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# Metaverse-Based Demonstrators as an Alternative to Traditional Presentations: Case Fossil-Free Steelmaking Processes

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## ABSTRACT

In recent years, metaverse platforms have developed to the point where they are expected to become a new revolutionary marketing tool. This paper provides a case study of their use as a powerful alternative to traditional presentation means. An enterprise-targeted, standalone metaverse experience was developed with Microsoft Mesh to compare two different steelmaking processes of a major company in the industry participating in a maritime project. The developed experience was tested on several occasions in systematically controlled environments, involving 22 participants, all of whom were either affiliated with the maritime industry or academic researchers working with the maritime industry. The participants were asked to complete a user feedback survey after testing the experience. Based on both observational data and the survey responses gathered, it was evident that metaverse solutions built for informative purposes could significantly improve or even replace traditional means to showcase otherwise complex processes.

**Keywords:** Virtual reality, Metaverse, Steelmaking, Marketing, Communication, Sustainability, Process visualization

## INTRODUCTION

Metaverse is a complex and not unilaterally agreed term centering on the idea around the next revolution of the Internet that becomes more embedded with virtual reality (VR), mixed reality (MR) and augmented reality (AR) services. Metaverse, or metaverses, can be seen as post-reality universes, spaces combining material, digital and virtual content so that a multitude of users can interact with the environment, digital objects, and each other (Lee et al., 2021; Fernandez & Hui, 2022; Mystakidis, 2022). Generally, a metaverse is defined as a virtual place in which users can interact with each other and the environment (Ball, 2022).

In a metaverse, users are usually represented by their avatar, which can usually be customized to a certain degree. Metaverses can be accessed through various means, all technological in nature. Over the past 20 years, metaverses have developed significantly. Before the successful launch of the first commercial VR headset in 2012 known as Oculus Rift, metaverse platforms were only accessible through computers and mobile devices,

and the major platforms were only meant for entertainment purposes. In entertainment use, platforms with VR possibilities have only existed for a decade, starting with AltSpaceVR which was launched in 2015 and later discontinued in 2023 (Alcala, D'Achille and Bruckman, 2023).

Because of the development within the metaverse industry and the technological advancements of VR headsets after Oculus Rift (Hamad and Jia, 2022), the industry is nowadays mature enough for enterprise usage. Major enterprises like NVIDIA, Microsoft and Siemens have already introduced their platforms targeting enterprise usage, and businesses are starting to establish presence within the platforms, creating a completely new way to reach their target audience.

This study can be seen as marketing research. More specifically, it is marketing research in a Business-to-Business (B2B) context, using a metaverse experience as a marketing tool. The experience acts as a replacement for PowerPoint presentations and other, more traditional marketing tools. Marketing is a kind of communication, and this study focuses on the communication of sustainability information. More specifically, it is a study on the communication of the ecological aspects of sustainable development, the concept of which is built on the Report of the World Commission on Environment and Development (1987, p. 41). The book describes sustainable development as economic development done while meeting the needs of the present without compromising on the ability of future generations to meet theirs.

This study is conducted as part of the Sustainability through Information Flows (SusFlow) research project. SusFlow researches the flow of sustainability information within the maritime industry and aims to improve it to increase overall sustainability (Heimo et al., 2024). In this study, the complex topic of steelmaking was used to demonstrate the advantages of a metaverse platform in the context of marketing. An enterprise-targeted, standalone metaverse experience was developed to showcase a comparison of two different steelmaking processes of a major company in the industry; the traditional blast furnace one that produces $CO_2$ emissions, and an upcoming process producing virtually zero $CO_2$ emissions.

This study researches the potential of metaverse platforms as a marketing tool, specifically in the maritime industry. The study explores what benefits and problems a metaverse platform brings when compared to traditional presentation means in the enterprise context. In addition, the ease of use and efficiency of content creation on a metaverse platform is also investigated. Finally, the study provides a solid background for future research regarding the topic by proposing new research directions based on the insights gathered.

First, the paper presents a view of the current research and situation in the maritime industry, also providing ground on the necessity of the study. The paper then continues to state the requirements that were present during the design phase for the metaverse experience to be developed, after which the design and implementation phases are discussed. After the design and implementation, the paper describes the systematic environment that was present during the test sessions for the experience. Finally, the results gathered based on the survey responses are presented, followed by discussion that analyzes the results and suggests future research directions.

## RELATED RESEARCH

Metaverse platforms targeting industrial usage are expected to trigger a large transformation in the marketing and communication industry, which will allow significantly more user-friendly and immersive experiences based on complex processes (Bamberger, Reinartz and Ulaga, 2025; Ghali, Rather and Khan, 2024). With the features of a well-equipped metaverse platform, the possibility to have custom 3D objects and logic enables organizations to produce detailed representations of the subject under demonstration. In addition, the user can have an expert with them in the same session, answering questions and giving more details. Applying this kind of approach in design reviews of cruise ship interiors has been experimented by Helle et al. (2025).

While metaverses are yet to be widely used in the maritime industry, in the production industry, for example, BMW will start using them in its production in 2025 (Geyer, 2023). The company will start using digital twins, which are reusable, highly accurate digital counterparts of physical objects. Digital twins can support sustainability through assisting process optimization and are compatible with the creation of experiences similar to this study.

In some cases, it may also be beneficial if the participants do not know with whom they are discussing and interacting in the virtual world. For such a scenario, it is possible to collaborate anonymously on a metaverse platform, which has been previously studied by Nyyssönen et al. (2023).

Corporate sustainability communications can be divided into three different cases based on the communication goals: The public case where contributions to society are emphasized, the business case where internal sustainability management is emphasized, and the marketing case where communications are used to supplement marketing goals (Signitzer and Prexl, 2007). While the case in this article falls squarely within the marketing case, these cases are not mutually exclusive. Societal and market demands for sustainable solutions can result in new processes that need to be understood by customers before they can be bought (Mäkelä, Apostol and Heikkilä, 2018). In addition, integrating sustainability communication into a business strategy can lead to collecting sustainability data regarding how the company operates. This data can later be repurposed as marketing material.

Contemporary research on sustainability communication suggests that current implementations are lacking in two-way communication (Golob, Podnar and Zabkar, 2023). This is something that metaverses naturally enable and is present in the experience as well. The promotion of sustainability communication solutions is currently done through traditional means employing one-way communication, such as slideshows, pitches and brochures.

The experience was designed to be used in a trade fair context. B2B trade fairs are marketing events that can reduce the cost of a sale by as much as (Pitta, Weisgal and Lynagh, 2006). Included in this cost is the dramatic reduction of the amount of communication needed to close in on a deal. While the efficient communication metaverse applications can provide is

desirable in any context, it can be especially fitting for trade fairs with their function of shortening communications within the limited timeframe a visitor is at a booth. The typical ways of communicating with visitors at booths, personal conversations and displaying promotional material, can both easily be integrated into metaverse experiences.

Focusing on the perspective of the visitor is a trend in contemporary trade fair research (Sarmento and Simões, 2018). A technique suggested by this research is concentrating on two-way communications, similarly to what sustainability communication research suggests. The trade fair research also suggests utilizing an innovative trade fair strategy, which positively correlates with trade show performance. The usage of metaverse experiences at trade fairs could be considered as innovative, thus correlating with the suggestion.

While traditional means of communication have established their position as the standard tool for B2B marketing and visualization, metaverse platforms targeting enterprise usage have the potential to make even complex processes more user-friendly and perceivable. When combined with VR and other related technologies, new ways of immersion can be achieved.

## PROTOTYPE DESIGN AND IMPLEMENTATION

For the implementation, Microsoft Mesh (Microsoft, 2024), NVIDIA Omniverse, and Meta Horizon Workrooms (Meta, 2024) were considered as the target platform. These were chosen as potential platforms because the solution was targeted for enterprise use, thus it required an enterprise-focused metaverse platform. From the mentioned platforms, Mesh and Omniverse were categorized as well-equipped ones, as they allowed importing custom 3D objects that could be made outside the platform. They also focused on features for industrial usage, while Horizon Workrooms was mainly offering features targeting productivity improvements.

During the analysis, the content creation flow for Mesh did not require a powerful workstation and was rather smooth, while Omniverse required a specific kind of powerful graphics processing unit. In addition, Omniverse was more focused on providing tools for realistic simulation and 3D models, while the implementation was designed to be a simplified representation because of the technical limitations of solutions designed for mobile VR headsets. Because of these facts, Mesh was chosen as the implementation platform. The experience would be accessed with a Meta Quest VR headset (Meta, 2024).

The experience was designed to be a marketing tool, with its duration limited to 5–10 minutes. Due to the official age requirements by Meta, the experience was limited only to users over 10 years old. In addition, the experience was designed to be usable while either sitting or standing, and by different target groups. One of the key objectives for the experience was to effectively communicate factual information, while keeping the users engaged. A key factor in ensuring metaverse capabilities for the experience was to allow a steel manufacturing expert to connect into the same session from a different physical location. The expert was able to provide virtual

guidance for the user, such as answering their questions, with the help of virtual notes about the processes.

The experience was designed to emphasize how the fossil-free process could, in principle, produce zero $CO_2$ emissions, unlike the traditional blast furnace process. Both processes are demonstrated in a miniature size, and the flow of different substances between the components is shown to the user. As the user progresses in the experience, text, audio and visual effects are used to guide their focus among the components. The left side of Figure 1 shows a meetup with the expert, and the right side is a general diagram about the fossil-free process miniature. The diagram also demonstrates the limitations of traditional presentation means as opposed to a metaverse presentation. It is limited in how accurately it corresponds to the real-world process, and it cannot be made as engaging.

To ensure engagement in the experience, gamification was an integral part of the design, which was in the end implemented in the form of a task about catching $CO_2$ molecules produced by the traditional process. In this activity, the user was given a virtual net, with which they could catch the produced molecules. The activity consisted of several phases, each with different spawning and moving speeds for the molecules. At the end of the activity, the user was shown a percentage of how many molecules they managed to catch. This activity was repeated two times during the experience. Overall, the gamification part was designed to reflect how problematic and unpleasant $CO_2$ emissions are.

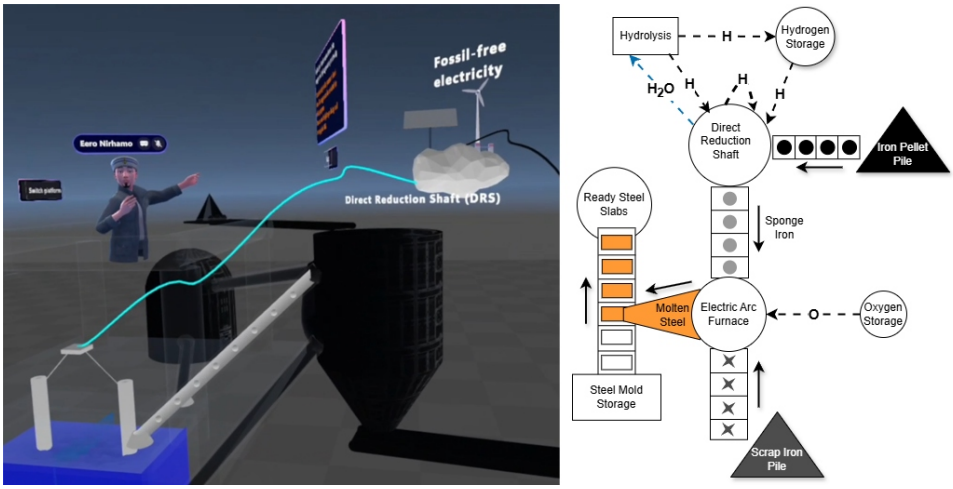


**Figure 1:** A meetup with the expert, and a general diagram about the simplified version of the fossil-free process in the experience.

The experience was implemented with the development platform Unity using its official Mesh toolkit ('microsoft/Mesh-Toolkit-Unity', 2024) to enable features of the Mesh platform. Implementations done through Mesh are also integrable into existing Microsoft infrastructures used by organizations, such as those residing in Azure. Mesh provided two methods

of scripting logic into the experience: visual block coding built on top of the Visual Scripting plugin of Unity in which the blocks were provided by Microsoft or writing C# code and publishing it to Azure. During the implementation, the latter method required two different.NET SDK versions for certain parts of the publishing pipeline, 6.0 and 7.0, which introduced problems during the process. Thus, the implementation was made using only the block coding method.

The processes are demonstrated to the user one at a time in the experience, and they are placed diagonally under the user. This enables the user to see both the components and their connections with minimal head movement, as they are positioned horizontally within a 90° angle of each other. The expert is also positioned diagonally, but at the same altitude as the user. In addition, both the user and the expert have an additional platform which they could teleport to, to provide a different point of view of the miniature.

In both processes, the flow of substances between the components is visualized either with particle systems or shaders provided by Unity. In each part of a process, the observed components and their connections are lit, and the other parts are darkened with shaders. In addition, videos demonstrating the chemical reactions inside the most important components are shown to the user.

## TEST SETTING AND SURVEY

The developed experience was tested on several occasions, involving 22 participants, all of whom were either affiliated with the maritime industry or academic researchers working with the maritime industry. The tests were organized in a systematically monitored environment, and the participants were asked to complete a short survey after testing the experience. The experience provided virtual notes for the person acting as a steelmaking expert, allowing anyone to act as one. All tests employed an academic researcher as the expert. In addition to the survey, aspects regarding the physical location of the test session and the spoken feedback received during the tests were observed and noted.

In the survey, the testers were first asked some background questions, such as their experience with VR, after which it centered on asking about four key topics. These were usability and user experience, learnings from the steel manufacturing processes received, opinions about the future development direction, and practicalities regarding the solution as a marketing tool. Within the questions about what the testers learned during the experience, sustainability communication was also briefly covered. The survey questions will be presented in more detail in the next section.

## RESULTS

The experience was tested in four different sessions by a total of 22 testers. The survey included 12 questions, of which the first three asked about the background of the tester and their previous experience with VR. Based on the answers received to these, the testers were either affiliated with the maritime

industry or academic researchers working with the maritime industry. 64 % of the testers had used VR a few times before the test, it was the first time for 23 % of the testers, and the rest had used it many times before. Only 23 % of the testers had used VR at their work.

The testers were also presented with several open-ended questions, which focused on major usability improvement areas for the experience and whether there was something that should have been communicated better or was left out completely. Finally, the open-ended questions asked what the testers see as the major potential issues and benefits, if a similar metaverse experience would be used at a seminar or exhibition.

Regarding the usability improvements, the testers proposed easier interaction with the grabbable net, as they felt it required some practice. Some also suggested being able to move to different locations, which would enable the tester to see the processes from different perspectives. For the communication aspect, the testers proposed for example being able to interact with certain components to gain additional information and showing a comparison summary of both processes in the end. In addition, some testers pointed out that people with different backgrounds can perceive the concepts as more difficult to understand than others.

The survey also presented several statements to the tester, asking if they disagree or agree with those. Answers to these can be seen in Figure 2, which shows that while 86 % of the testers felt the experience was easy or somewhat easy to use, 23 % of them felt that the experience was somewhat confusing or unnecessarily complex. The figure also shows that most of the testers felt that a necessary part of a metaverse, the steelmaking expert in this context, improved the experience. Over 80 % of the testers felt that they reached a better understanding of the processes through the experience.

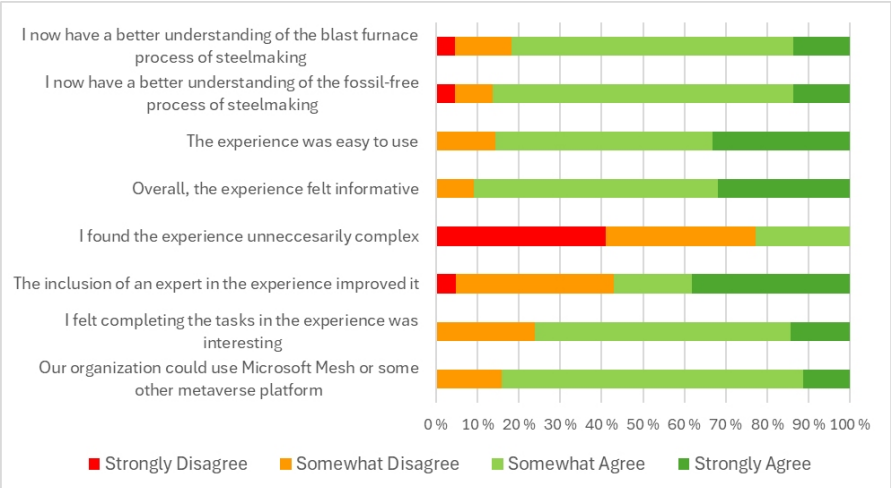


**Figure 2:** The key statements presented and the answers received.

During the survey, the testers were asked to rank their preferred ways of showcasing the fossil-free process to others on a scale of 1-5, 1 being the most preferred. Figure 3 shows a diagram of the results for the ranking.

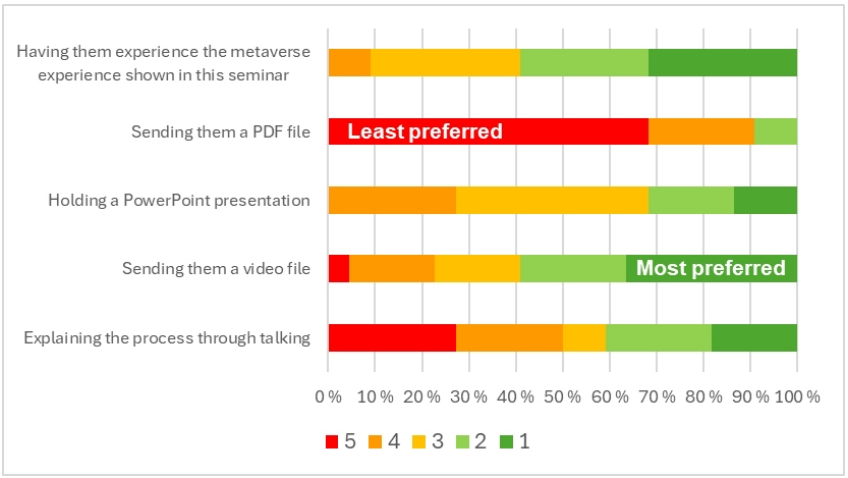


**Figure 3:** The percentage of testers ranking each showcasing method in a certain way.

Based on the figure, 59 % of the testers chose to showcase the fossil-free process to others with the presented experience. Only 32 % of the testers chose to do the showcasing through a PowerPoint presentation. The preference varied based on the tester's background. From the shipbuilding professionals, 46 % ranked the experience as their most preferred option, followed by explaining through talking with 28 %. This changed among researchers, as 64 % of them chose video file as the most preferred option instead, followed by the experience with 18 %.

When observing the test situations, practical issues inside and outside of the experience were also present. Inside the experience, for example difficulties interacting with the net and positioning of the guiding text boxes were present. It was also noticed that the audio heard by the tester inside the experience reacted to distance, which meant that in some scenarios they were not able to hear the expert well. Outside of the experience, some testers expressed their opinions about the lack of interaction in the experience, suggesting adding more interactivity. In certain test locations, there was background noise present in the testing scenario, such as people speaking, which affected the testing experience negatively. Some locations also had obstacles such as walls next to the testers, which made physical movement difficult.

Overall, during the observations the testers agreed on the potential of using metaverses instead of traditional presentation means, while stating that it would require more research and development to achieve the optimal outcome especially regarding the interactive part.

## DISCUSSION

While the tester's background was one factor affecting the ranking of the showcases based on the survey responses received, other factors such as stress caused by time restraints might have also affected it. The experience was also slightly different between the first and later test sessions, which could be another affecting factor.

In terms of the suggestions for more interaction, the experience was heavily time restrained from the very beginning as it was designed to be suitable for booths and exhibitions, where time can be very limited. Despite this, the inclusion of a steelmaking expert led to extending the experience duration significantly in some situations, when the tester had multiple questions to ask. If more interaction possibilities were added, for example other gamification tasks or the possibility to interact with different components to inspect them, the time consumed would be increased even more often. This combined with the movement possibilities offered inside the experience is something to be carefully evaluated for the planned use case.

In addition to the practical issues mentioned in the results, another possible one comes from the fact that Mesh requires Internet connection with certain network requirements to work, which could be a significant problem in some organizations. As some organizations can have strict network architectures in place, including firewalls and intrusion detection or prevention systems implemented by their IT departments, it is not guaranteed for Mesh to work instantly when its requirements are not acknowledged. In the worst scenario, too strict network requirements can prevent Mesh from working at all, forcing the users to use another network, such as a mobile hotspot.

## CONCLUSION

Previous research indicates a lack of the two-way view of communication within traditional presentation means, which is crucial to ensure the best possible outcome when communicating about sustainability. Metaverse solutions not only naturally fill this gap, but also enable an entirely new level of immersion, especially with VR, which is one of the reasons why they are seen to become a revolutionary marketing tool in the future. This paper researched the use of metaverses as a B2B marketing through a case study for a steelmaking company participating in a maritime research project. An enterprise-targeted, standalone metaverse experience was designed and implemented as a solution for the case, and it was tested during several occasions along with a user feedback survey. The survey was presented to 22 participants, all of whom were either affiliated with the maritime industry or academic researchers working with the maritime industry.

Based on both observational data and the survey results gathered, it was evident that metaverse solutions built for informative purposes have the potential to significantly improve or even replace traditional means to showcase complex processes. While this study proved their potential, future research is needed to provide more conclusive results, including a comparison between the presentation means. In addition, the balance between the time needed for the experience and an engaging gamification experience needs to be researched more. Other aspects that need to be evaluated are the practical limitations introduced by the selected metaverse platform, and whether the experience needs to support movement at all.

In addition, another possible area of future research comes from contemporary trade fair research. The importance of studying the benefits of the interactions and relationship building between company representatives

and potential business partners is emphasized (Sarmento and Simões, 2018). As the interaction between people inside a virtual world is fundamentally different from real-world interaction, there is a need to explore relationship forming through metaverse interaction. This could range from the different modalities of interaction available to the changed dynamics of sociocultural conditions.

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