It is also *holistic* since it comprises the simultaneous activation of processes and integrates them into a meaningful whole. Experience design incorporates different levels of interaction with technology:

- Be-goals: Motivation, meaning, and emotion of an activity
- Do-goals: The desired plan and outcomes of activities
- Motor-goals: Activities on an operational level

Experiences are *situated* in a dialog with the world at a particular place and time. The extension over time makes an experience *dynamic*, as the order and timing of activities can be designed by scripting the interactions. Finally, a designed experience should be *positive* as it creates value and meaning while fulfilling **universal psychological needs of competence, stimulation, relatedness, autonomy, popularity, meaning, security, and physical striving**. On the other hand, the need to meet these needs depends on the deprivation when the need fulfillment is blocked. The experience design of this project's starting point is identifying those blockers.

Pizzo et al. (2021) mention that managing the new service experience involves planning, coordinating, and evaluating consumer interactions. To do this, this project aids the Enschede marathon in analyzing the interactions between them and the runners to find opportunities to enhance customer satisfaction by increasing engagement, resulting in a co-created added value proposition with a new experience. Furthermore, according to Funk

(2017), the proposed experience should include a dynamic sequence of operational activities related to what, where, how, and when runners are exposed to generate distinctive psychological and physical responses by fostering an emotional connection, predicting loyalty to the sports organization.

Technology must be designed considering the experiences and user's background to effectively increase well-being and create real meaning. In this way, technology becomes motivational as they fulfill psychological needs while engaging in activities. Technology has to be instrumental to satisfy a need, allowing to shape the experience as desired with functionality and usability. **However, functionality and usability without fulfilling needs make experiences meaningless.**

This project experience design process starts by following the principles of technology experience design by exploring the existing knowledge of Sports Experience (SX) design and marathons. By analyzing first-hand experiences from blogs, we could observe and map the experience patterns along the track, creating an image of the participant's needs and connecting them to the selected frameworks. Additionally, the researchers conducted semi-conducted interviews to narrow the experience to the Enschede Marathon context, providing us with pinpointed opportunities to improve the event's sports experience.

The following section aims to classify and understand the interrelated elements of the sports experience design of the Enschede Marathon to develop a new experience based on technology. First, the Sports Experience Design (SX) framework is presented to understand the physiology of an LDRE and how its components interact. Afterward, a deeper explanation of the personal marathon experience and needs of recreational runners and spectators is given. This theme exploration is a theoretical foundation for shaping motivational components in an LDRE.

2.3 Sports Experience Design (SX) framework

The Sports Experience Design (SX) framework offers a conceptual user-centered understanding of how sports organizers should design the sports context to boost customer satisfaction and engagement. By responding to consumer needs within and outside the sports experience, organizers can improve the usability and enjoyment of their services. It consists of three interrelated elements: the sports organization, sports context, and sports user, which together give numerous angles on user-organization-context interactions (Funk, 2017)

The sports context represents the user experience of the physical and technological environment provided by the sports organization. The sports user is the consumer with individual psychological needs and characteristics, influencing the experience and behavior. The sports organization is the entity that seeks to accomplish goals and objectives to maximize profit by shaping the sports context for the sports user's needs. (Funk, 2017). When viewed as a whole, the EM organization aims to achieve goals by developing the physical, social, and technological context to which the runners and spectators are exposed. These elements offer a holistic conceptual framework for exploring how a sports experience is designed to increase user engagement and satisfaction by improving use (Pizzo et al., 2021). The three components of the SX frameworks are discussed in detail within the context of the Enschede Marathon event. Additionally, the shared experience of runners and spectators will be further analyzed.

2.3.1 Sport Organization

The sports organization is the Enschede Marathon which provides a set of service experiences before, during, and after the day of the event. When marathon runners run the day of the event, they do it in a physical and social context that is managed and supported by the EM organizers. Goals for the EM include maintaining operations and maximizing profits. The EM organizers provide members of the running community a chance to connect while promoting social interactions before, during, and after the LDRE (Shipway et al., 2013). Larsen et al. (2019) suggest that these events develop a sense of social identity, they are vital for individuals to bond and belong to the running community. To address this, the EM organizes before the race a series of running clinics where runners can meet, support, and prepare for the marathon.

The settings provided by the EM organization act as a connection between runners and spectators. Therefore, the sense of 'togetherness' can be managed by enhancing spectator connection and engagement to ensure they have the opportunity to interact in real-time with the runners (Knaving, 2015). By incorporating real-time interactive technology, the EM organizers may create plans to meet their business objectives while improving the runner's service experience. In particular, by encouraging social connection through technology, marathon organizers enable runners to meet their own social needs while gaining revenue from participation fees and spectators using their services, maximizing the service experience at the event (Funk,2017).

2.3.2 Sport Context

The sports context element represents the physical, social, and technological environment offered by the EM organizers, through which runners and staff navigate the sports experience and encounter touchpoints (Funk, 2017). A touchpoint in the sports context refers to the direct or indirect interaction between the organization and user, where they engage through the environment, technology-mediated settings, social actors, and services. For example, for marathon runners, critical factors for a memorable experience include amenities, marketing, personnel, and provisions (Kruger & Saayman, 2012). An example would be the Enschede Marathon event accessibility at the start and finish of the race, properly provided information by the website, mobile application, social media, hygienic facilities, and successful technicalities (music, announcements, etc.).

Research demonstrates the importance of engaged spectators as part of the marathon's event context since they also use the facilities and services the organization provides while cheering a particular runner (Bouchet et al., 2011). At the same time, runners benefit from the presence of engaged spectators through a personal connection. Furthermore, the interactions such as cheering, use of their name, and social pressure positively impact the runners' motivation and performance (Knaving et al., 2015).

The EM organization should recognize spectators as part of the sports context. It is necessary to understand their variety and specific needs to enhance engagement. By segmenting the sports spectators' profiles into categories based on their desires and goals, the EM organizers can use targeted marketing strategies and strong positioning among competitors (Bouchet et al., 2011). For example, the EM spectators mainly fall in the categories proposed by Bourgeon & Bouchet (2001):

Spectator profiles	Description	Psychological needs	Environmental needs
Supporter	They cheer their own and other runners, having the feeling of being co-producers by showing physical and vocal presence.	<ul style="list-style-type: none"> - Autonomy - Competence - Relatedness - Influence 	<ul style="list-style-type: none"> - Space along the track and finishline to cheer - Platform to follow runners' progress
Interactive	They base their behavior on reactions and interactions with objects or other people's actions. They interact and project themselves into the event, sometimes beyond it.	<ul style="list-style-type: none"> - Relatedness - Pleasure - Security 	<ul style="list-style-type: none"> - Platform to interact with spectators and know when and where to cheer runners.
Opportunist	These spectators are neutral on demonstrating support, influenced by social pressure to participate and hopes to be incentivized by the	<ul style="list-style-type: none"> - Stimulation - Relatedness - Security 	<ul style="list-style-type: none"> - Background music and entertainment - Merchandise

	organisation to contribute to the atmosphere.		
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2.3.3 Sport User

For the aim of this project, the sport user is the EM recreational runner, both intrinsically and extrinsically motivated to participate in the LDRE, regardless of the physical and mental challenges (Schüler & Brunner, 2009). Motives to train for participating in the LDRE like the Enschede Marathon include improving general health, weight concern, achievement of personal goals, affiliation with other runners, psychological coping, life meaning, and self-esteem (Buning & Walker, 2016). In addition, the intrinsically rewarding nature of long-distance running activities contributes to motivation, regardless of the physical and mental challenges (Schüler & Brunner, 2009). The EM organization categorizes runners by age, sex, and level of expertise (elite or recreational). Participation type (individual or team) often allows runners to identify as part of the running community and develop a social identity (Van Middelkoop et al., 2008).

When runners concentrate on their running performance, they use association, according to Morgan and Pollock (1977), whereas when they dissociate, they divert their attention from it. A second dimension, internal (e.g., physical sensation monitoring) and external focus (e.g., scenery, music), were presented by Stevinson and Biddle (1998). Their results proposed that recreational runners with a higher internal association *hit the wall* in earlier stages of the race than runners who practice external dissociation. Furthermore, as a result of the runner's focus on the internal body processes, the discomfort sensations increase, for example, feelings of pain and tiredness. As a recommendation, Knaving et al. (2015) mention that recreational runners' attention should be focused externally while keeping occasional internal monitoring to maximize enjoyment during the LDRE.

According to Knaving et al. (2015), interacting with spectators when runners lose the flow helps strengthen the runners' internal motivation. Support mediated by technology should enable runners and spectators to create their own experiences during the LDRE. While the SX framework aids in conceptually connecting these elements to account for how technology innovation impacts how sports organizations are handled (Pizzo et al., 2021), the DyPECS framework (Figure 2) analyses the shared experience of runners and spectators (Bi et al., 2019). The technology combines the sports user and organization to create a holistic sports experience, shaping the cognitive factors mentioned above.

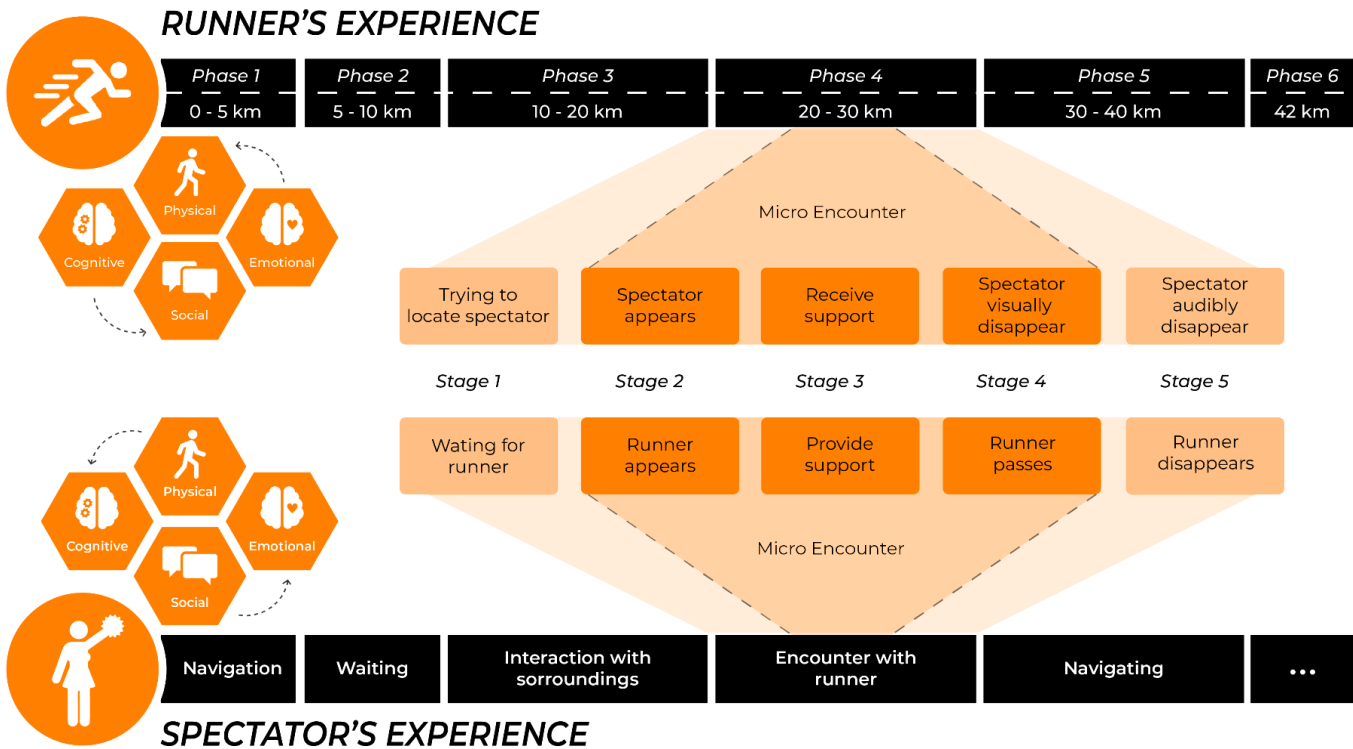


Figure 2. DyPECS Framework. Adopted from: Bi, Bianchi-Berthouze, Singh & Costanza (2019)

The DyPECS (Dynamic, Physical, Emotional, Cognitive, Social journey) framework presented by Bi et al. (2019) describes the micro-encounter experience of runners and spectators during a marathon event. This framework represents the phases and stages of physical micro-encounters during the LDRE, highlighting the complex dynamic nature of their interactions. Their study shows that the running experience is characterized by social, emotional, psychological, and cognitive components (4C's) that change throughout the race according to the runners' needs. Technological interventions during these events can enhance the overall experience by shaping the components (Kaplanidou & Vogt, 2010) as the 4C's interact during the running experience.

The physical and emotional demands of an LDRE are coped by runners supported by the atmosphere and audience help. Amateur and beginner runners have limited training and experience, with differing coping capabilities and emotional needs (Morgan & Pollock, 1977). For this group, social aspects play a role as important as performance. Understanding how these components interact for amateur runners is essential to designing technologies that capture and support the runner's experience (Bi et al., 2019). The EM has geographically spread locations where spectators actively participate in helping their runners. For this, spectators track the athletes, plan routes, navigate specific events at particular places, and interact with other spectators (Bi et al., 2019). The EM recognize their role, but there are no

in-depth analyses on their specific activities and hence fall short in designing specifically for them for their event. In table 3, an example of each component from the runner and spectator perspective is shown:

DyPECS components	Recreational runners' perspective (Sport users)	Spectators' perspective (Sport context)	Services provided by the EM organization
Emotional	<ul style="list-style-type: none"> Complex emotions such as anxiety before events and exhilaration after successfully completing the race are part of the emotional experience. Emotional traits related to performance and create complex relationships between them depending on enjoyment levels. 	<ul style="list-style-type: none"> Nervous and excited to see their runner appears Disappointment when missing their runners. Empathy with runners achieving goals or <i>hitting the wall</i> 	<ul style="list-style-type: none"> Positive ambience at beginning and end of the race to motivate runners.
Physical	<ul style="list-style-type: none"> Levels of fatigue and exertion are experienced through body senses. Hitting the wall Sensations expressed based on the perception of the external environment such as the sensation between feet and ground, weather, sound, and olfactory sensations. 	<ul style="list-style-type: none"> Physical effort to navigate through the track in order to be in time to observe their runners. The effort to be noticed by the runner. 	<ul style="list-style-type: none"> Emergency medical points Track design for optimal ground for running Track map available online Space along the track for cheering Waterpoints
Cognitive	<ul style="list-style-type: none"> Strategies and coping mechanisms used by runners to respond to their body signals. Two common cognitive strategies used by runners in LDRE are association and dissociation. 	<ul style="list-style-type: none"> Planning the moment and location to meet the runner according to their goals. Positive ambience created by organization and other spectators 	<ul style="list-style-type: none"> Successful technicalities in music points Screens at the finish line Pacers
Social	<ul style="list-style-type: none"> Engagement and interactions with spectators to cope with the rest of the components. Interactions with other runners along the track Use of tracking technology to share the experience. 	<ul style="list-style-type: none"> Connecting with other spectators and runners along the track while waiting. Special connection with runners they know. Use of social media or tracking apps to share experience 	<ul style="list-style-type: none"> Successful technicalities in music points Use of app to share important information about the event Social media experience sharing. Events prior the race to connect

			with other runners
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Table 3. Four components (4C's) of experiences and interactions with examples taken from Bi (2019), Buman et al. (2009), Kaplanidou & Vogt (2010), and Bi et al. (2019).

In conclusion, the runner's 4Cs are influenced by the running context provided by the EM organization, creating an experience as the organization-context-user interact. To answer the sub-research question 1 of 'How can a long-distance running event experience shape the motivational components?' these frameworks will be used as a theoretical base for the exploratory research to understand the component's state throughout the EM race and discover where an intervention is needed. As a result of the next section, the SQ2: 'How can sports organizations use service design to engage runners and spectators through technology?' will be explored by analyzing the specific context and technical possibilities of a new experience for the EM.



PHASE II
DEFINE



Method

As this study aims to explore how technologies can mediate an engaging sports experience for runners and spectators, a qualitative approach was chosen using service design tools. Qualitative research is appropriate to discover an in-depth understanding of the sports user's underlying values, needs, and concerns (Design Council, 2015). To set a clear overview of the services, an interview with the EM organizing director resulted in a service blueprint that overviews the totality of service components and their context from an organizational perspective. A customer journey map was created to map the interactions and overall experience of the runners. Seven semi-structured interviews with past edition EM participants (full marathon and half-marathon) were conducted to gain first-hand knowledge about the experience.

This approach facilitated a holistic analysis of the experience by triangulating consumer and organizational perspectives according to the SX framework (Funk, 2017) and the 4C's specific needs during an LDRE (Bi et al., 2019). This enriched the depth of the study's findings in understanding organization-user-context interactions with innovative technology and services. Participants addressed various design factors and interactions, providing first-hand insight into their experience. We could handle the gap in past studies by merging the perspective of marathon organizers and customers.

The current study explores how to design an engaging technology marathon experience for runners and spectators by conducting a complete analysis of the organization-user-context interactions that define the sports experience. This brings us a step closer to answering the research question by defining the specific challenges of the Enschede Marathon experience.



CUSTOMER JOURNEY

This service design tool describes how the user interacts with the service throughout its touchpoints. It is used to map a synthetic representation of step-by-step how users interact with the service (Design Council, 2015). The process is mapped from the user perspective, describing the actions at each stage of the interaction, involved touchpoints from the organization, and what obstacles and barriers they may encounter. (Interaction design foundation, 2017). This study's tool was complemented based on the related literature and the event context. The goal is to understand the runner's experiences, have a proper understanding of the runner's experience, and can be meaningful in the EM customer experience track improvement strategies through technology.

The journey map is often integrated with additional layers representing the level of positive/negative emotions experienced throughout the interaction. For this study, feelings were replaced by the experiences described using the DyPECS framework for the classification of the chronological stages and 4C's (physical, emotional, cognitive, and social). As a reference to running experiences during LDRE, a Google search was conducted with the keywords: "marathon," "experience," and "blog." From the results, we filtered blogs and videos based on the level of experience and content (marathon event running). Surprisingly, one of the blogs was about the Enschede marathon experience, which gave us detailed insights into the event experience. Selected blogs are mainly about the marathon experience of amateur runners. For privacy, the list of the blog URLs will not be shared. There were no spectator blogs that documented their experience.

	Awareness	Registration	Preparation	Day of Race	Phase 0: Pre-race	Phase 1: 0-5 km	Phase 2: 5-10 km	Phase 3: 10-20 km	Phase 4: 20-30 km	Phase 5: 30-40 km	Phase 6: 40-42 km	Phase 7: Post-race	Reflect	
Customer Actions	Search for races online Talk to friends on running community	Visit website to register and pay for race	Plan travel Diet plan Runner's apparel/accessories Training plan Study race course Download app and register	Collect start number & post-registration Visit Runners Fair Place tracking chip provided by organization	Navigate to start Warm-up	Set rhythm Follow runner group	Energy Gel Consult other runners	Drink Water	Check Pace Encounter loved ones	Energy Gel	Check Pace	Celebrate finishing the race	Compare statistics Find and share footage	
Touchpoints	Social Media	Enschede Marathon Website	Enschede Marathon Website	Registration Desk Runners Fair	Start Line	Race Track: Water points & first aid placed regularly along the track B2 booth Other races taking place simultaneously						Finish Line	Social Media Enschede Marathon Website	
Pain Points	Determining the right challenge	Technical difficulties Deciding which extras to choose	Understanding the track Finding accommodation and transport	Locating the registration office Waiting time to start race	Finding the correct start location for that category Finding loved ones in the crowd	Finding suitable running partners Setting a good rhythm	Sticking to own running rhythm, not being influenced by other runners Determining the correct moment for gel consumption	Reaching the water bottles Navigating past other runners and parked bottles	Locate loved ones Get loved ones attention and connect	Overcome 'the wall'	Drink the negative mental spiral Physically push on	Hiding mental and physical pain Finding loved ones	Finding footage Lack of community to share with	
Opportunities			Providing user friendly informative sources	Automatic cameras placed on city highlights, runners will know where to be placed	Using the race track chip for personal live use and sharing	Display general pace of runners currently passing	Substitute running companion Screen that activates pictures/videos of loved ones as you pass	Optimize water handout system Substitute the game to prevent trashed bottles	Show where runner and loved ones are Notify runner when loved ones are near (e.g. sound)	Play favorite song while passing a point Mediate social support in order to provide suitable cheer phrases	Support runner visualizing a strong race finish Projection of pace and resulting finish time	Support runners meeting with loved ones Price pick up	Provide service to simplify process of finding relevant images (e.g. live) Provide service to share and compare race results	
	HITTING THE WALL													
PHYSICAL	Lightness	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Euforisch	Recovery
EMOTIONAL	Content	Surprised by pace	Optimistic	Neutral	Motivated	Lack of confidence	Relieved	Eager	Pride					
COGNITIVE	Internal Association	External Association	External Association	Internal Monitoring	External Association	Internal Association	External Association	Internal Association	External Association	Internal Association	External Association	External Association	External Association	
SOCIAL	Part of the community Encouraged by loved ones	Connect with smaller runner group Interact with spectators	Group falls apart Less social interaction	Sharing experiences with runner next to you Less social interaction	Trying to receive attention Runners of the half marathon leave	Boosted by goal Wish for empathy	Encouraged by them Social pressure	Motivating fellow runners Wish to hide discomfort	Receiving compliments Celebrating with others					Sharing results and experiences with community

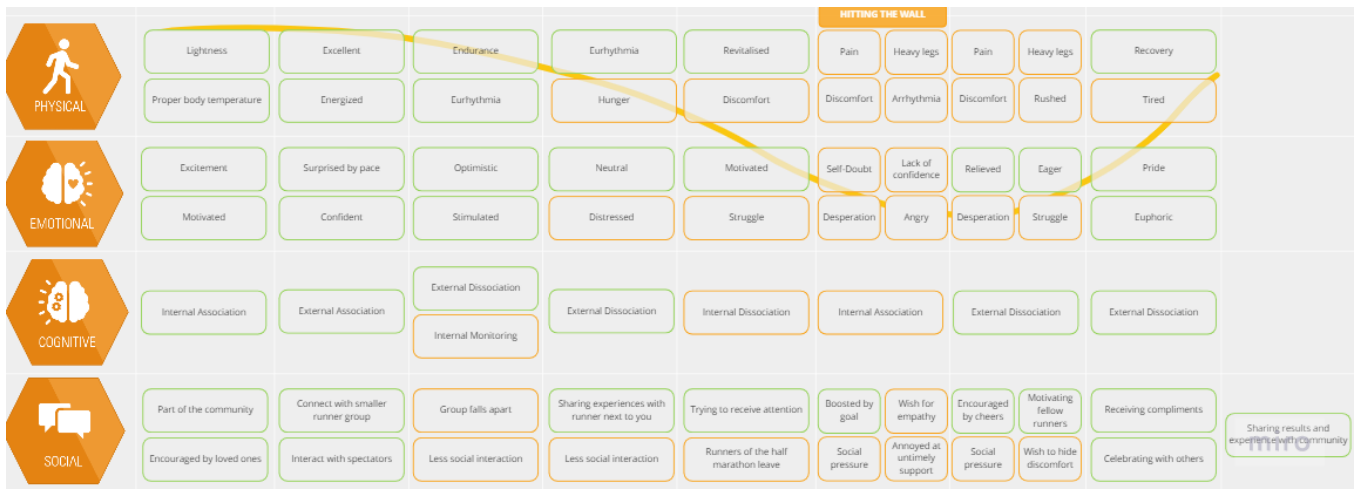
Figure 5. Customer journey adapted to this project literature framework. A full sized image can be found on [MiroBoard](#)

Adapted map construction

The DyPECS framework was used to define the different stages during the event to construct the map. This went from Phase 0 (start of the race) to Phase 7 (finish line). Each phase had a distance mark, and the activities were placed following that order. To classify the different components of the running experience, each action was assessed on its physical, emotional, cognitive, and social component. For the cognitive component, we classified each phase action by identifying which strategy the runner was going through on each phase, based on the blog information. The physical and emotional sensations described on the blogs were placed on the corresponding kilometer described by the runner. We observed where the spectators met during the race description for the social encounters.

Results

As a result of this method, we could identify the opportunity areas of the track experience journey for most recreational runners. An increase in discomfort was observed in runners from phase 5 to 6, where runner blogs reported hitting the wall more often. These phases were between km 30 - 42, the final part of the track. Normally, spectators were expected at stage 4 to support the difficulties. As the race continued to phase 5, the decrease of spectators seemed to relate to the overall runners' physical and mental discomfort. The organization's services as music and drink stations complement this part of the track, but the number of spectators may decrease as they go back to the finish line to wait for the runners.



These findings gave the researchers the theoretical foundation to design the questionnaire for the interview procedure in the next section. Questionnaires focused on the personal experience of the different stages of the marathon and specific parts with a lack of engagement and discomfort. Additionally, it inquires about the used technology, presence, and interaction with spectators along the EM track and finish line.

MARKET ANALYSIS

To create or improve a service, extensive research about the existing context needs to be done. In this section, we analyze the European marathon market size to understand how this project can address the gap in the current marathon market. This is done to establish the project's market stance to satisfy the runner's needs and observe the environment where the Enschede Marathon coalesced with other competitors in this sports market.

As a result, this analysis will allow us to critically evaluate the generated ideas to identify weaknesses of the internal and external organizational and technological barriers within the final concept must be placed. This section will also include an extensive analysis of the Enschede Marathon user profile, defining their specific needs, values, and desires, including demographics. The definition of these traits will show the user's motivations to use particular technologies the organization provides.

Materials - Technology used in marathons

A growing number of runners are utilizing technology to track their progress. According to Pobiruchin et al. (2018), around 75% of runners employed wearable technology for training optimization and distance recording. According to Janssen et al. (2017), recreational runners employed different sports technologies; 60% used a sports watch, and more than half used specific running applications to track personalized training data. His findings imply that the most potent motivators are instant feedback when achieving goals and insight into accomplishments based on distance or pace.

As the number of runners using technology has increased, efforts to create technological systems connected to running and other sports have also gained substantial attention. This study focuses on the role of running interactive technology in connection to the social elements of running and runner motivation. Table X. analyzes the technologies used by marathon organizers to understand the functionalities and materials these organizations are currently using to engage runners and spectators.

The analysis starts by enlisting the technologies used in the last edition of the Abbot World Marathon (2022) majors and continues with smaller marathons in Europe. Then, it enlists the functionality of their applications and specialized materials used to enhance engagement in their events. To find this information, a web search with the event name + the words 'technology' and 'apps.'

The Abbot World Marathon Majors technology analysis				
Event Name	Last edition	Technology used for engagement	Functionality	Materials
Tokyo	6/03/2022	Specator navigator: Predicts the position information and time of runners from the measurement data of running competitors and displays the information to help spectators cheer in the right time	<ul style="list-style-type: none"> - Track and display runners you want to support - Display multiple runners - View record list and share - Display your position as spectator - Replay mode - Send a support message to runner 	Mobile app <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor - Text and voice message sharing - Personalized interactive map for the event
		Leaderboard: Displays finishing order and times of top runners in real time	<ul style="list-style-type: none"> - Available in spectator navigator app and website - Displays top 100 finishers of each category in real-time 	Website and app <ul style="list-style-type: none"> - RFID tracking technology
Boston	8/04/2022	Security technology: Real-time tracking of the race for efficient crisis management and communication	<ul style="list-style-type: none"> - Real-time movement of runners - Live traffic - Weather - Medical tents - Vehicles and helicopter landing pads 	Government technology and equipment <ul style="list-style-type: none"> - GPS tracking - Bluetooth
		B.A.A Racing App: Features live tracking of all participants, social media integration, interactive course maps, selfies and all information you need to know about the B.A.A. and Boston Marathon.	<ul style="list-style-type: none"> - Live tracking on course maps - Live leaderboards - Participant times, paces, estimated finish times, and push notifications - Race related information and resources - Custom selfie frames - Social media sharing - Sponsors 	Mobile app <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor - Notifications - Personalized map Camera
London	3/10/2021	The Official Virgin Money London Marathon App: Provides event week and event day information allowing runners track and record their virtual marathon run. Supporters can follow participants's progress and see where they would be on the traditional course map. The 2021 app contained tailored advice for runners to	<ul style="list-style-type: none"> - Live tracking on course maps - Runners get motivational audio experience - Spectators can follow with an interactive map the runners progress and details: <ul style="list-style-type: none"> - Starting time - Distance covered - Elapsed time - Active time - Finish time - Elite leaderboard showing updates about the elite men's, 	Mobile app <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor - Text and voice message sharing - Personalized interactive map for the event - RFID tracking technology

		prepare before the race.	women's and wheelchair races. - Social sharing available using hashtags and marathon-themed selfie frames - Donations to charity can be done through the app	
		COVID-safe Restrata platform: Used to help ensure the elite marathoners arrive at the starting line in Greenwich for the 41st London Marathon	- Tracking technology for elite runners using a tag, detecting everywhere they go within the hotel - Identifies the level of infection risk depending the contact the elite runner had with the infected person	
Berlin	26/09/2021	BMW Berlin Marathon: Used to provide relevant information and features to prepare for the event day. With an interactive map you can see information about the race and the week highlights in the calendar.	- Live tracking of up to 10 runners or inline skaters - Course map: Routing, course crossings Reviews mention the app doesn't work at all	Mobile app - GPS tracking - Mobile data connection - Personalized interactive map for the event
Chicago	10/10/2021	The Bank of America Chicago Marathon App The app includes relevant information to prepare for the race week for runners and spectators.	- Runner tracking - Live leaderboard - TV broadcast streaming - Interactive course map - BIB share - Selfie cam - Digital cheer submission App reviews mention the app doesn't properly work	Mobile app - GPS tracking - Mobile data connection - Personalized interactive map for the event - RFID tracking technology - Camera
New York	07/11/2021	TCS NYC Marathon App: Hybrid platform that enables in-person and virtual runners, along with their supporters and spectators, to share in the marathon experience. Virtual runners will appear on the marathon course map in red and in-person runners will be in blue.	- Live, on-map tracking of runners— allowed users to track an unlimited number of runners for the first time! - NYRR Race Predictor Powered by Tata Consultancy Services—used each runner's unique running history to predict accurate finish times. - The Live Pro-Athlete Leaderboard –provided the list of leaders, along with their bios including stats and career highlights. Users could instantly track these runners with one tap. - Cheer Cards – allowed users to create digital cheer cards to	Mobile app - GPS tracking - Mobile data connection - Position predictor - Text and voice message sharing - Personalized interactive 3D map for the event - RFID tracking technology - E-commerce - Social media - Personalized

			<p>share on social media. Nearly 70,000 cheer cards were created and sent to runners at the end of the race</p> <ul style="list-style-type: none"> - Post-finish tracking - showed when runners exited Central Park for easy reunification. - Real-time runner tracking for the Abbott Dash to the Finish Line 5K (the day before the marathon). - E-commerce section - drove users to newbalance.com, where they could shop for official TCS New York City Marathon merchandise. - Interactive maps to guide users through the TCS New York City Marathon Health and Wellness Expo, and 'connected' maps of the race course and subway to plan where to see and cheer on specific runners. 	camera filter for image sharing
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Other marathons in Europe				
Event Name	Last edition	Technology used for engagement	Functionality	Materials
Paris	22/04/2022	<p>Schneider Electric Marathon de Paris app: This app is for runners and spectators to follow specific runners the day of the event. It contains preparation depending on level, challenges and training monitoring</p>	<ul style="list-style-type: none"> - Consultation of participants - Real time localisation of the runner on the map - Rankings by categories after elites - Sharing social media (Facebook / Twitter) - "Finisher" badge activation with result data - Preparation guide depending on the runners level, adapted to time target time over distance - Exclusive prizes when completing challenges during preparation for motivation - Monitoring of training sessions and possibility to compare with friends participating in the event <p>Reviews mention the app doesnt work at all</p>	<p>Mobile app</p> <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Personal data processing - Social media - RFID tracking technology
		<p>Marathon Photos Live Professional pictures of</p>	<ul style="list-style-type: none"> - Take automatic pictures from beginning to end of participants 	<ul style="list-style-type: none"> - Cammera connected to

		runners during the event that can be bought as a package	<ul style="list-style-type: none"> - Take HD video - Identify BIB number - Take picture when passing the camera - Assign the picture to the BIB number - Store the assigned pictures - Protect information 	<ul style="list-style-type: none"> - internet - RFID tracking technology - BIB identification algorithm - Website
Amsterdam	17/10/2021	<p>TCS Amsterdam Marathon 2021 app: Runners and supporters can compare runners participating in the TCS Amsterdam Marathon To keep runners motivated, they can listen to the sounds of Amsterdam for the full immersive experience Runners can take selfie and share on social media.</p>	<ul style="list-style-type: none"> - Race info - Live tracking - Compare runners - Course interactive map - Leaderboard - Sound experience - Selfie tool - Live broadcast - Social Feeds <p>Reviews mention the app doesn't work at all</p>	<p>Mobile app</p> <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor - Text and voice message sharing - Personalized interactive map for the event - RFID tracking technology - E-commerce - Social media - Personalized camera filter for image sharing
Frankfurt	27/10/2019	<p>Mainova Frankfurt Marathon Track: Ideal for runners and spectators to be close to the action at every event.</p>	<ul style="list-style-type: none"> - Monitor current position - Show split times Leaderboard - Expected finishing time 	<p>Mobile app</p> <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor
Rotterdam	23/03/2022	<p>NN Marathon Rotterdam App: Shows important event information and updates. Runners and spectators can follow their favorite participants and themselves</p>	<ul style="list-style-type: none"> - Show important event information - Track runners on the route - Location of services points - Selfies with event filters and marathon logo - 'Finisher' badge added to participants when they are done - Ranking of runners 	<p>Mobile app</p> <ul style="list-style-type: none"> - GPS tracking - Mobile data connection - Position predictor - Video message sharing - Personalized interactive map for the event - RFID tracking technology - Personalized reward - Leaderboard
		<p>Running supporter: Supporters who cannot be in the event the day of the race can send personalized</p>	<ul style="list-style-type: none"> - RFID sensor activation - BIB number identification 	<p>Website</p> <ul style="list-style-type: none"> - Personal information identification

		videos beforehand. These are shown in KM34 in Boszoom and help by motivate runners with the last push of the race.		<ul style="list-style-type: none"> - Internet connection Outdoor event screen <ul style="list-style-type: none"> - RFID tracking information
Enschede	25/04/2022	Enschede Marathon Tracking app: Find important information about your race information, tracks progress times and personalized pictures to share on social media	<ul style="list-style-type: none"> - Show important event information - Leaderboard - Personalized selfie camera - Aftermovie of the event - Sharing social media 	Mobile app: <ul style="list-style-type: none"> - Personal information identification - Internet connection - RFID tracking technology - Social media - Personalized camera filter for image sharing
		Close app: Receive relevant information for the event while receiving targeted messages	<ul style="list-style-type: none"> - Processing of personal data - Social media 	Mobile app: <ul style="list-style-type: none"> - Personal information identification - Internet connection

The most prevalent technology functionality among the analyzed apps is tracking. Developers offer apps with tracking services using GPS and RFID technology. Users should be able to track and share the location of runners and get relevant information about the event, live leaderboard, and other personalized services. The materials mainly focus on mobile apps, having their most considerable functionality used on the day of the event. Marathon organizers hire complementary services from external sports technology providers like photography, safety monitoring, and updates about the event. Having separate applications for the same event might not be optimal for enhancing the engagement of runners and spectators.

Competitors - Companies developing sport technologies

Technology plays an integral role in sports, making it more exciting and engaging for runners and spectators (Pizzo, et al., 2020). In addition, sports users seek these devices to gain a competitive advantage and share their experiences with loved ones (Bi et al., 2019). Key functional areas of sports technology for marathons observed in the analysis above include sports performance analysis, data collection, time measurement accuracy, a replay of events, instant feedback, and digital fan engagement.

The global market for sports technology is predicted to generate USD 40.22 billion in revenue by 2028, according to Emergent Research's sports market research (2021). The market's revenue growth is due to rising participation in sports and fitness activities and the quick adoption of IoT and artificial intelligence in sports. As a result, companies and tech start-ups are concentrating on research and development projects to create more effective technical solutions in the domains of sports technology. With the highest adoption rate of cutting-edge technology across the regional markets, Europe accounted for the most significant revenue share (Emergen Research, 2021).

Next, an analysis of the companies who developed the technology for marathon organizations mentioned above is done to understand the efforts and effectiveness of their implemented technologies. It considers the features, number of users/downloads, and feedback reported in the app store about the performance. With this, the gap between the developers and users will be identified.

TCS: Tata consultancy services

Headquarters: Bombay, India with offices in all the world.

Clients: TCS London Marathon 2022, TCS Amsterdam marathon 2020, Boston Marathon 2022, Chicago marathon 2021.

With a vast network of innovation and delivery centers, Tata Consultancy Services is a world leader in IT services, consulting, and business solutions (Tata Consultancy Services, n.d.). As part of their services, they offer sports sponsorships to drive engagement among customers and employees with cutting-edge digital technologies. They have developed mobile applications to track runners during the event day and



promote engagement among runners and spectators. From the competitor analysis table, we can observe that their apps have been widely used by spectators who reported that the apps did not work correctly on the tracking. Others mentioned that too many features in the app made it too busy to achieve their primary goal: Precise monitoring of runners to cheer. There is no specific information about their services while designing the app. All the information about app reviews and downloads is challenging to find from an official website.

RTRT.me:

Headquarters: Orlando, Florida, United States.

Clients: NN Marathon Rotterdam 2022

Real-Time Race Tracking® and other services are provided by RTRT.me for world-class running and multi-sport events. They offer a unique platform to suit the high-performance requirements of the most significant global events as their primary offering. Numerous RFID active and passive timing technologies are supported by their software, in addition to GPS tracking options. Furthermore, they redesign their system for event partners to appeal to runners and spectators of a particular event. We can observe that their app developed for the Rotterdam Marathon received very positive feedback about its functionality and tracking accuracy. This resulted in high ratings in app stores and overall runner and spectator satisfaction. For further information about specialized/custom software campaigns, organizations are invited to contact directly RTRT.me. Other LDRE uses their services and gets good reviews from users who downloaded and used their applications.



TRACX:

Clients: Enschede Marathon

A new iteration of the MYLAPS EventApp platform is called TRACX. TRACX works to provide each participant and spectator with the greatest possible event experience. TRACX is the event community for athletes that push themselves at the biggest sporting competitions worldwide. They provide an adaptable platform for cycling, running, swimming and walking events. They process personal data mainly for advertising purposes and GPS/RFID based location. Their application for the Enschede Marathon received negative feedback because of its functionality limitations and inaccurate tracking. There is no specific information about their personalization services while designing their apps. From their product overview in the appstore we can observe how their apps are duplicated in functionalities

and only adapted to the organizations' brand. This has led to user dissatisfaction from users who downloaded and used their applications.

SSC Events GmbH & A.S.O.

Clients SSC: BMW Berlin Marathon

Clients A.S.O.: SE Marathon de Paris 2021

SSC Events is one of the biggest Sport Event organizers worldwide with 20 events a year, including the BMW Berlin-Marathon and training services. Amaury Sport Organization (A.S.O) is an international sport organization Provides the service of designing, organizing, media and sales of 90 events in 30 countries per year, including the Schneider Electric Marathon de Paris (Amaury Sport Organization, 2022). Both sports organizations are specialized in organizing world-class mass sport events, not in technology development. This is reflected in the bad reviews provided by users who downloaded and used the app. In the reviews, users often mentioned the apps were not working at all or shutting down.



Tech Company	Technology services for runners and spectators (users)	Clients / Mobile Apps	Rating	Rating notes
TCS	<ul style="list-style-type: none"> - Live tracking (GPS & RFID) on with an interactive map and the runners progress and details - Spectator maps - Runners get motivational audio experience and support messages - Elite leaderboard showing updates about the elite men's, women's and wheelchair races. - Social sharing available using hashtags and marathon-themed selfie frames - Donations to charity can be done through the app - E-commerce section for sponsors and brands 	B.A.A Racing App	3.9/5	<ul style="list-style-type: none"> - Too many features makes it hard to navigate - Most features important features didn't work effectively
		TCS NYC Marathon App	3.0/5	
		The Official Virgin Money London Marathon App	2.3/5	
		The Bank of America Chicago Marathon App	2.9/5	
RTRT.me	<ul style="list-style-type: none"> - Branded timer, event, or event series Mobile Apps - Web Tracker & Leaderboard - Real-Time Scoring & Results hosting - Social Media updates and branded frames - Interactive Multi-Course Map Creator with Live Map Tracking - Team Sign-Up and Live Team Scoring - Real-Time Slot Selector 	NN Marathon Rotterdam App	4.8/5	<ul style="list-style-type: none"> - Great reviews about tracking and features performance

	<ul style="list-style-type: none"> - Real-Time Remote Racing by mixing remote Racing (GPS) & In-Person (RFID) in the same event! - Big-Screen 'Send a Cheer' Campaigns - Baggage Tracking - Real-Time Fundraising 			
TRACX	<ul style="list-style-type: none"> - Branded mobile application for event updates - Personalized digital fram for pictures of the event - Live athlete data statistics - Accessible data overview 	Enschede Marathon tracking	2.3/5	<ul style="list-style-type: none"> - Bad reviews about app functionality. - Poor personalization of the app
SCC EVENTS GmbH	<ul style="list-style-type: none"> - Outsource small technology company for app development. - Efforts mainly focused on technologies for amenities such as music and entertainment. 	BMW Berlin Marathon	1.9/5	<ul style="list-style-type: none"> - Bad reviews about app functionality and usability. - People mention the app does not work at all
Amaury Sport Organization (A.S.O)	<ul style="list-style-type: none"> - Develops app in-house - Efforts mainly focused on technologies for amenities such as music and entertainment. 	SE Marathon de Paris 2021	1.7/5	<ul style="list-style-type: none"> Bad reviews about app functionality and usability. People mention the app does not work at all

Limitations:

Feedback from the NYC Marathon app, London Marathon app, and Chicago Marathon app was retrieved from app store reviews found in the Wayback machine; most links to apps are disabled by the TCS organization right after the event. The rest of the apps can be found online for Android and iOs users. Unfortunately, it was not found further information about the Tokyo Marthonapp developer.

Conclusion:

This analysis was done to understand the competitors in the market of developing sports technologies for marathons. For this, a listing of the services and technology provided by sports I.T. companies was done: T.C.S., RTRT.me, TRACX, SCC EVENTS GmbH, and A.S.O.





- T.C.S., RTRT.me, TRACX focus on developing advanced tracking user-friendly technology using location and internet services used before, during, and after the event.
- S.S.C. & A.S.O. are sports organizations focused on organizing sports mass events. The target market of T.C.S., S.C.C., and A.S.O. is the most prominent sports organization in the world (excluding Tokyo). From the reviews, we can observe severe technical difficulties for app users, resulting in user dissatisfaction. They simply do not have the technical capability to develop an app with such high technological complexity and user needs.

- Even though T.C.S. has developed advanced tracking technology, they fail to provide a functional service in user experience and technical support.
- TRACX's strategy is to use a generic app template and provide a branding service and live-data analysis dashboard.

RTRT.me has medium/big size LDRE events as target customers. Reviews in the app store report good functionality and user experience. The company offers customized functional technological solutions tailored to their client's needs. As the Enschede Marathon is a medium-scale event with a considerable amount of runners and spectators, it could create a competitive advantage by investing in RTRT.me services for a better technology experience adapted to the Enschede Marathon needs. Rotterdam's runner and spectator user experience is a reference of a holistic technological design solution using an app and a virtual supporter experience along the track.

Customer personas - Ideal marathon organisation

As we are designing for a medium/large sports organization, a hypothetical customer persona was created to show the products/services used, event size, placement, customer benefits, and pain points. This will summarize data from the Netherlands's Elite Label Race organization events. In 2022, the World Athletics federation marked the Enschede Marathon as an Elite Label Race. Whereas the Abbot World Marathon Majors hosts up to 50K+ runners and more than 1M spectators, smaller events like the Enschede Marathon host around 11,000 runners and 80,000 spectators yearly. The outcome of this project will strive to be scalable to organizations within the Elite Label races.

Customer profile:		
Groenlo Marathon	Traits: Emotionally stable, goal-directed, responsible	
 <p>NEDAP GROENLO MARATHON 2023</p> <p>Event editions 15</p> <p>Industry: Private sport organizer</p> <p>Company size: 25-70 employees and 950-2,000 volunteers</p> <p>Strategy: Entry fees and promote local economy</p> <p>Location: Hengelo, NL</p> <p>Attendance: 15,000 runners 170,000 spectators</p>	<p>Needs</p> <ul style="list-style-type: none"> - Increase event attendance at least 5% every year. - Improve runner and spectator engagement by using technology and services. - Personalized technological solutions within the budget. <p>Pain points</p> <ul style="list-style-type: none"> - Budget not big enough to invest in complex technological solutions - Not enough capability to understand the wide variety of runner and spectator needs. - Finds the use of different tracking apps and wearables too complicated 	<p>Target market</p> <ul style="list-style-type: none"> - Local recreational runners - Targeted elite runners - Running enthusiasts <p>Categories:</p> <ul style="list-style-type: none"> - Marathon - Half-marathon - 10K & 5K - Kids run - Your marathon challenge <p>Preferred partners and sponsors:</p>   
	<p>Products / Services</p> <ul style="list-style-type: none"> - Changing room and shower facilities/toilets - Water and care stations - Pacers - Time registration - Pictures - Time measurement - Massage - Medal engraving - Music and amenities - Mobile application 	

User Analysis - The EM recreational marathon runners' profile

Running a marathon can be considered an important life event for a person, affecting one's perception about life in general and potential future achievements (Gorczyca et al., 2016). Exercise is thought to be useful for increasing general psychological well-being and is associated to a better mood (Edwards and Loprinzi, 2018). For many runners, the challenge of running a marathon allows them to put their physical and psychological abilities to the test, feeling inspired by personal awareness and self-esteem (Jordalen and Leymere, 2015).

Based on the findings from the exploratory research, we created three user personas to understand the different kinds of runner and spectators' needs, experiences, behaviours, and goals. By understanding the expectations, concerns, and motivations of the target audience, it will be possible to design a focused product that satisfy users' needs and delivering value for the organization.

The leading motivations to participate in a marathon were goal achievement, physical fitness, and influence of others, corresponding to the level of satisfaction with three universal psychological needs: **competence, autonomy, and relatedness** (Summers et al., 1982) The intrinsic motivation of runners is focused on **pleasure and satisfaction developed and achieved during the training process**, using exercise as a preparation to achieve a goal. Extrinsically motivated actions range from fundamental external needs to integrated control, like socializing and belonging (Bell and Stephenson, 2014).

Waskiewicz (2019) classified personal goal achievement as the strongest motivation for recreational runners and recognition as the weakest. Additionally, self-esteem, health, and finding purpose in life were powerful motivators for many runners, particularly women. Health motivations were divided into disease prevention and prevalence of fitness. Beginning recreational runners are often unprepared for the physical, emotional and psychological challenges of competing in a marathon. Another significant discovery was that female marathon finishers were more driven by weight concern, social factors, psychological coping, life purpose, and self-esteem than male marathon finishers, but less motivated by competitiveness.

Enschede Marathon recreational runner personas:

User 1: Henk

Traits: Emotionally stable, goal-directed, responsible



Quote

Age: **63**

Work: **Retired**

Family: **Married, 2 kids (adults) and 3 grandkids**

Location: **Hengelo, NL**

Character: **Focused**

Goals

- Train to spend time in nature and prepare for a local marathon
- Run two marathons a year
- Train to keep moving and stay healthy while socializing twice a week

Frustrations

- Physical age limitations such as pain
- Difficulties finding family during big running events
- Finds the use of different tracking apps and wearables too complicated

Motivations

Personal goal achievement

Stay healthy and avoid diseases

Feel proud about himself

Bio

Since he retired, Henk set a new life goal: Run two marathons a year. As he doesn't enjoy big cities and prefers the Twente area, he chose to run the 2022 Enschede Marathon. He prepares by training with a group twice a week and sometimes on his own. He uses strava on his mobile phone to track his pace and progress to prepare for the marathon. He prefers not to listen to music since the sound of nature is better. For the event, Henk invites his whole family to cheer him along the track, and they accompany him from the start. Henk feels prepared for this marathon; he attended some running workshops before the race and has no specific goal but finishing. However, he knows he needs to keep a pace where he feels physically comfortable.

Preferred brands:

STRAVA



DECATHLON



User 2: Marieke		Traits: Introverted, Self-sufficient, Forthright	
 <p>Quote Age: 35 Work: IT Expert Family: Dating Location: Borne, NL Character: Individual competitive</p>	<p>Goals</p> <ul style="list-style-type: none"> - Keep programmed training and follow a healthy diet to prepare for the NL marathons - Complete the Abbot World Marathon majors - Trains to keep a healthy lifestyle and achieving personal goals <p>Frustrations</p> <ul style="list-style-type: none"> - Limited vacation and traveling time to attend big marathon events - Not finding enough time to train because of working hours - Difficulties finding her friends during events because apps for spectators are not accurate 	<p>Motivation</p> <p>Physical and mental health</p> <p>Staying fit</p> <p>Affiliation</p> <p>Life meaning</p> <p>Self-esteem</p>	
	<p>Bio</p> <p>Marieke started running while studying at UT to keep a healthy lifestyle. She participated in the Berlin Marathon, loved the experience, and decided to complete the Abbot World Marathon majors one day. She likes to attend smaller events like the Enschede Marathon and train regularly by herself as part of her preparation. She uses a smartwatch linked to strava to track her progress and share it with her loved ones. She prefers to listen to music while running and uses a pair of earbuds to get full focus. For the event, she invites a couple of friends from the area to cheer her up and have a beer after the event is done. On the race day, she is nervous but happy to know she will find her friends along the track. Marieke followed personalized virtual training and has a personal pace goal to beat. She takes this goal seriously but keeps in mind to have fun and enjoy the event.</p>	<p>Preferred brands</p> 	

User Analysis - The EM spectator' profile

Bi et al. (2019) mentioned in their study that spectators identified themselves as runners' supporters. They are interested in knowing the optimal times to cheer and support runners while they struggle with tiredness or feeling stressed. Interviewed spectators were aware of the difficulties of the multi-faceted running experience and that to truly help and support their runners, they needed to be aware of their runners' specific cognitive demands and goals. Spectators start their support from the training phase, building up their involvement in the marathon events. This study treats spectators as users to enhance engagement, satisfaction, and wellbeing as they are involved from the early stages, observing their needs and efforts to support runners. While the primary incentive for running includes personal success, enjoyment, competitiveness, and a sense of belonging to the running community, participation in organized events involves both forms of motivation for the involved users (Bell and Stephenson, 2014).

Enschede Marathon spectator persona:		
User 3: Yolanda	Traits: People-centred, Enthusiastic, Empathetic	
 <p>Quote Age: 42 Work: Local municipality office Family: Married, 2 teenagers Location: Almelo, NL Character: Supporter</p>	<p>Goals</p> <ul style="list-style-type: none"> - Help her partners' training preparation to achieve personal and health goals - Involve with husbands' sport activities and enjoying the experience together - Being recognized as her husband's personal supporter <p>Frustrations</p> <ul style="list-style-type: none"> - Tension of planning for the best meeting spot during the race - Too little time and space to meet runners during the event, provoking to miss the runner - Difficulties with tracking apps precision on time and location 	<p>Motivation</p> <p>Support personal goal achievement</p> <p>Recognition</p> <p>Affiliation with runners and other spectators</p>
	<p>Bio</p> <p>Yolanda has been married for some years and loves supporting her husband's healthy lifestyle. She goes to every marathon event with her husband to support him since she knows the difficulties of the 42 KM and his personal goals. As her kids are teenagers now, she has time to contribute to her husband's enthusiasm about events and enjoys being a part of the preparation. Her husband will participate in the</p>	<p>Preferred brands</p>  <p>LINDA.</p>

Enschede Marathon for the first time after corona, a popular regional event. She knows how much effort and time he has invested in this, so she prepares everything necessary and uses a mobile app to track her husband's progress. On the race day, she follows the course track to find the right spot to cheer on her husband and enjoy the event's ambiance. When she sees he is close to finishing, she returns to the city center to wait for him. As she has been involved in his whole process, she feels a lot of emotions when she sees him crossing the finish line and celebrating together after the race. She loves to see her husband achieve his personal goals and be part of it.





INTERVIEWS

Method

A semi-structured interviewing method was chosen for conducting the study, which allows for asking open-ended questions and gathering in-depth information about people's experiences, as well as the freedom to explore emerging topics of interest during the interview (Adams, 2015). The research questions formulated for this study are:

Objective: Understanding the shared experiences of runners and spectators during the Enschede Marathon
What makes the EM track enjoyable? What does not?
What technologies do runners use or do not during an LDRE?
What cognitive strategies did the runner use throughout the race?
What emotions did you experience through the race?
What was the effect of encountering spectators?

Table 3. Interview research questions

The interview as a methodological procedure can be seen as a descriptive rather than prescriptive method. The participant was not given any predefined information, but rather the interviewee indicates the essential topics for conversation within the frame of the interview protocol.

Experience mapping

The experience mapping session aimed to gather varied perspectives about the EM track experience. This was done to illustrate the runner's processes, needs, and perceptions as they take steps to achieve their goals and satisfy their needs. This helps understand how participants solve their problems without an organization's solution. This is for punctually identifying and locating opportunities in this study's future solution to smooth out and solve painful experiences.

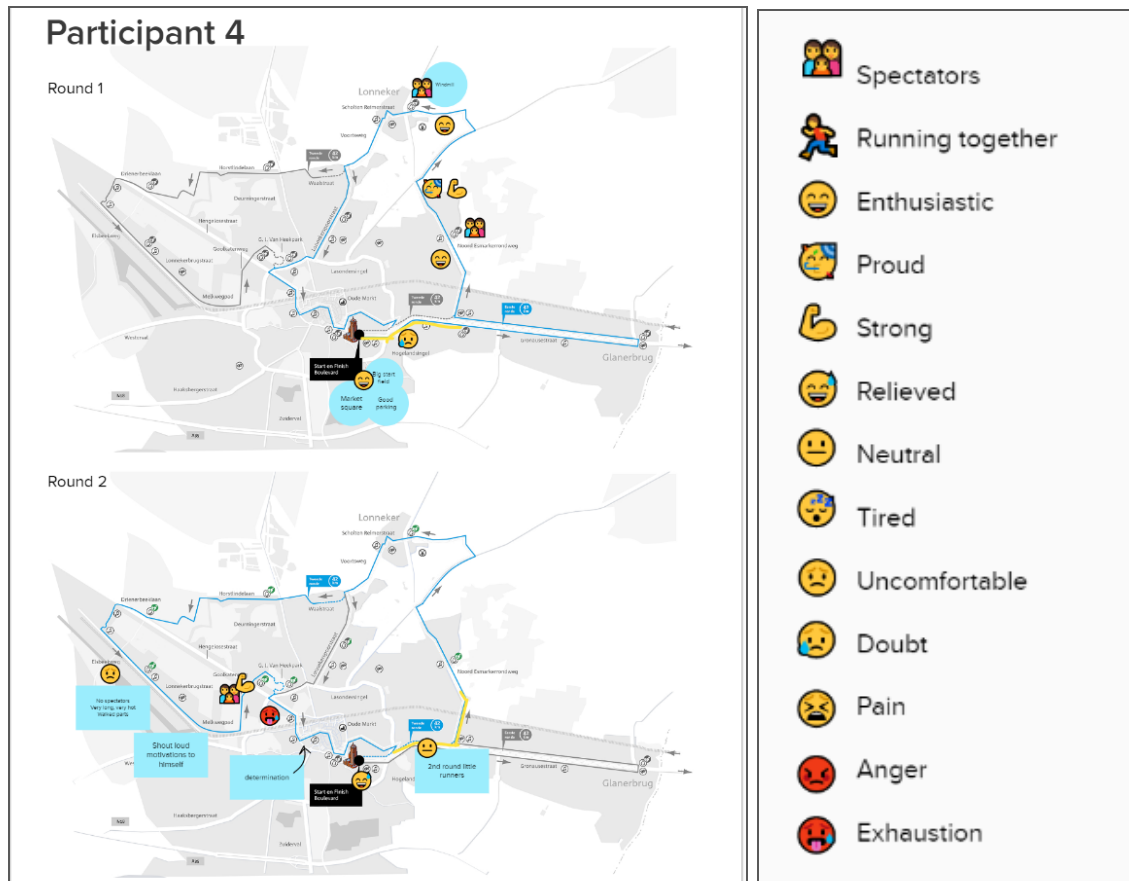


Figure 6. Interview research questions

For safety reasons, this method was adopted for holding online, giving limited possibilities for interaction compared to a one-to-one live session. To understand the specific physical and mental challenges of the Enschede marathon, it is essential to build upon the personal interpretation of the participants' marathon experience from the first-person perspective.

Therefore, the interview was introduced and a set of initial questions placed the participants on the map. The questions during the interview were focused on exploring the "feeling" and "strategies" runners experienced during the EM. To support their memories, we suggested placing on the map a predefined set of emotions. The presented maps were adapted to the distance information (full or half-marathon) given by the participants when they signed up for the study. These were a mix of physical, cognitive, emotional, and social emotions related to the literature about the running experience.

The goal of experience mapping is to locate and interpret the EM running experience and its context. These exploratory sessions aim to provoke insights into important functional and emotional issues about the LDRE.

Participants

Through their digital communication platforms, which included a monthly newsletter, website, and social media outlets, the Enschede Marathon organization aided us in recruiting participants.

To participate in the study, recruited participants must have completed the full or half-marathon within the last five-year editions of the Enschede Marathon. As the event participants must be at least 18 years of age, therefore, all participants were adults. Interested runners could sign up using a Google Form collecting their name, email address, EM edition where they participated, distance, and type of participation (group or individual).

Ethics

Suitable participants were reached via email and invited to share their experiences through an online interview. An information brochure and informed consent form were sent and asked to be signed.

The Natural Sciences and Engineering Sciences Ethics committee reviewed this study and based on the submitted material has formulated positive advice. The request has been registered under reference number 2012.116 at the University of Twente.

Procedure

Each procedure consists of an interviewer, observer, and participant. The interviewer leads the conversation following the protocol and assists the participant through the mapping process. The session was organized for a maximum of 30 minutes, including an introductory presentation on the interview goal and practical activities.

First, basic questions were covered to understand your running efforts. This includes running habits, focused on their running experience during the EM event. After the introductory conversation, the observer shared their screen to display the EM track and the set of possible running-related emotions.

The interviewer proceeded to ask the participant to place their emotions as they went through the questions related to the map. The map served as a memory aid while the observer took notes and placed the emotions on the map. Participants were encouraged to suggest changes and add annotations. The discussion followed relevant questions following the protocol:

- What do you remember most vividly when thinking back on the marathon as a whole?
- What do you have on your mind every time you are about to start a race?
- How do you keep your rhythm?
- Where did you feel you lost your rhythm?
- What was the most difficult part of the marathon?
 - How did you get past this?

- Which part of the race did you enjoy the most? Why?
- Did you invite your relatives or friends to meet you at a certain point of the race? Where?
 - How was it to see them during the run?
 - What role do spectators play at the marathon for you?
- What was the most boring part of the track?
- If you have been to other races, what technology used there really impressed you?

By the end of the session, participants were invited to make additional remarks about the marathon experience. The gathered data was processed and categorized into themes according to their content. This was done to group segments of relatable data based on patterned responses across participants. This resulted in the themes that set a clear problem statement to start the ideation process. The resulting themes are further discussed in the next section.

Data collection

Interviews were conducted online using MS Teams and Mural, a real-time collaborative whiteboard. Each meeting was recorded and data saved on a personal computer to be deleted after the project. Audio files were transcribed online using MS Word transcriber automatic speech-to-text software, resulting in raw text, which was checked against audio recordings and manually edited to reduce transcription errors and improve clarity.



THEMATIC ANALYSIS

A thematic analysis (Braun & Clarke, 2006) was applied to analyze the interview's qualitative data. After the information was transcribed, it was examined to identify common themes based on patterns. It followed a six-step process: familiarization, coding, theme generation, review, definition, and further description.

Interactions with friends and family

During the marathon, most participants invited friends and family to cheer them on. Friends and family members of the runners would navigate through the track to cheer their runners. Prior to the marathon, they would set up a meeting spot along the track; it was mentioned by one of the interviewed runners that the meeting spot would be in a difficult part of the track. After meeting the runners, friends, and family would go to the finish line to wait for their runners to finish. Many participants were born or studied in the area, therefore it was easier for friends and family to come to the event. Runners mentioned they have also interacted during other marathon events through technology such as social media and tracking chips for location and sensor activation. At the same time, runners expressed their frustrations when they could not interact nor find their family and friends along the track as well as at the finish line area.

Effect of stranger spectators along the track

Interviewed runners found the presence of spectators along the track encouraging and energizing. They mentioned that spectators contributed to the atmosphere of the event. Being cheered was motivating and helped them when they are going through physical and mental challenges. One of them mentioned, "I did enjoy other people I did not know cheering me on". The spectator's presence helped runners overcome fatigue and recover a sense of rhythm.

Cognitive strategies during the event

Interviewed runners mentioned the discomfort of *hitting the wall* while running in the EM event. "Being physically and well mentally trained to know you can also walk through [...] everything is going to hurt, and you have to shift your focus to other things, not on those sore legs". Finding distractions with other runners or the environment was used as a regular activity to distract from the physical distress. Runners mentioned that they tried to look physically better when they encountered their family and friends.

Location of spectators

Runners mapped the biggest presence of spectators at the Van Heekplein (finish and start location), around the city center, and Lonneker (an adjacent small town along the track). Participants mentioned that spectators created a positive atmosphere in Lonneker. Due to the town's narrow streets, spectators could stand closer to the passing runners, making the track feel busy and accompanied. After passing Lonneker, runners noticed a lack of spectators, especially at KM35. One of them mentioned: "At a certain point you go up the KM35 and then it gets quieter and quieter, and you're on your own. Then you notice that the crowd has an effect."

After passing the fietssnelweg (KM35-38) and approaching the city center, runners noticed the number of spectators increase. While crossing the city and approaching the finish line, local businesses and visitors join to cheer the runners passing by. Once runners crossed the finish line, they reported having trouble navigating the marathon area to find their family and friends.

Track improvements

Interviewed runners found the track confusing as it makes a loop bringing them back to the start/finish line area at the same time as half-marathon runners: "The loop was demotivating because I just thought 'oh, we are almost there', but then suddenly we had to add another Kilometer because we went back and forth."

Participants mentioned that there were difficult parts of the track related to the lack of spectators and environmental conditions. The complaints were mainly focused on the KM35, about how boring and difficult it was because of the weather conditions and the infrastructure of the area. As spectators are waiting for runners to finish the last kilometers of the race, this part of the track is reported to be alone and very difficult to go through. This is also the point where interviewers reported losing their rhythm and hitting the wall. One of the runners suggested: "Perhaps it is nice to encourage the participants here extra, for example with encouragement signs, digital, personal encouragement linked to the start number or chip where supporters can submit them in advance. There may also be countdown signs with: only 5 km to the great finish, or extra music."

Runners reported enjoying the music points provided by the EM and how this supported some of them to find their rhythm. Waterpoints had no additional remarks but suggestions to have a clock showing the current time and pace: "What would be useful for a runner is to have somewhere in the last part clearly the time or clearly a sign of, for example, 2 km to the finish. And 2 km to the finish is not the 40-kilometer point, but just a little after. And that there is also a time clock. With the time you are on the road or the time you are on the road"

Discussion: Rebrief

The research objective of understanding the shared experiences of runners and spectators during the Enschede Marathon led to a set of directions and punctual opportunity areas to improve the engagement of the marathon event experience. The customer journey map suggested that the intervention had to be somewhere between 30 and 40 KM of the track. From the interviews this was narrowed down and the 'Fietssnelweg' (35KM) point was identified as the most crucial point for an intervention, which identified the 35KM. This answers an important part of the main research question and allows a rebrief of the problem statement, specifying the challenge of this study further.

New RQ: How to improve the KM35 track experience with interactions mediated by technology?

Old RQ: How should we design an engaging technological marathon track experience for runners and spectators?

Table 4. Rebrief

In the next section, an exploration of the existing marathon sport technologies is done to gain insight about the available platforms and tools that could be used to develop marathon technology. An analysis of the European competitors will list the companies who focus on developing sport technology products, allowing us to identify the gaps in the market. Additionally, a customer analysis will result in finding different marathon organizations where the developed technology could be applied. Finally, a detailed description of the user's profiles of recreational runners will identify opportunities to fill needs. This will result in design requirements, listing the functional attributes that will enable the designer to convert ideas into design features. By matching the design requirements with the result of the thematic analysis, a set of ideas will be explored in the ideation phase, bringing us closer to develop a new sport experience.

Design requirements

The objective of this section is to transform concepts into design features enabled by the functional characteristics known as design requirements. The experience technology development began by researching the literature about the Enschede Marathon sports experience and related literature. From the market analysis, we obtained a deeper understanding of the technological and cognitive needs of marathon organizers, runners, and spectators.

List of design requirements for conceptualization:

- The technological experience should be a short intervention → Runners have limited time for encounters as they cannot stop to interact
- The technological experience should enhance external dissociation on runners with social interaction with spectators to feel support and a positive emotional impact

- The technological experience should enhance external dissociation without losing rhythm
- The technological experience should involve the organization's user-friendly mobile app connected to the internet with tracking functionality and event information for runners and spectators
- The technological experience should limit the complexity of interaction by simplifying the interface
- The technological experience should use effective tracking using RFID or GPS technology to alert spectators about the place and time to cheer runners
- The technological experience should use affordable technical support to maintain the app working during the event
- The technological experience should display information about the time and position of the runners
- The technological experience should allow digital interactions between runners and spectators during the distance
- The technological experience should be scalable for medium size events interested in increasing engagement
- The technological experience should be unique to fulfill the needs of runners within the marathon context

These design requirements provide the necessary features to answer part of the new RQ: *How to improve the KM35 track experience with interactions mediated by technology?* This will allow sports users and organizations to resolve issues with minimal difficulty and with available technology. In the next section, the ideation phase will explore a combination of the design requirements with the results from the literature review.



PHASE III

DEVELOP



IDEATION & PROTOTYPING

Design goal and vision

Design requirements and themes were created based on the literature insights and further interview input. Aided through informal brainstorming sessions with the information gathered, this section aims to conceptualize various technological experiences that fit the broad direction of mediating social interactions between runners and spectators, aligned with this thesis goal. The approach was to categorize the theme exploration results by assigning them to the 4 Components of running: Physical, emotional, cognitive, and social. To go as wide as possible, the exploration focused on connecting these topics to narrow the scope to a more targeted direction. To break up the space and create engaging concepts that use these questions as a foundation, the ideas were supported by addressing a range of "how could we" questions.

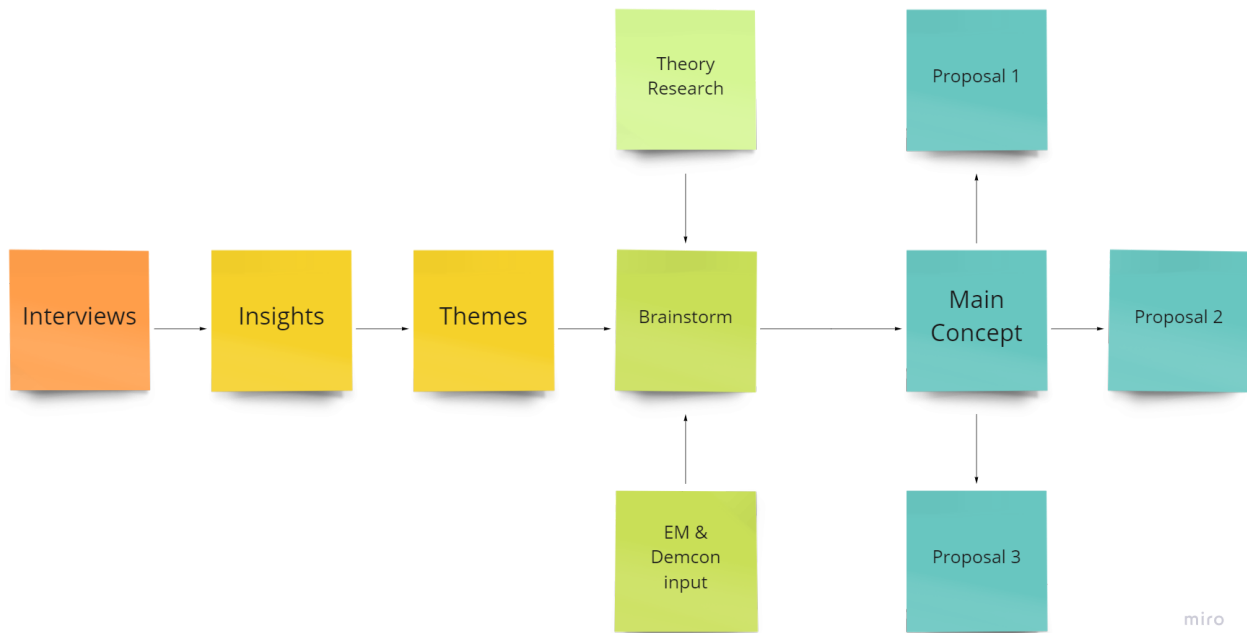


Figure 7. Brainstorming process

Design cycle 1:

The ideation phase strives to answer the new research question:

- *How to improve the KM35 track experience with interactions mediated by technology?*
 - *What would be the tools R&S would use to connect?*
 - *How would they express themselves in a short space of time?*
 - *How can the EM help runners while engaging spectators?*

From the outcomes of the previous research, I have concluded that sports technologies for runners and spectators have one ultimate goal: to have social interaction for support while accurately tracking the runner during the event's totality. Therefore, three 'how could we' questions were generated to explore solutions to these particular issues:

- How could we shape the other components through social interactions?
- How could we connect the other components to enhance social interactions?
- What available technology could aid the generated ideas?

By focusing on these particular questions, the brainstorming will explore the possible interactions that R&S are experiencing in their one-of-a-kind encounters. A final concept will be proposed and further developed through three initial proposals and evaluations. This resulted in the map presented in figure 8:

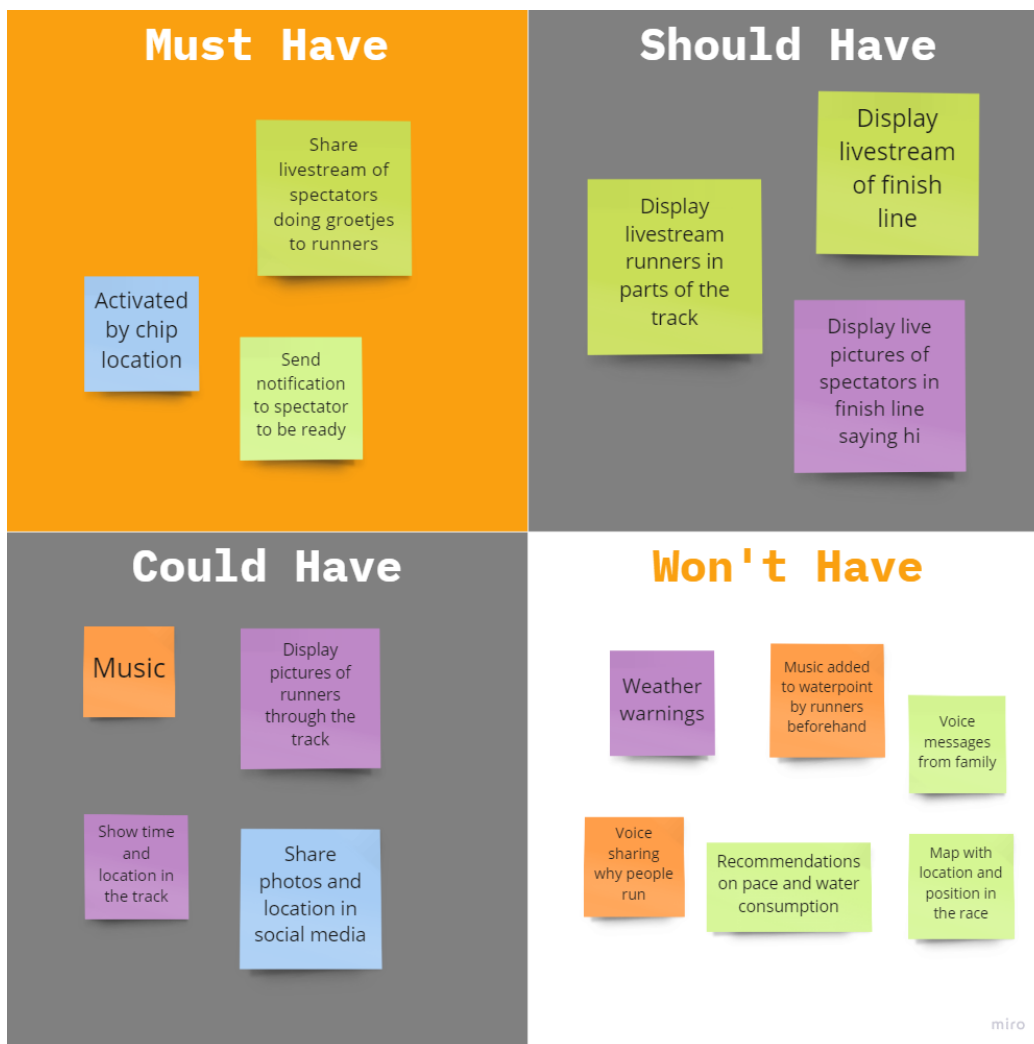


Figure 8. Brainstorming based on 4C's results

Conceptualization:

By categorizing the produced ideas using the MoSCoW analytics tool, we were able to prioritize product features and prevent featuritis (having too many features) (Schicker, 2020). This design method uses a four-quadrant chart, with each quadrant representing different feature kinds in descending order of importance, clockwise.

- **Must-Have Features (Enhance real-time social interactions):** These features are essential for the experience to function. They are required and specify how the product works.
- **Should-Have Features (Enhance social interaction):** Features that, although not essential, are sufficiently substantial to motivate runners through social incentive.
- **Could-Have Features (Shapes other components):** These desirable features don't have much of an interactive component on the functioning or design of the experience as a whole.
- **Won't-Have Features (Do not enhance social interaction):** These features aren't important, aren't really feasible with the EM infraestructure, and don't really affect how well the product does.



Design cycle 2:

With these insights, a main concept was developed and explored through three different proposals, going into detail about the technical requirements. The guidelines for developing these concepts were:

- Enhance interactions in real-time
- Runners and spectators and runners connect from a distance through the KM35
- Runners can see messages/videos from spectators and motivate them to keep going.
- Spectators can see the runner's reaction while waiting at the finish line.

Concept 1: Sending the 'groetjes'

Spectators can send their greetings and best wishes beforehand to the runners going through this part of the road (with their ID), it can be about 5 seconds long, and it will activate when the runner comes close to the screen. Input can be done from spectators who couldn't be present during the race.

On the other hand, the reaction of runners can be seen through a live stream. This way, they also know the runners are about to finish. Music will be included in these points. Additional information such as time, location/race position, and weather warnings could be included. Health recommendations and water consumption reminders from the organization can be displayed.

Required technology:

Actions needed	Technological needs	EM tech possibilities	Possible solutions
Videos sent beforehand by spectators	Safe cloud platform	No	- Hire services by technology company
	Identification of runners	Yes	
Individual tracking information	RFID location	Yes	
Livestream of this part of the track	Camera connected to internet	No	- Hire services by screen providers
	Streaming platform	No	- Use OBS studio - Use free streaming platforms from social media
Screens at the track and finish line	Outdoor LED screen	Yes / No	- Need to hire more screens
	Internet connection	No	- Use 5G connection through mobile chip
Activation with	RFID sensor updating the	Yes	

tracking	app		
	Push notification	No	- Ask for this feature to the app developer company

Concept 2: Photo Challenge

People can take pictures during the event and upload them to a platform using #runner or #spectator. By using the runner's ID, the pictures will be activated on the screens when the runner comes close to the screen. This could also be done by an internal photographer and managed by a team to be available to display.

These pictures will be displayed:

- For runners: Pictures of spectators displayed along the 3 km of the fietssnelweg.
- For spectators: Photos of runners during the event on the screens in the city center.

Required technology:

Actions needed	Technological needs	EM tech possibilities	Possible solutions
On-site input of photos of runners by spectators	Safe cloud platform connected to social media	No	- Hire services by technology company
	Identification of runners image	No	
Individual tracking information	RFID location	Yes	
Screens at the track and finish line	Outdoor LED screen	Yes / No	- Need to hire more screens
	Internet connection	No	- Use 5G connection through mobile chip
Activation with tracking	RFID sensor updating the app	Yes	
	Push notification	No	- Ask for this feature to the app developer company

Concept 3: Finish Livestream

A live stream of the finish line where runners can see the different spectators waiting for them to finish. On the other side, spectators will be able to see their runners and know when to look with a push notification when the runner comes closer.

The live stream will be displayed:

- For runners: Along the 3 km of the fietssnelweg
- For spectators: On the screens in the city center

Required technology:

Actions needed	Technological needs	EM tech possibilities	Possible solutions
Individual tracking information	RFID location	Yes	
Screens at the track and finish line	Outdoor LED screen	Yes / No	- Need to hire more screens
	Internet connection	No	- Use 5G connection through mobile chip
Activation with tracking	RFID sensor updating the app	Yes	
	Push notification	No	- Ask for this feature to the app developer company
Livestream of this part of the track	Camera connected to internet	No	- Hire services by screen providers
	Streaming platform	No	- Use OBS studio - Use free streaming platforms from social media

FINAL CONCEPT

Problem statement:

Recreational runners who participated in past editions of the EM described the 35 km of the EM track as boring, lacking spectators, and very hard to go through. This place is the fietssnelweg of Enschede, part of the last 7 km of the track. The conducted interviews results showed this is where runners are reported to be already physically and mentally overwhelmed, finding it especially difficult to go through without any external motivation.

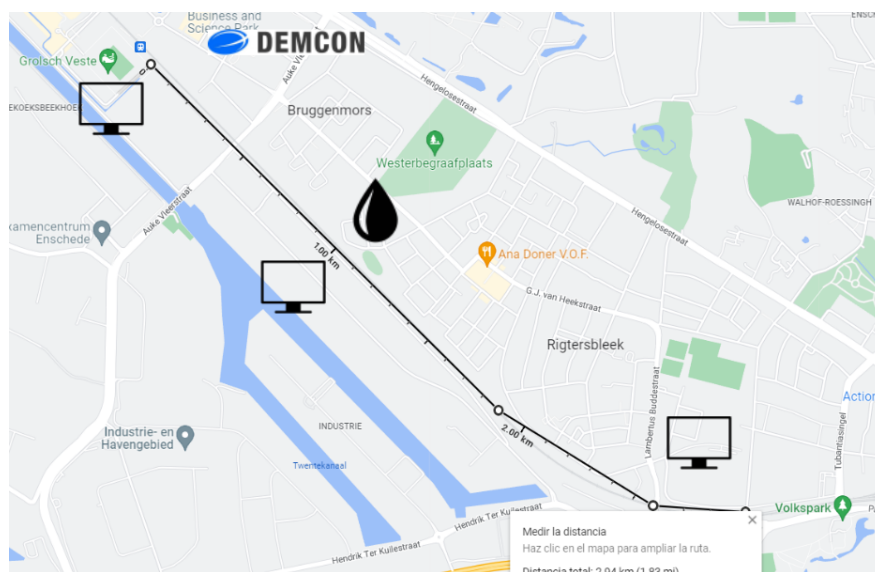
Solution: Virtual Spectators experience

By using real-time interactive technology, Virtual Spectators aim to create a sense of social interaction and a positive emotional impact on the runners. In addition, this concept seeks to provide external motivation to overcome the difficulties of the track and help the runners recover their rhythm in the last part of the race.

On the other hand, spectators will be encouraged to greet their runners through a notification inviting them to participate through the Greeting Booth. This is done to personalize the experience and create a sense of connection between the participants and spectators.

Where?

The Fietssnelweg in Enschede consists of three km bikeways that start at a train station and end in a park close to the city center. The VS screens are planned to be distributed between the 3 km. One at the track section's start, middle, and end, as the runners continue with the last couple kilometers of the race.



How?

Runners will activate with their tracking chip a notification for spectators subscribed to the

app, letting them know that they reached KM 35 and inviting them to send them greetings through the greeting booth in the city center.

Screen	Streaming content	Related work	Thematic analysis
1	Once they reach the first screen, they can see their loved ones sending greetings and waiting for them close to the finish line.	-Using technology to personally connect R&S -Use external dissociation to pull a runner's focus outward.	-Lack of spectators at km35 -The presence of non-related spectators also has a positive impact on runners
2	On the second screen, they can see a live stream of the finish line's cheery atmosphere.	-Visualizing a strong finish -Sense of being part of the running social world	-The party environment motivates runners
3	On the third screen, runners get a final view of the greeting booth and reach the park.	- Social interaction can help avoid hitting the wall	-A second chance to create a personal connection

Table 5. Screen content related to research

During this, spectators can see their runners passing and greeting back from the greeting booth, creating a digital interaction between them. In the booth, people can bring their banners and go as cheery as they want.




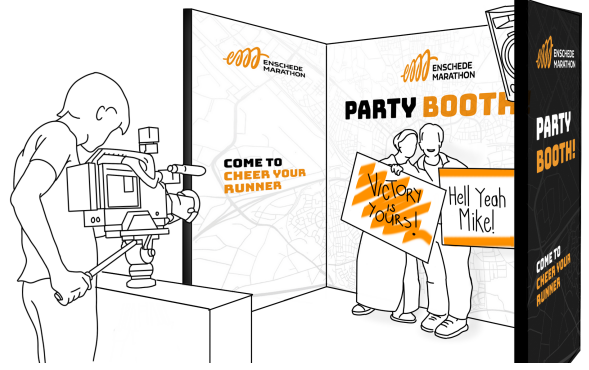
When?

During the Enschede marathon, when runners reach the KM 35 at the beginning of the fietssnelweg, the Virtual Spectator experience begins.

While spectators are waiting in the city center for their runners, they get invited to participate as Virtual Spectators.

Storyboard

The intention of this storyboard was to show how the VS experience might be integrated as an EM service, to enhance the experience of runners and spectators. The purpose was to use this as an 'envisioning' asset around which presentations with critical stakeholders could be conducted. This supported understanding of the idea and technological requirements for the prototype implementation.

For runners	For spectators
	
<p>1. Runner reaches KM35 and his chip sends a notification to their loved ones</p>	<p>1. Spectator gets notification with invitation to join the greeting booth.</p>
<p>When a runner reaches the KM35, their personal chip will push a notification to their loved ones who are tracking him through the Close App.</p>	<p>The notification will be inviting them to come and cheer at the greeting booth.</p>
	
<p>2. Runner reaches the first screen</p>	<p>2. Spectators go to the greeting booth.</p>
<p>Runner reaches the first screen and greets back its loved ones, feeling motivated to continue</p>	<p>Spectators arrive at the greeting booth and cheer for their runners. They observe them greeting back.</p>

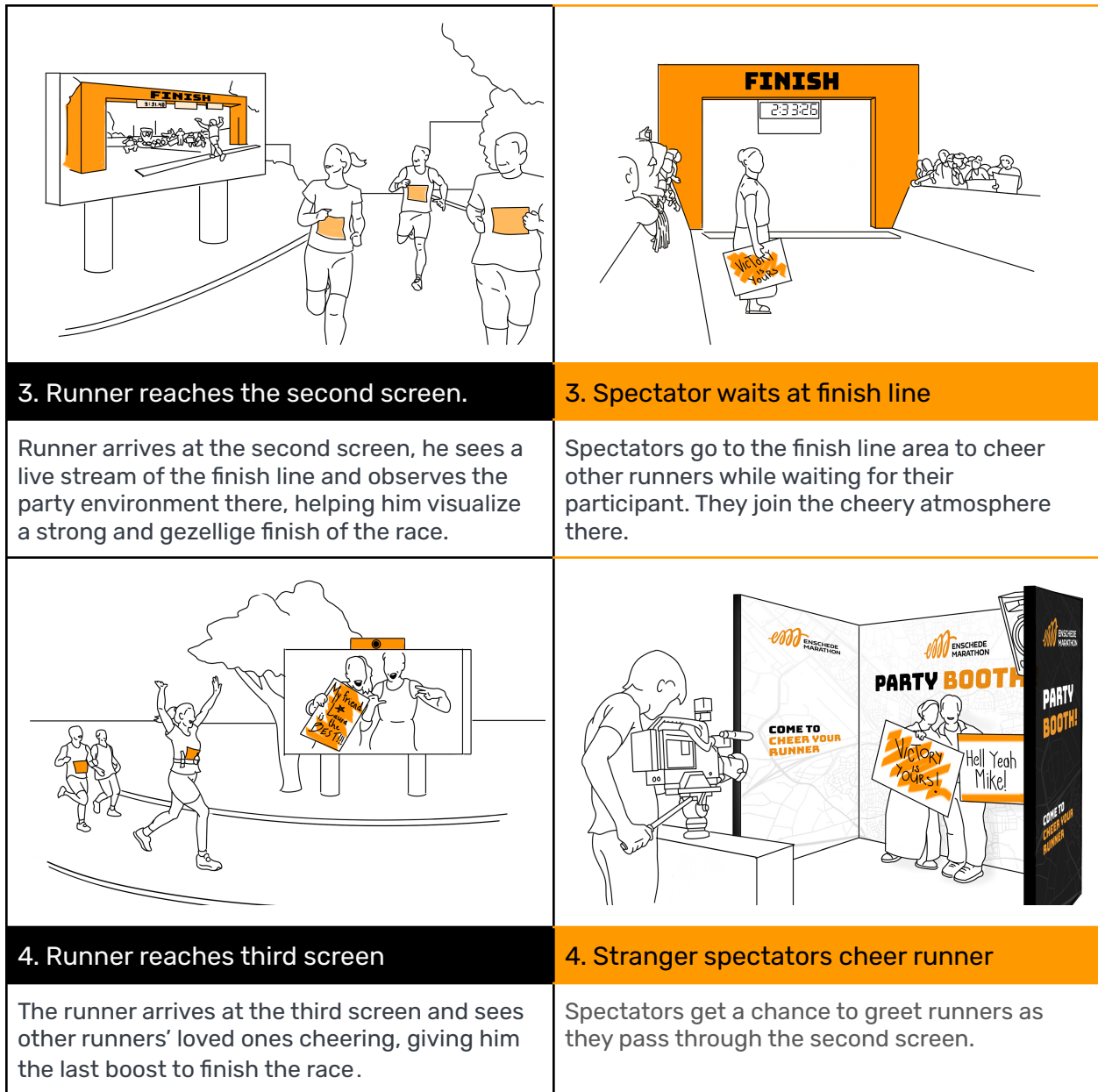


Figure 11. Storyboard

After the experience is done, the runner continues with the last 4 KM of the track. Finally, they meet at the finish line after finishing the race.



PHASE IV

DELIVER



TESTING

This study aims to discover how to improve the KM35 track experience with technology-mediated interactions. For this, the Virtual Spectator concept was developed and adapted to assess the impact of social interaction, considering the EM organization and researcher's possibilities to obtain the minimum viable product. For this, the list of design requirements vs. the final concept solution gets assessed for the testing implementation.

Requirement	Final concept solution	Possible for testing
Short intervention	- Runner receives the cheer while passing the zone, just like in real life	Yes
	- Several opportunities to see screens	No
External dissociation	- Use of big screens for visuals	Yes
	- Sound of cheering motivates	Yes
	- Enhance social interaction	Yes
Rythm	- Screens placed along the track	Yes
	- Doesn't create an obstacle	Yes
	- May motivate runners to retrieve energy	Yes
Notification	- Activates when runner passes KM35 and enters fietssnelweg	No
	- This information is supposed to be available live on the app	No
Simple interface	- Spectators get a notification and only have to appear on time in front of the camera	Yes
	- No need from both sides to physically interact with the devices	Yes
RFID tracking	- Uses RFID sensors on the ground to activate notification when runner passes	No
Time and position of runners	- Use application to track time when crossing the RFID sensor	No
Interactions on the distance	- Runners and spectators can interact through the screens	Yes
Scalability	- Concept can be tested in other medium-size LDRE	Yes

The prototype could not be implemented in this year's EM edition because of logistical complications. Instead, the prototype was technically adjusted and placed during the biggest estafeta race in Europe: the 50th edition of the Batavierenrace. This LDRE event started on Friday evening, April 29, 2022. The route runs from the center of Nijmegen, via Germany, the Achterhoek, the Oude Markt in the heart of Enschede to the campus of the University of Twente.

Theoretical and practical research lead to the premise that real-time interactive sports technology along the track where there is a lack of spectators could have a positive physical, cognitive and emotional impact, helping the runners go through the last part of the track.


Hypothesis

Real-time social interactions mediated by technology could have a positive impact on runners' physical, cognitive and emotional components

Table 6. Hypothesis

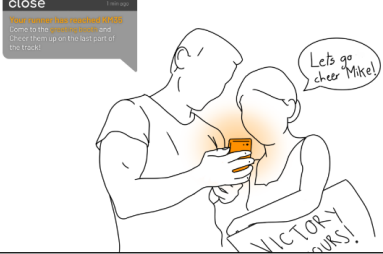
The storyboard was adjusted and synthesized to only use one screen for prototyping purposes. The synthesis shown in figure 12 portrays the prototype storyboard, where the greeting booth placed at the finish line would show personal support from the spectators and the live event atmosphere at the finish line. This concept was presented to runners, the EM, and the Batavierenrace organization. It had a positive response from these parties and decided to go for the implementation of the concept.

FOR RUNNERS




Runner reaches KM35 and his chip sends a notification to their loved ones

FOR SPECTATORS



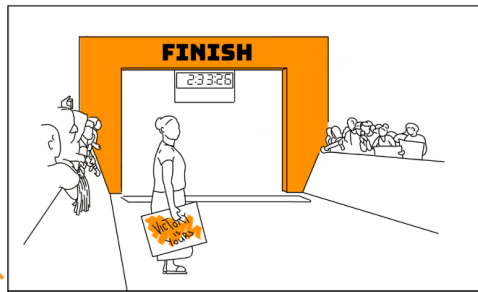
Spectator gets notification with invitation to join the greeting booth.



Runner reaches first screen and greets back its loved ones, feeling motivated to continue



Spectators arrives to greeting booth and cheers their runners. They observe them greeting back.



Spectator and runner meets in the finish line and celebrate with the atmosphere

Figure 12. Prototype storyboard

Batavierenrace

The total walking distance is more than 175 kilometers and is divided into 25 stages (16 men's and 9 women's stages). About 8,500 athletes participate each year, all students. The route of the Batavierenrace consists of 25 locations, which are more than 175 km long. These 25 stages are divided into the night, morning, and afternoon blocks. The first 9 stages form the night block that runs from Nijmegen to Uft. In Uft, a restart follows, after which the subsequent 8 runners run towards Barchem in the morning. After this, the last block runs towards the Oude Markt in Enschede, where the previous restart takes place for the final two stages.

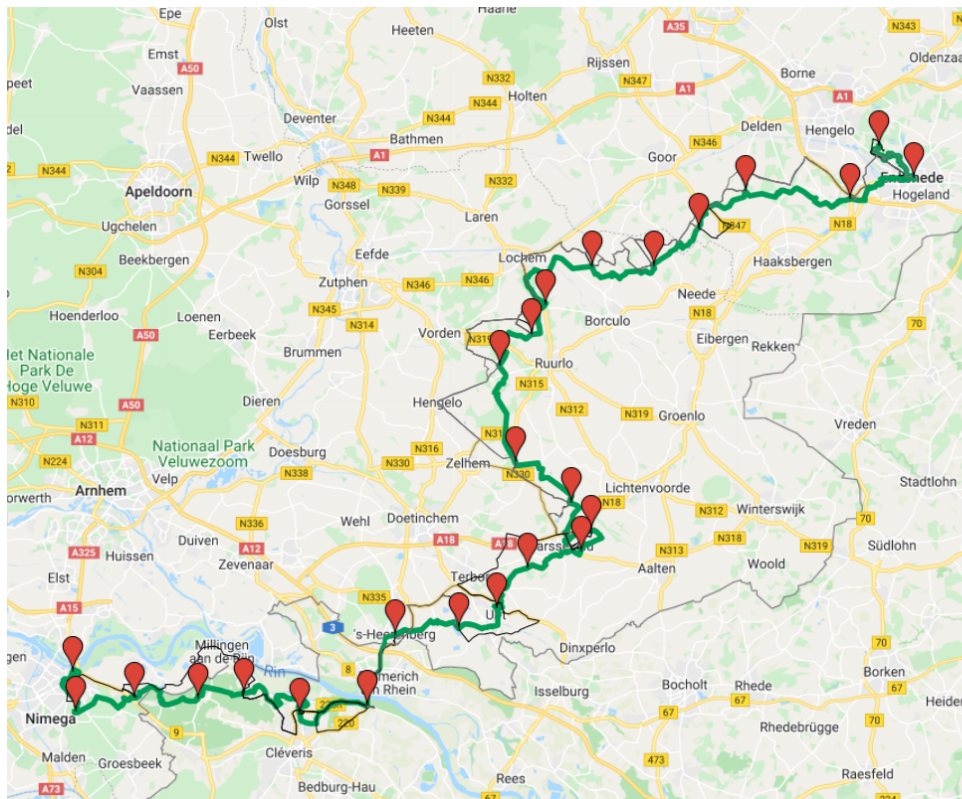


Figure 13. Batavierenrace route retrieved from [Bata map route](#)

Testing location

The space to test the VS concept given by the Bata organization was in Barchem, where teams gather to switch from the morning to the afternoon shift. The race organization mentioned that the runners usually are fatigued and sleepless at the end of the morning shift. Since the tracking and activation system of the runner's location is unavailable, the testing focuses on showing the finish line (planned as the runners' screen), which is proven to help the runners visualize a strong race end. Therefore, the spectator screen was placed next to the finish line where teams could come by to cheer runners passing through the runner's point.

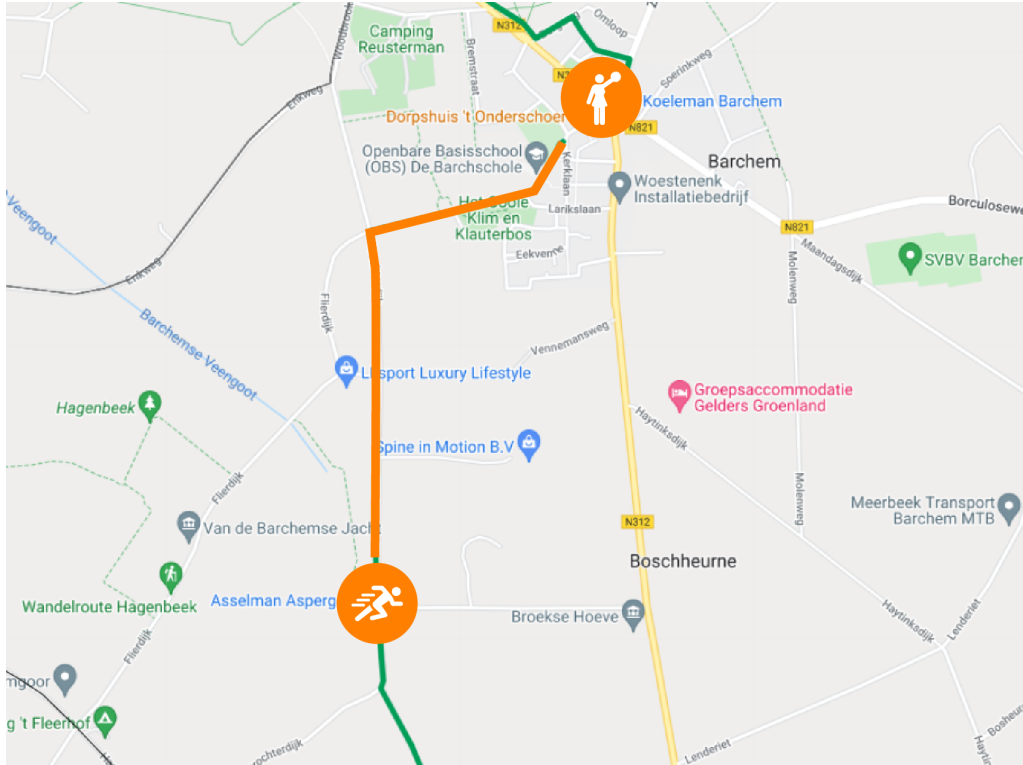


Figure 14. Runner and spectators point for testing.

The runner's point was located along the route, 1.5 km before the Barchem finish line. For this, a local white asparagus farm along the track provided the electrical power and space to do the installation. The intervention was planned to start from 9:00 am, approximately when the first group of runners would come by and end at 12:45, when the last group left the area.

Materials used

Physical technological materials were provided by the BMS lab at the University of Twente to make the installation possible. At each location a laptop was present with the necessary software which individually ran the same live stream application and the atmosphere sound. The equipment was managed by the researcher and a student who volunteered to help. The internet connection was provided by two smartphones with a 4G Wi-Fi hotspot. The final list of materials used was:

- TV screens: Located along with the track and finish line
- TV Stands
- Party tents to protect the screens
- Wireless internet connection (4G)
- Power supply
- Web cameras
- OBS video streaming system (Open source software)
- Discord video call platform
- Chairs

- Tables
- HDMI Cables

Procedure

First, the participants (spectators) are invited to cheer their team in front of the screen placed at the finish line. At the same time, the researcher could observe the reaction of runners passing and interact with the screen. Afterward, for quantitative feedback, a short questionnaire was presented to get the participants' individual opinions. This questionnaire was intended to let the participants (runners & spectators) describe their experience and find out what specific aspects of the Virtual Spectator experience enhanced the relatedness and enhanced a positive experience.

Two different surveys were designed for the two participants since each had a different experience with the prototype. Starting with an open question, spectators were asked if they recognized one of their team's runners on the screen and who they interacted with while waiting at the finish line. For runners, the participants were asked if they felt recognized and if they joined the VS experience after they crossed the line. As a final step, both participants were asked to rate how connected, encouraged, motivated, and identified felt with the experience.

Spectators' screen

The event area of Barchem is marked in figure 15. from the finish to the start location. Here the morning shift can meet their afternoon team. Runners finishing have been running throughout the morning and reaching the afternoon team to continue with the next part of the track. In Barchem all necessary facilities for runners and spectators were provided. Figure 15 illustrates the event area and different services of the site, and the placing of the Virtual Spectators.

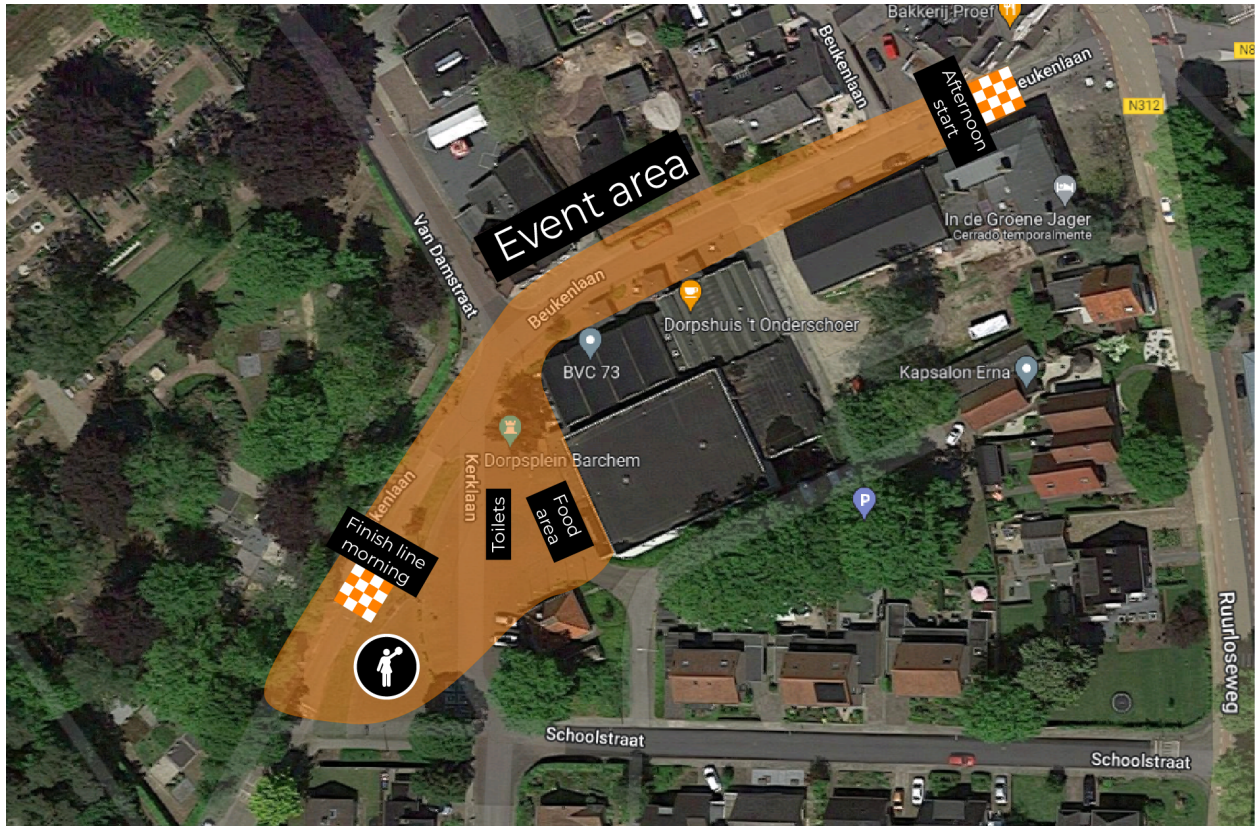


Figure 15. Mapping of the services and spectator screen location

The spectator's screen was placed in a parking lot next to the finish line, where most of the spectators were waiting for runners to come by. A 55 on the screen displayed the runners passing by the runner screen, placed 1.5 km before the finish line. It was equipped with a high-quality webcam capturing the personal greetings and ambiance at the finish line.

As the nature of the event was by stages, once the runners crossed the finish line, spectators moved from the finish line area to meet the runners and continue with the afternoon start. In the event area, runners and spectators could meet, rest, get food, and use the restroom. Afterward, new teams (spectators) came by the finish line area to wait for the subsequent stage runners.



Figure 16. Spectators real-time view to the track

Spectators were invited by the researcher to cheer for their team or other runners as they were waiting for them to finish. I explained the concept, and afterward, participants were asked to complete a survey about the overall experience after participating in the VS experience. The image overlapped the text ‘Say hello to your runner’, the project title, and the involved organizations’ logos. In the background, spectators could observe the real-time activity of runners passing by the part of the track.



Spectators in the finish line area waiting for runners



Spectators screen set up



Spectators participating in the VS cheering their team's runner



Spectators participating in the VS cheering other runners

Table 7. Spectator screen installation and interactions

Runners' screen

The runner's screen installation is marked in figure X. along the race track, 1.5 km before the finish line, next to an asparagus farm. Runners passing there are going through the last distance of the morning shift. They reported being fatigued and sleepless while running this part of the track. The area is mainly surrounded by farms and can be boring for some runners, according to the Batavierenrace organization.

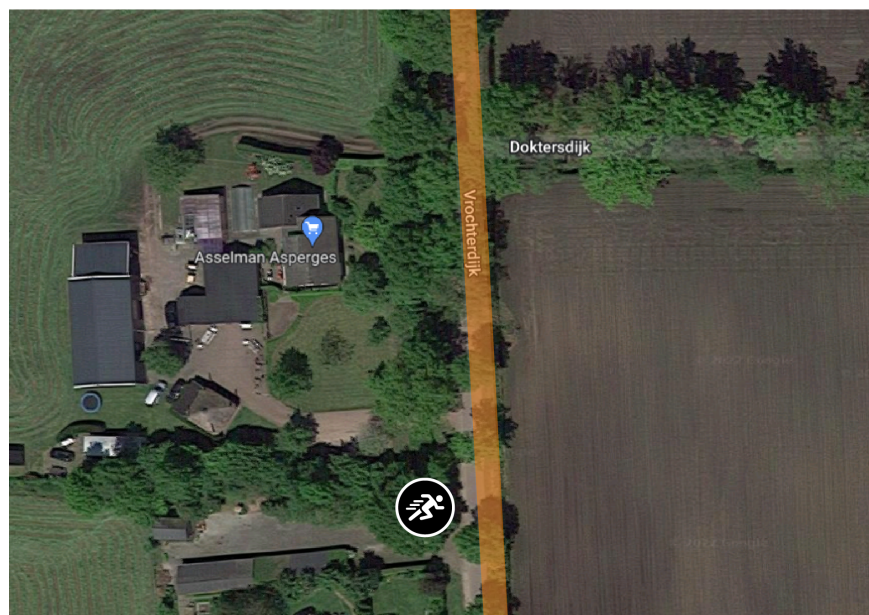


Figure 17. Runners screen location

A 55 on the screen displayed the lively atmosphere at the finish line and personal cheering from spectators. In addition, it was equipped with a high-quality webcam capturing the

activity of runners passing by. The first runner came by 10:15 am and the last at 12:30 pm. Runners were accompanied by a team member riding a bike, carrying water, music, or whatever the running participant needed.

	
<p>Runners screen set up</p>	<p>Track view</p>
	
<p>Runners screen testing</p>	

Table 8. Runners screen installation and interactions

Runners passed next to the screen as they reached the finish line. After they crossed, they were asked to fill out a survey about their experience. The image displayed an overlay with the text 'Say hello to the finish line' and additional information. In the background, runners could observe real-time cheers from spectators waiting at the finish line.



Figure 18. Runners real-time view to the finish line

Participants

A total of 46 participants (27 runners & 19 spectators) took part in the study. They were 18 years of age or older. As the nature of the LDRE (estafeta race) differs from a marathon, their participation and running needs also differ. For this, the differences between their emotional, physical, cognitive, and social needs are described:

DyPECS components	EM recreational runners needs (Single participation)	Batavieren recreational runner needs (Mornign team participation)
Emotional	<ul style="list-style-type: none"> Complex emotions such as anxiety before events Exhilaration after successfully completing the race are part of the emotional experience. Emotional traits related to performance and create complex relationships between them depending on enjoyment levels. 	<ul style="list-style-type: none"> Positive attitude generated by team support Does not care about performance, it is about having fun
Physical	<ul style="list-style-type: none"> Levels of fatigue and exertion are experienced through body senses. Hitting the wall Sensations expressed based on the perception of the external environment such as the sensation between feet and ground, weather, sound, and olfactory sensations. 	<ul style="list-style-type: none"> Fatigue because of staying awake all night Fatigue generated for poor preparation prior the event Alcohol consumption before and after running is common among participants Shorter distance participation
	<ul style="list-style-type: none"> Strategies and coping mechanisms used by runners to respond to their 	<ul style="list-style-type: none"> Strategies and coping mechanisms supported by the team's cyclist.

Cognitive	body signals. <ul style="list-style-type: none"> Two common cognitive strategies used by runners in LDRE are association and dissociation. 	<ul style="list-style-type: none"> Positive ambience created by organization and other spectators at finish line As the track is across the country, there is no music or water points along the track, enhancing internal dissociation/association.
Social	<ul style="list-style-type: none"> Engagement and interactions with spectators to cope with the rest of the components. Interactions with other runners along the track Use of tracking technology to share the experience. 	<ul style="list-style-type: none"> Connecting with other runners along the track. Connecting with cyclist. Special connection with their team and people they know from university. Use of tracking apps to share experience.

With this, we can conclude that while marathon runners have higher emotional distress, Batavieren racers are less prepared for the running experience, resulting in a certain level of fatigue. At the same time, the context of the Batavierenrace is different as they do not provide amenities along the track, such as music and waterpoints. This increases the possibility for internal association/dissociation, enhancing fatigue levels. In the social aspect, the Batavierenrace only expects spectators at the finish line. To support runners, a cyclist from the same team needs to give the runner company, food, and water, creating a connection between the runner-cyclist while spectators wait at the finish line. This study considers these differences to measure the level of relatedness of the experience.

Discussion

Observations were made during the duration of the event, explained in the next section. In general, the screens available for the installation were not the right kind, as they were not suitable for outdoor use. The ratio of the screen layout was not sufficient and created visibility issues. This was not an impediment to the spectators as they came close to the camera to cheer. For runners, this complicated the visibility of the cheering spectators. The background noise of the event and real-time cheering sounds had an impact on both sides of the VS experience. Spectators tried to have conversations with runners they could see on the screen. Furthermore, the mobile 4G internet connection was stable and sufficient through the mobile phones, allowing runners and spectators to interact with a minimum video and sound delay.



QUALITATIVE RESULTS

In order to answer the second research question, the observations gathered by the researcher are further explained about how the prototype shaped the motivational components of runners and spectators. The technical needs and behavioural reactions of runners and spectators are described below:

Spectators' screen

The placing was off since most spectators were not facing the installation as they waited next to the finish line. Despite this, curious spectators came by to ask about the installation and expressed their thoughts about it. Others were invited by the researcher as they passed by.

Spectators were highly enthusiastic about interacting with runners, as they screamed motivational quotes and cheers through the screen. Some teams were tracking runners through WhatsApp and came by the screen once they were close. On the screen, they waited for their team's runner to pass and cheered for them and to other runners. They could identify their runner by their clothing and participant number. The total amount of time spent in front of the screen reached a maximum of 5 minutes. When spectators recognized their team's runner, they made funny motivational gestures and sounds, so runners could listen clearly. When they couldn't recognize them, they cheered other teams' runners in a lower intensity, and some teams came back to check if their runner was already there. Spectators mentioned this gave them a sense of their position in the race.

Runners' screen

As mentioned above, the TV screens used for the prototype were not suitable for outdoor use. This complicated the visibility for most runners, as well as the limited ratio of the screen layout. On the other hand, most runners showed curiosity as they were approaching the installation, and interacted with it when they knew they were on camera or heard the spectators' voices. The volunteer student quickly told them the finish line was on the other side of the screen and to 'say hi to the finish line. Runners were interacting with the screen while running by screaming back to the finish line, cheering, raising their hands, and increasing their speed as they approached the screen. The sound of spectators made it easier for the runners to identify what the installation was about. Runners who were walking increased their pace or started running again when they identified the cheering sounds or even their name. Additionally, runners were happy to hear they were on the last kilometer and a half of the race,

To be identified, runners were wearing a blue vest with their participation number provided by the organization. They were accompanied by a person on a bicycle to support them with motivation, water, or food goods. The cyclist was wearing a red vest with the same number

to identify them as the support person of the team.



Figure 19. Runner and cyclist wearing different identifiable vests. Retrieved from [here](#)



QUANTITATIVE RESULTS

Method

A descriptive research method was chosen for conducting the VS experiential evaluation, which provides a way to verify and quantify the findings of exploratory studies (Nargundkar, 2008). The material gathered in descriptive research is preplanned and arranged to be statistically inferred from the participants (runners and spectators).

The major goal of this form of study is to better define a group of people's opinions, attitudes, or behavior on the VS experience. For this, a typical multiple-choice question was created and filled out by runners and spectators. It is classified as a descriptive study since the responder must pick from established categories. These questions obtained statistically inferable data by classifying the replies into specified categories. This enables the researcher to assess the impact of your findings on the larger population you're researching, as well as the evolution of your respondents' ideas, attitudes, and behaviors over time(Nargundkar, 2008).

The survey was designed to encompass both runner and spectators' perspectives. For this, two surveys were created with Google forms with the objectives:

Objective:
Evaluating the impact of the VS on the runners and spectators' social relatedness

Table 9. Survey objective

Procedure

At the spectators' screen location, participants were invited by the researcher to participate in the VS experience and fill out the survey on paper. Because of the nature of the event, participants did not have easy access to their mobile phones or time to fill out an online survey. Therefore, physical copies seemed like a better option to capture the participants' attention. Spectators could fill out the survey right after participating in the VS experience. The researcher approached runners who just finished the last stage of the race. Most of the runners were visibly tired but willing to participate in the study.

The introductory text of the survey included information about the purpose of the study, confidentiality, expected completion time (about one minute), and included the contact information from the researcher. In order to participate in the study, each participant provided their consent before filling the initial survey's answers. As a result, two questionnaires were created to understand the different perspectives of the experience:

Survey questions:

For runners	For spectators
The Virtual Spectators screen was placed one	Did you recognize a runner on the screen?

kilometer before the Barchem switch point. It was livestreaming the ambience at the finish line. Did you see this screen along the track?	
Did you see your team / friends / people you know on the screen?	When I was waiting at the finish line I had direct contact with:
Do you know if your friends / team saw you?	
Did you see/cheer other runners on the finish line screen once you were done?	

Table 10. Survey questions

In order to scale respondent's attitudes and opinions, a likert scale was used to measure the spectators and runners social relatedness. As it is measuring a unidimensional construct, a 5-point scale was incorporated as: *Totally disagree, Somehow disagree, Neutral, Agree, Totally agree*. Related questions were retrieved from previously validated surveys measuring the belonging, social interactions, presence and support in a sport related context. Selected questions focused on social interaction between athletes and spectators and measured social relatedness by gauging either a sense of belongingness or sense of connection.

Likert scale statements:	
For runners	For spectators
Please indicate to what extent you agree with the following statements while arriving at the screen along the track "I had the feeling that it made me feel... "	Please indicate to what extent you agree with the following statements while waiting and interacting with the screen at the finish line "I had the feeling that it made me feel... "
Connected with spectators	Connected with runners
Encouraged by spectators	Connected to other spectators (other teams)
Connected to fellow runners	Was part of a larger group
Helped me visualize a strong finish	Could be myself
Like greeting back to the finish line	Felt compassion for the runners
Representing my team	Willing to cheer runner
I was proud to be a part of this	I was proud to be a part of this
	My cheering helped runners

Table 11. Survey likert scale

At the end of the survey, participants were thanked for their participation by the researcher. After the event, surveys were filled out by the researcher to process the given answers.

Participants

The Batavierenrace organization provided an overview of the teams and start times to recruit participants who were participating in this part of the race. To participate in the study, recruited runner participants must have completed the last part of the morning shift or wait at the finish line area as spectators. As the event participants must be at least 18 years of age, therefore, all participants were adults. Interested runners and spectators could participate by filling out the physical survey, only collecting their team name and overall experience. The introductory text of the survey included information about the purpose of the study, confidentiality, expected completion time (about one minute), and included the contact information from the researcher.

Ethics

Suitable participants were reached in person to share their experiences through a physical survey. An information brochure and informed consent form were sent and asked to be signed.

The Natural Sciences and Engineering Sciences Ethics committee reviewed this study and based on the submitted material has formulated positive advice. The request has been registered under reference number 2012.116 at the University of Twente.

Results

A total of 27 runners and 19 spectators completed the survey, resulting in 46 evaluations of the VS experience. Respondents were divided into two groups based on whether they identified someone through the screen or not. Their likert scale responses (with 1 - totally disagree and 5 - totally agree) were analyzed using an independent samples t-Test with IBM SPSS Statistics software, yielding comparable means for perceived connectedness for both groups.

According to Pimentel (2010), the five-point Likert scale can be considered an interval scale. Therefore, the mean is a significant indicator for the analysis. If we want to revert the found means back into a Likert scoring using the interval scale, we get that a mean value between 1 and 1.8 means strongly disagree; From 1.81 to 2.60, it means disagree; from 2.61 to 3.40, it means neutral; from 3.41 to 4.20, it means agree; from 4.21 to 5, it means strongly agree. The Likert statements scores were averaged for the group of runners and spectators separately and reverted to this interval scale to test the effect of the VS intervention. The results of this are given below. **To test whether recognizing somebody on the screen significantly affected the experience for the runner or spectator, an independent variable t-test was performed.**

Runners' Survey - General results

The results of the runner's likert survey are summarized in table 12. **These are the average scores for each question for all the runners who saw the screen while running.** The results shown that runners felt connected to and encouraged by the spectators, whereas

the same statements were neutrally perceived concerning other runners. Most participants agreed with the statement that the VS prototype helped them visualize a strong finish and made them greet back to the spectators on the screen. In the sense of belonging, runners agreed to feel they were representing a team they were part of. Finally, runners strongly agreed to be proud to participate in the event.

Likert survey experience results

	N	Minimum	Maximum	Mean	Std. Dev.	Mean value
<i>Connection with spectators</i>	27	2	5	3.70	.724	Agree
<i>Connected to fellow runners</i>	27	1	5	2.70	.823	Neutral
<i>Encouraged by spectators</i>	27	3	5	3.85	.602	Agree
<i>Encouraged by other runners</i>	27	1	4	2.96	.980	Neutral
<i>Helped me visualize a strong finish</i>	27	2	5	3.70	.724	Agree
<i>Greet back to the finish line</i>	27	2	5	3.85	.770	Agree
<i>Representing my team</i>	27	2	5	3.78	.974	Agree
<i>I belonged</i>	27	2	5	3.89	.801	Agree
<i>I was proud to be a part of this</i>	27	2	5	4.22	.847	Strongly agree
<i>Valid N (listwise)</i>	27					

Table 12. Average scores for each runner likert scale questions.

Runners' Survey - Effect of recognition

Another area of interest is whether it matters if the runners/spectators recognized anybody on the screen. For runners, we compared the mean value of their connection and encouragement experience related to whether they recognized the people on the screen or not. This is to show if there is an increase or decrease in the experience in relation to recognition. In the case of the runners, there was no increase nor decrease in the experience related to recognition. This means that, for runners, it did not matter if they could recognize the person on the screen, they still felt supported and encouraged by spectators.

Did you recognize spectators on the screen?

	<i>Answer</i>	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>	<i>T-Value</i>	<i>2 sided p</i>
Connection with spectators	Yes	9	3.89	.782	.261	.901	.282
	No	18	3.61	.698	.164		
Encouraged by spectators	Yes	9	3.89	.601	.200	.224	.825
	No	18	3.83	.618	.146		

Table 14. Perceived feeling of connection and encouragement depending on whether spectators were recognized

Spectators' Survey

The results of the runner's likert survey are summarized in table 13. **These are the average scores for spectators who participated in the experience and interacted with the screen.** Spectators strongly agreed about feeling connected with runners and like they helped them by cheering. They were neutral about feeling connected to other spectators and being part of the event. Spectators also agreed they felt they could be themselves during the VS experience and belong to a larger group.

Likert survey experience results

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Mean value</i>
Connected with runners	19	3	5	4.21	.631	Strongly agree

<i>Connected to other spectators (other teams)</i>	19	2	5	3.53	1.020	Agree
<i>Felt compassion for the runners</i>	19	3	5	4.37	.597	Strongly agree
<i>Was part of a larger group</i>	19	2	5	3.68	.946	Agree
<i>Could be myself</i>	19	3	5	3.89	.737	Agree
<i>I was proud to be a part of this</i>	19	2	5	3.47	.772	Agree
<i>Willing to cheer runner</i>	19	3	5	4.16	.834	Agree
<i>My cheering helped runners</i>	19	3	5	4.37	.761	Strongly agree
<i>Valid N (listwise)</i>	19					

Table 13. Average scores for each spectator likert scale questions.

Spectators' Survey - Effect of recognition

The same comparison was made for spectators about connectedness and support. Again, this was connected to whether they recognized a runner on the screen or not. In the spectators' case, who reported a very positive experience through the screen, there was no significant difference in the experience related to recognition. Runners agreed that watching and listening to spectators through the screen made them feel connected and encouraged, independently of whether they recognized the spectators or not. Similarly, it was not relevant for spectators to know the runner on the screen to feel connected and willing to motivate runners.

The results of the analyses might be biased by the positive atmosphere of the event. In addition, runners participating in the Batavierenrace event ran a shorter distance than a marathon runner and had less training and running experience. Therefore, further research must be done in an Enschede Marathon event to measure a deeper understanding of the Virtual Spectators' experience.

Did you recognize a runner on the screen?

	Answer	N	Mea n	Std. Deviat ion	Std. Error Mean	T-Value	2 sided p
<i>Connected with runners</i>	Yes	11	4.27	.647	.195	.494	.628
	No	8	4.13	.641	.227		
<i>Felt compassion for the runners</i>	Yes	11	4.45	.522	.157	.692	.502
	No	8	4.25	.707	.250		
<i>My cheering helped runners</i>	Yes	11	4.45	.688	.207	.544	.596
	No	8	4.25	.886	.313		
<i>Willing to cheer runner</i>	Yes	11	4.18	.751	.226	.136	.894
	No	8	4.13	.991	.350		

Table 15. Perceived feeling of connection and support depending on whether runners were recognized

Conclusions

The total samples for this study were 27 runners and 19 spectators. User survey results revealed data on the impact of the Virtual Spectators' experience. In addition, they provided quantitative and qualitative data on the perceptions of runners and spectators' connectedness, sense of belonging, and support during the race. In this section, the results are discussed, and conclusions are drawn to determine the effects of the VS experience.

To determine whether a significant difference in the population means exists, the researcher could do a 2-sample test. The resulting tables show no difference in the mean values for the two groups. The survey results show that runners and spectators mostly do not care whether they recognize or not the person on the screen to have a positive social interaction. Further research should be conducted to understand the impact of recognition on recreational runners during the EM event.

Limitations

The validation of the final concept was, among other things, limited by having a different set-up than the Enschede Marathon, available technology, resources, and time. Therefore,

the test relies on the screens' visual and auditory capabilities; participants might have had insufficient visibility of the screen input to assess the concepts thoroughly. The diversity of testable participants, whose feedback and responses might not be representable for the amateur marathon runners.

Participants are now (drunk) students running a small distance (just 3.6 km) in a group, which may be very different from older adults running 42km by themselves. In addition, Batavierenrace runners from the morning shift have been running throughout the morning, some doing multiple stages and others only a single one. As a result, these runners' motivation differs from that of a marathon runner, focusing more on leisure and less on performance. Also, the participants' moment of exhaustion differs from hitting the wall.

While providing a representation of the envisioned experience, the added background real-time event sound from the finish line ambiance and spectators' support also influenced the purely visual assessment. As a result, it might have altered the participant's evaluation of the presented visuals. Besides, minimal visibility of the interaction prototypes might have reduced the accuracy of the evaluation.

Lastly, no further indication of the project's context and its link to social relatedness were given for this testing. As accommodating the final design, this context knowledge might influence the participant's perception of the experience. Furthermore, because this survey was conducted during the Batavierenrace event day, the overall results of the analyses might be biased by the positive atmosphere.



PHASE V

REFLECT



PROJECT CONCLUSION

While the conclusive parts of the previous chapter discussed the insights and recommendations for the final design of the Virtual Spectators experience, this section will give a summary of the project and its outcomes. The knowledge contributions towards the field of SX design are discussed, and opportunities for future work are given.

5.1 Project Summary & Outcome

The goal of this graduation project is to provide an engaging technological marathon track experience for runners and spectators. This project is about creating meaningful experiences, adding to what a marathon experience could be, challenging what it is with technology, and providing alternatives to help marathon runners and spectators have an improved Enschede Marathon event experience. Ultimately, this study can be seen as an exploration of sport technology design directions proposed by previous work transformed into a practical application.

The popularity of long-distance running events has increased recently, attracting more recreational runners who struggle with the physical and mental challenge of running 42 KM. As a result of the research conducted for this project, it is possible to state that there are opportunities to support recreational runners in their struggles by enhancing social interactions with spectators. However, runners and spectators differ in needs, values, and concerns during the LDRE. Despite this, the marathon event organizers must understand and address both perspectives.

The initial step to understand the customer journey of recreational runners was the mapping of the experience based on the Enschede Marathon services and available blogs about running a marathon. With a market study of the European marathon market, we could address the gap found in the services provided by the EM, identifying weaknesses of the internal and external organizational and technological barriers within the final concept must be placed. As a result, we conclude that an intervention such as the Virtual Spectators must be placed in a medium-sized marathon event. The main reason the intervention cannot be in a larger marathon event is that the massive amount of R&S would make it extremely hard to give enough space and opportunity for Spectators to cheer, creating logistical trouble for the organizers and increasing discontent among the participants. On the other hand, organizations might not have enough resources to implement the intervention for smaller events.

Additionally, a set of semi-structured interviews with runners from past EM editions allowed us to pinpoint the opportunity areas to improve engagement. As a result of those conversations, it was concluded that an intervention in KM35 is needed since runners reported this part of the track to be extremely hard and lacking in social interactions with spectators.

Understanding how technology can mediate social interactions in the current EM context was essential for designing the technological intervention. Feasible concepts to shape new interactions during the event were designed from a sports service experience perspective. These interactions are focused on enhancing the sense of belonging, connectedness, and perceived support, according to Knaving et al. (2015)

The proposed solution of the Virtual Spectators came from a brainstorming session about how technology can be applied to achieve these goals. This is a Livestream connecting the city center to the 35KM point of the track, where runners and spectators can interact through technology while running. Spectators will be notified that runners are coming close to the finish and invite to come and cheer from the city center greeting booth. There, they can meet runners through the screen and have a personal connection with their family and friends and support them in real-time. Runners will see their family and friends cheering on the first screen. For the second screen, runners would observe the finish line's live atmosphere, helping them visualize a strong finish. And on the third screen, runners will have a second chance to meet their family or other spectators as they reach the last 2 KM of the race.

In the final stage of this study, the VS experience was tested during the Batavierenrace. Two screens were placed in Barchem during the event, one at the finish line (Spectators screen) and another 1.5KM before (Runners' screen) along the track. Through the screens, spectators could see runners cheering and the finish line in the background.

A survey was conducted to examine how the real-time cheering impacted the runners' motivation. It was found that the VS experience positively affected the perceived sense of belonging, connectedness, and support. It was also investigated whether it matters if the runners have a personal connection to the spectators. Still, the results showed no significant relationship between having a personal connection and feeling connected to and encouraged by spectators. However, the test set of this research has a limited representation of how it would be in a marathon context.

What takes to design a new technological experience for a sports event is to understand the complex relationship between sports user-context-organization. It is about being empathetic with each of their specific needs and the nature of the sport. By being in their shoes and understanding the different journeys, the designer can appreciate the perspective of all the involved parties. The project's value is not what it achieves but how it makes people feel, especially if it is part of such a special moment for R&S by helping and encouraging runners to achieve their goals and making their loved ones part of the experience. This project does not offer a specific set of guidelines to design but just an example of how to create a meaningful experience for a sports event by applying literature in a real-life context.



ANSWERS TO RESEARCH QUESTIONS

5.1.1 How to shape the motivational components through a long-distance running event experience?

The long-distance running event theme exploration and customer journey map resulted in understanding the dynamic experience of running a marathon for recreational runners. Preventing amateur runners from *'hitting the wall'* can be achieved by triggering external dissociation. Social interactions have been found to have the highest impact on the motivational components and are the most effective in distracting runners from their physical pain. Therefore, in order to shape the motivational components, marathon organizers should enhance social encounters to improve the runners' experience throughout the 42KM race.

5.1.2 How can service design engage runners and spectators through technology?

In the second theme exploration the currently applied technologies in SX design were analyzed. Apps, tracking, and social media solutions are providing real-time interactions between sports users and context. Service design can take these SX technologies and integrate them into a service, which targets the users specific needs. Sport organizations can use service design techniques to identify the part of the track where runners are in the most need of an intervention. Organizations should combine these technologies here to mediate a real-time interaction between runner and spectator to enhance the engagement with the event.

5.1.3 How should we design an engaging technological marathon track experience for runners and spectators?

To make an engaging technological experience, the organization needs a deep understanding of the runners's sport user experience, how it evolves during the event, and how it is shaped by the current context. From this understanding opportunity areas in the context can be identified. With the information on the runners' specific needs and context capabilities, organizations can find what kind of intervention is needed and what available technology can provide this in order to design the possible solution. The effect of the intervention on the user experience should be tested and evaluated during the event. This results in information on how to improve the intervention and therefore, the engagement of runners and spectators with the event according to their goals.

5.1.4 Scalability

To implement and achieve the goal of the proposed concept, it must be placed in a medium-sized LDRE. If the event is too big, screens are insufficient to support every runner's personal interaction. This limits the relative spectator-runner interactions, leading to frustration among participants. For smaller events, the technical requirements (e.g., requiring an app, real-time tracking, etc.) might stress the budget too much, putting the

other aspects of the LDRE at risk. There is also the risk that as the event gets smaller, there are not enough participants and spectators present to create an immersive experience, leading to frustration, especially among the participants. By taking the EM as a reference, the Virtual Spectator concept should be implemented in an event with a minimum of 10,000 runners and 90.000 spectators. As a maximum, the event should host 20,000 runners and 100,000 spectators. Still, the specific user-context-organization needs to be analyzed for the particular event.



IMPLEMENTATION INSTRUCTIONS

Project background:

Recreational runners who participated in past editions of the EM described the 35 km of the EM track as boring, lacking spectators, and very hard to go through. This place is the fietssnelweg of Enschede, part of the last 7 km of the track. The conducted interviews results showed this is where runners are reported to be already physically and mentally overwhelmed, finding it especially difficult to go through without any external motivation.

Solution:

By using real-time interactive technology, Virtual Spectators aim to create a sense of social interaction and a positive emotional impact on the runners. This concept aims to provide external motivation to overcome the difficulties of the track and help the runners recover their rhythm in the last part of the race.

On the other hand, spectators will be encouraged to greet their runners through a notification inviting them to participate through the Greeting Booth. This is done to personalize the experience and create a sense of connection between the participants and spectators.

Objectives:

- Help recreational runners overcome this difficult part of the track with social interactions.
- Avoid the lack of spectators in the area.
- Improve engagement of runners and spectators participating in the event.

Benefits:

- Decrease the number of runners hitting the wall
- Engage spectators while they are waiting at the finish line area
- Position the Enschede Marathon as a sport organization interested in improving their experience with the use of science and technology for recreational runners.

Phases:

- ***Before the event:***
 - Inform participants of the VS experience and explain how it works.
 - Give spectators advice on what technology to use to track runners in order to participate in the VS experience.
 - Prepare the logistical implications to have the experience ready when the first marathon runner reaches KM35.

- Make an accessible greeting area in the finish line so spectators feel comfortable to cheer.
- Contact providers of the required equipment for the installation (Further explanation below).
- Train personnel to handle the equipment and software needed for the installation
- **During the event:**
 - Supervise internet connection between the devices.
 - Invite spectators to participate in the VS experience as they wait in the finish line area.
 - Observe the initial behavior and reactions of the participants.
- **After the event:**
 - Evaluate the experience from the runners and spectators experience separately
 - Find opportunity areas, setting new objectives to improve the service.
 - What could be improved?
 - What was something different than what we expected?
 - Prepare to improve the next version of the prototype for the next event.

Required equipment:

For building a functional prototype for the next EM event, these are the recommended equipment to use. These can be hired through local companies who provide a complete delivery and pick-up service. The LED screens, cameras, video encoder, and powerplants are part of the services that a scherm verhuur company could provide.

For track

Quantity	Product	Placement
3	Outdoor LED screen 3x5 meters	<ol style="list-style-type: none"> 1. Start of the fietssnelweg 2. Middle of the fietssnelweg 3. End of the fietssnelweg
3	Power plants	Next to each screen
2	Webcams	TBD - best view of the runners, not too far
3	Internet connection	Next to each screen
3	Computers with streaming platform	Next to each screen Keep it plugged to the power source for better performance and avoid interruptions
1	Party Tent	Covering the person and equipment

		controlling the screen from environmental changes (e.g., rain, heat, etc.)
1	Fence protection for screen	Avoid spectators being too close to the installation

For finish line

Quantity	Product	Placement
1	Outdoor LED screen 1.5 x 2.5	In the greeting booth so people can see the runners while they are cheering
1	Power plants	Next to the screen
2	Webcams	<ol style="list-style-type: none"> 1. TBD - best view of the spectators from close 2. TBD - best view of the finish line from distance
1	Mobile phone with internet / usb with sim card	Next to the computer to keep a stable connection
1	Computer with streaming platform	Next to the screen
1	Greeting booth background	TBD - Somewhere in the van Heekplein where most spectators gather
1	Party Tent	Covering the person and equipment controlling the screen from environmental changes (e.g., rain, heat, etc.)

Risks

To avoid accidents during the event, the design recommends to take these safety measures. The materials for this could be arranged through a current partnership, since it is already used in other parts of the track and finish line.

Spectator's proximity - Fences

One of the biggest risks from installing the screens along the track is the proximity of spectators to them. Observations by the designer showed that during the EM 2022 edition there was a considerable amount of people supporting the runners in the area.



As observed in the pictures, spectators stand on the left side of the track, in front of the houses from the area. Therefore, the installation of the screens along the track should be on the right side, next to the train tracks. It is advised to protect the area of the screen with fences to avoid spectators to come closer and hurt themselves or the screens.

Environmental conditions - Tent

To protect the personnel from extreme environmental conditions (e.g. rain, heat, hail, etc.) we recommend to hire a party tent, placed above the technical installation. There, the person supervising the installation can sit comfortably during the race. This tent would also protect the electrical equipment.

Quality Management

In order to assess the impact of the VS experience, the researcher advises to ask participants to fill out surveys evaluating the installation. Two different surveys must be created in order to understand the different experiences of runners and spectators. Each survey should have its own assessment goals related to the goal of the installation.

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ADD APENDIX

- Questionnaire
- Survey questions
- Ethical approval
- Ideation stuff

PAPER for graduation