Acceptance Analysis of the Metaverse: An Investigation in the Paper- and Packaging Industry

Research Paper

First Author[1], Second Author[1], Third Author[1,2], and Fourth Author[2]

[1] Institution, Department, City, Country
{first.author,second.author,third.author}@example.com
[2] Other Institution, Other Department, Other City, Other Country
{third.author,fourth.author}@anotherexample.com

Abstract. This explorative study investigates the acceptance of metaverse in workplace environments, with a particular focus on the paper and packaging industry. Grounded in Technology Acceptance Model 3, the research explores key factors influencing employee adoption. To assess these factors, a living lab experiment was conducted within a leading packaging company, combining qualitative content analysis with quantitative analysis through multiple regression modelling. The findings identify significant determinants of metaverse acceptance, such as perceived usefulness, perceived ease of use, computer self-efficacy and job relevance, ultimately leading to an overall acceptance score. The study provides valuable insights for organizations looking to implement metaverse technologies, emphasizing both potential benefits and adoption barriers in the traditionally conservative paper and packaging sector. These findings contribute to the broader Human-Computer Interaction discourse, shedding light on the practical implications of immersive technologies in industrial workplaces.

Keywords: Metaverse, Technology Acceptance Model 3, Living lab, Paper and Packaging industry, Workplace

1 Introduction

The digital transformation of industries, accelerated by technological advancements such as artificial intelligence (AI), augmented reality (AR), virtual reality (VR), and the Internet of Things, is reshaping the way companies operate and collaborate (Vig, 2023). The COVID-19 pandemic further underscored the need for effective remote collaboration tools, driving rapid adoption of digital platforms to maintain productivity (Park et al., 2023). In this context, the metaverse has emerged as a promising technology, blending physical and virtual worlds to enable immersive environments for interaction, work, and innovation (Clemens, 2022; Ng, 2022; Lim et al., 2023). With companies like Meta, Microsoft, and Google investing heavily in this new technology, it is becoming increasingly relevant for industries seeking to enhance their digitalization strategies and improve operational efficiencies (Lim et al., 2023). However, alongside these opportunities, the metaverse presents organizational challenges—requiring new strategic approaches, resource allocation, and alignment of human capital and corporate management (Mackenzie, 2022; Vig, 2023). While studies highlight the potential benefits of corporate metaverse use, research on user acceptance remains scarce, even though such

20th International Conference on Wirtschaftsinformatik,
September 2025, Münster, Germany

acceptance is critical for successful workplace integration (Jeong & Kim, 2023). In a corporate environment, the users of metaverse may be employees, that work in an office or in a remote space (Park et al., 2023). This underscores the need to examine how employees perceive the metaverse, how they accept it to fulfil work and collaboration in a corporate environment and what barriers may exist to its widespread adoption. A structured database search (Ebscohost, Web of Science) confirmed this gap: from an initial 492 hits for 'metaverse' and 'acceptance,' only 42 remained after adding terms like 'employee', workplace', and 'collaboration'. Narrowing to studies published post-2020 (due to Covid-19) and identified title/abstract relevance resulted in only two studies: Besson & Gauttier (2023), who emphasize the interplay between intrinsic motivation (e.g., enjoyment, playfulness) and extrinsic factors (e.g., perceived usefulness, ease of use, and social norms) in shaping employee acceptance in the pharmaceutical industry, and Wiangkham & Vongvit (2023), who research drivers of adopting the metaverse in an engineering context and offer practical strategies for fostering positive user behavior.

To extend these findings and to make the results of this study usable for practice in the context of a situational approach, this study also requires an industry-specific focus (Herzwurm, 2000). Companies in the paper and packaging industry are conservative but striving to digitize internal workflows and processes through new technologies. (Rockwell Automation, 2023; Porsche Consulting, 2016). The industry consequently fits in with the situation and is used as a representative of the research context of this study. Therefore, the current study seeks to explore **what acceptance employees of the paper and packaging industry have towards the use of the metaverse for work and collaboration**. This explorative research leverages the Technology Acceptance Model (TAM) to assess employee perceptions of ease of use, usefulness, and behavioral intentions (BI) regarding the metaverse. Data was collected through a living lab experiment conducted in a German paper and packaging company. By analyzing employees' responses with quantitative and qualitative methods, this research provides insights into the drivers and barriers of metaverse adoption.

2 Theoretical Framework

2.1 Metaverse and Human-Computer Interaction

The term 'metaverse' was first used in 1992 in Neal Stephenson's novel 'Snow Crash'. It describes a virtual world that is modelled on the real world and in which users can interact with each other via avatars (Besson & Gauttier, 2023). Since then, the concept has evolved considerably and now encompasses a variety of definitions and applications. The metaverse is often described as the next level of the internet, linking physical and virtual worlds (Rosenstand et al., 2023). It combines real and virtual worlds, enabled by technologies such as AR, VR and Mixed Reality (MR), and promises to revolutionise the way people interact and work (Singh & Vanka, 2023; Ng, 2022; Besson & Gauttier, 2023). Currently, the metaverse is defined as a virtual space in which multiple users, represented by avatars, interact both with their surroundings and with each other (Ball, n.d.; Ng, 2022; Park & Kim, 2022; Hölzle et al., 2023, Park et al., 2023; Singh & Vanka, 2023).

From a Human-Computer Interaction (HCI) perspective, the metaverse introduces new paradigms of user experience and interaction, necessitating the adaptation of established frameworks. Norman's usability principles (1988) highlight the importance of visibility, feedback, and user control, which are particularly relevant in metaverse environments where immersion and real-time interaction require intuitive design. Similarly, adaptive systems in HCI (Schuetz & Venkatesh, 2020) suggest that metaverse interfaces must evolve based on user behavior and cognitive load, ensuring accessibility for both novice and expert users. Heuristics for Virtual Environment Design (Sutcliffe & Gault, 2004) further emphasize the role of presence, engagement, and affordances, which are crucial for fostering effective interactions in the metaverse.

These HCI principles and models provide a structured foundation for evaluating usability, cognitive effort, and social interaction within metaverse environments, aligning with ongoing research on immersive collaboration and digital embodiment in professional settings. As companies integrate the metaverse into their operational workflows, the application of usability heuristics and adaptive interaction models will be critical to ensuring widespread adoption and effectiveness (Mackenzie, 2022).

2.2 Technology Acceptance Model

The adoption of metaverse in workplace environments presents both technological and HCI challenges, requiring structured models to assess user acceptance (Vig, 2023). The TAM, first introduced by Davis et al. (1989), aims to explain the determinants of technology acceptance, offering a framework applicable across various technologies and user groups. One of the core contributions of TAM is its ability to not only predict adoption but also explain rejection, making it a valuable tool for evaluating emerging technologies like the metaverse (Davis et al., 1989). TAM posits that two main factors influence an individual's decision to adopt a new technology: perceived usefulness (PU) and perceived ease of use (PEU). PU refers to the extent to which an individual believes that a system will enhance their job performance, while PEU represents how effortless the system is perceived to be (Davis et al., 1989). As the metaverse requires new forms of digital interaction, these factors become critical in assessing how users perceive and integrate virtual environments into their workflows (Besson & Gauttier, 2023). Over time, TAM has evolved, incorporating additional determinants to better capture complex socio-technical influences on user acceptance. TAM3, introduced by Venkatesh & Bala (2008), extends the model by including social and cognitive instrumental processes, making it more suitable for evaluating immersive and adaptive technologies. Unlike conventional enterprise systems, metaverse environments require higher levels of user engagement and presence, which TAM3 accounts for through constructs like subjective norms, experience, and job relevance (Wiangkham & Vongvit, 2023).

Why TAM3 over alternative models? Several alternative models exist for studying technology adoption, including the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) and Diffusion of Innovations (DOI) (Rogers, 2003). While UTAUT integrates a broader range of organizational and social influence

factors, it is primarily designed for mandatory workplace technology adoption, making it less applicable to the voluntary and experimental nature of metaverse adoption. Similarly, DOI focuses on macro-level diffusion trends, making it useful for understanding industry-wide adoption patterns but less suited for individual user experience and interaction design (Rogers, 2003). In contrast, TAM3 provides a balance between usability-focused considerations and social-cognitive influences, making it particularly relevant for studying metaverse acceptance in professional environments (Venkatesh & Bala, 2008). Given the high cognitive load and adaptive nature of virtual workspaces, constructs such as computer self-efficacy (CSE) and perceived enjoyment (PE)—both included in TAM3—are critical predictors of acceptance that are less emphasized in alternative models. Furthermore, mentioned relevant studies, used a UTAUT approach in their studies and concluded that traditional factors such as PU and PEU are the most relevant factors for technology acceptance (Besson & Gauttier, 2023). They stated that even in different fields of application these two factors have the most significant impact on the adoption of technological innovations (Wiangkham & Vongvit, 2023).
By applying TAM3 to the metaverse, this study aligns with HCI principles discussed in section 2.1, emphasizing the role of intuitive design, adaptive interfaces, and user confidence in fostering acceptance. As companies experiment with virtual workspaces and digital collaboration, TAM3 offers a structured approach to identify the key factors that drive or hinder user adoption, bridging the gap between technological potential and real-world usability (Venkatesh & Bala, 2008)

3 Research Methodology

3.1 Research Design and Approach

This study was conducted in the paper and packaging company and study partner Klingele Paper & Packaging Group (Klingele). Klingele aims to position itself as a technology leader in this industry and has agreed to serve as the study partner by setting up the living lab. The living lab approach allowed participants to test the technology in a controlled, real-world scenario, aligning the study with the open innovation framework (Anduschus et al., 2023). The setup was created within the company's building, enabling employees to experience the metaverse within a simulated workplace environment.

The living lab was designed to test employee interaction with a metaverse-based collaboration tool. The technology used in this living lab was classified as Technology Readiness Level 7, indicating that it is a prototype used in a real-world operational environment (Anduschus et al., 2023). Participants were able to use VR headsets to perform simulated tasks, replicating their daily work activities within the metaverse. They were able to select either a simulated office environment created by VR or a standard office environment. Both options encompass AR/MR elements, such as augmented interactive screens in the real-life office or a physical mouse and keyboard in the VR setting. The lab included tasks such as document editing, virtual meetings, and collaboration exercises.

A cluster sampling method was used to select participants, with relevant departments representing distinct clusters. Departments heavily engaged in remote collaboration, such as IT, marketing, finance, project management, and customer service, were targeted (Haan & Main, 2023). To capture broader insights, employees from departments with minimal exposure to remote work technologies, such as production and machine operators (Destatis, n.d.), were also included. Convenience sampling was then applied to select participants based on availability and willingness to participate in the study (Acharya et al., 2013). To define the tasks and the test procedure for the participants, rules for a usability testing scenario were considered, which is a commonly used approach in the field of HCI (Riihiaho, 2018).

3.2 Data Collection and Analysis

The study follows a usability framework, requiring participants to complete post-experiment questionnaires (Riihiaho, 2018; Svensson et al., 2010). The questionnaire is the main source of data for this study and was developed using a structured approach, guided by a model for systematic questionnaire design (Taherdoost, 2022). This model was chosen to ensure that the questionnaire effectively addresses the research question by using constructs from TAM3 as the basis for formulating the questions. The questionnaire included both closed and open-ended questions, allowing for the collection of quantitative data for statistical analysis and qualitative insights to capture deeper reflections on metaverse usage.

The quantitative data for this study was collected using 5-point Likert-scale questions for every TAM3 construct, including PU, PEU, and BI, as well as their respective determinants. In addition to the quantitative questions, two open-ended qualitative questions were included to gather deeper insights into the participants' reasoning.

The qualitative data from the open-ended questions was analyzed using Mayring's (2015) qualitative content analysis. This systematic, theory-driven approach allowed for an in-depth exploration of participants' responses to the open-ended questions about PU and PEU (Mayring & Fenzl, 2022). The framework involves several key phases, including defining the research question, establishing a coding system, and iteratively refining categories as the analysis proceeds. Key qualitative insights were then validated with the quantitative data.

The quantitative data was analyzed using multiple linear regression. The independent variables included Experience (EXP), Subjective Norm (SN), Job Relevance (JR), and other TAM3 determinants. For variables showing significant correlations, moderation effects were tested. While statistically non-significant variables ($p > 0.05$) are typically removed (Starbuck, 2023), they were retained in the model to provide deeper insight into the TAM3 framework's applicability. In the second step these non-significant variables are tested for a correlation with the statistically significant variables, as the determinants of PU and PEU in the TAM3 can vary depending on the technology context (Venkatesh & Bala, 2008). Voluntariness (VOL) and Objective Usability (OU) were excluded from the analysis. OU cannot be captured based on individual subjective opinions (Venkatesh, 2000). VOL is not measurable since the voluntary use of the metaverse is not yet possible in the German company.

4 Practical Execution of the Living Lab

The experiment was divided into multiple phases, starting from preparation, pretesting, and the main experimental sessions and had a total of n=53 participants. The experiment took place in a conference room within Klingele, optimized for this purpose. Seen in figure 1, each participant was provided with a laptop, a Meta Quest 2 headset, and essential peripherals such as a keyboard and mouse.

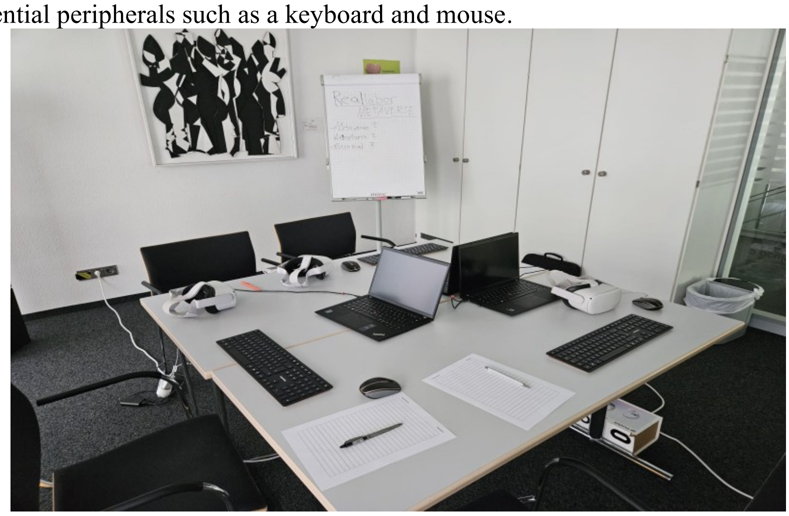

Figure 1. Living lab arrangements

Pretests were conducted to identify and resolve issues related to internet connectivity, VR visibility, and task design. These tests revealed several technical and ergonomic issues, such as poor seating arrangements and difficulties with tasks requiring typing due to limited visibility of physical keyboards in metaverse. Adjustments were made, including modifying seating arrangements to avoid distractions among participants and replacing typing tasks with click-based interactions to improve task completion.

Each experimental session followed a structured schedule: After a brief orientation introducing the study, lab setting, and VR headset use, participants engaged in Phase 1 – Individual Work (10 min) to perform typical solo tasks in a virtual office. This was followed by Phase 2 – Collaborative Meeting (10 min) in a virtual conference room, where triads completed shared tasks to simulate real-world teamwork. A short debrief (5 min) allowed for reflection and questions, followed by a buffer (15 min) to handle technical issues or overruns. If fewer than three participants were present, the facilitator filled in to preserve the collaborative setup. Table 1 lists the tasks that participants had to fulfill during the session.

Table 1. Experimental session tasks

Task Number	Phase 1—Individual Work	Phase 2—Collaborative Meeting
1	Generation of two additional screens for editing	Introduction of the participants by using a given DOCX document
2	Adjusting the screen size of the virtually generated screens according to requirements	Interaction with other participants through the following actions using the avatars: • Rock-paper-scissors game • High-five handshake
3	Open and fill in the DOCX document on the desktop	Sharing the screen and presenting the PPTX document saved on the desktop
4	Closing the additionally generated screens	Joint brainstorming
5	Open the PPTX-file on the desktop and read through its contents	Leaving the meeting room
6	Entering the meeting room	-

5 Analysis and Evaluation

5.1 Qualitative Analysis

The qualitative content analysis followed Mayring's (2015) method, based on questionnaire responses from 53 participants, yielding 106 open-text entries. These responses, capturing participants' reasoning behind their quantitative answers, were analyzed using content-based structuring aligned with predefined TAM3 categories. A structured content analysis has a differentiation of formal, content-based, typifying, and scaling structures (Mayring, 2015). Given the research question, content-based structuring was the most appropriate method to explore the predefined TAM3 categories. Each full response served as an analytical unit, while coding units—typically single words or short phrases—enabled nuanced categorization. The initial coding categories were derived directly from TAM3 (i.e. all independent variables) and defined clearly to ensure systematic analysis and transparency. Anchor examples (e.g., typical quotes or phrases) and coding rules were created to address potential category overlap. Notably, VOL was originally excluded due to measurement limitations; however, after a preliminary analysis, VOL was incorporated into qualitative analysis. This decision followed the identification of relevant statements reflecting the voluntary adoption of the metaverse for applications. A second iteration confirmed the validity of the adjusted coding guidelines, with no further category changes required.

The most frequently referenced category was PU with 74 codings, underscoring its critical role in BI. Participants highlighted benefits such as “simplified virtual collaboration” and “bridging spatial separation”, though concerns about the technology’s immaturity and limitations compared to existing tools emerged. PEU surfaced as another prominent category with 39 codings. Participants commonly expressed that the metaverse was “simple and intuitive,” yet hardware limitations (e.g., the weight of headsets and inconsistent image clarity) impacted the ease of prolonged use, creating a mix of positive and critical responses. EXP emerged as a significant factor, revealing that many participants had limited practical experience with using the metaverse. Those with limited experience expressed difficulty envisioning applications for the technology, citing “lack of practical experience in daily work” as a common theme. CSE strongly impacted PEU, with high technological confidence facilitating adaptation. However, some participants stressed the need for introductory training. Output Quality (OQ) yielded mixed responses: while some anticipated efficiency gains, others questioned actual productivity benefits. CA also played a role in participants’ responses, as some noted discomfort or eye strain after prolonged headset use, with others feeling “not quite at ease” using the hardware for extended periods. Lastly, perception of external control (PEC) and PE were both relevant categories, as the metaverse is “fun to use” but participants noted that the infrastructure must be restructured to use this technology. Low-frequency categories included SN**,** IMG**,** VOL, Result Demonstrability, and Computer Playfulness as these constructs were rarely highlighted in participants’ reflections, suggesting a limited relevance within the current context.

Reliability and validity of the qualitative content analysis were carefully considered throughout. To ensure reliability, consistency in coding was assessed, with revisions implemented only once during an initial review to address ambiguity between the categories (Mayring, 2015). Construct validity was supported by TAM3, which provided a structured basis for interpretation and enabled linkage to the theoretical framework, confirming the analysis’s alignment with the study’s broader research goals (Mayring, 2015). Figure 3 shows the number of codings of every category.

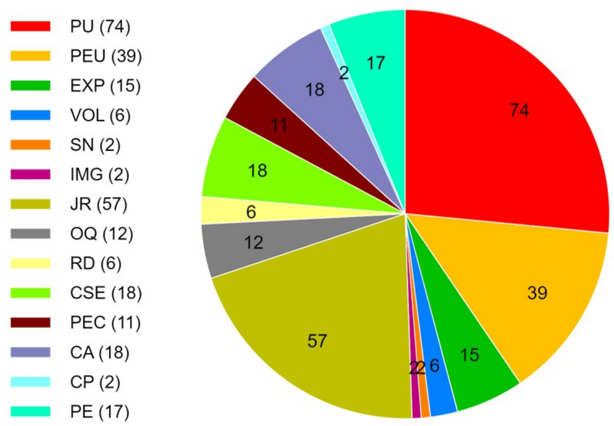

Figure 2. Number of codings per category

5.2 Quantitative Integration & Acceptance Evaluation

The quantitative data was analyzed using multiple linear regression to assess alignment with the prior content analysis and identify potential divergences. The dependent variable BI was regressed on PU, PEU, SN, and EXP. The model explained 32.5% of the variance in BI ($R^2 = 0.325$), with PU ($\beta = 0.331$, $p = 0.007$) and PEU ($\beta = 0.326$, $p = 0.007$) emerging as significant predictors, while SN and EXP were not. Further analysis showed PU was significantly influenced by JR ($\beta = 0.350$, $p = 0.010$), whereas SN, IMG, OQ, and RD were not. This result aligns with the qualitative findings, as PU, PEU, and JR were the most frequently coded categories. For PEU, only CSE was a significant predictor ($\beta = 0.295$, $p = 0.013$), suggesting confidence in using the metaverse is key to PEU while CA, PEC, CP and PE showing no significant effect. This outcome is noteworthy, given that the amount of coding in the content analysis was equivalent for CA and CSE.

A second step tested correlations of non-significant variables with JR and CSE. The model for JR ($R^2 = 0.565$) revealed significant effects from EXP, IMG, OQ, and RD, while SN and PEU remained non-significant. This partially contradicts qualitative results, where IMG and RD had low coding frequencies. For CSE ($R^2 = 0.257$), EXP showed a positive effect, while CA became a significant negative predictor. This supports TAM3's proposition that experience moderates CA, reducing anxiety through familiarity. Notably, PE and PEC had no relevance in the statistical model, despite their frequency in the qualitative data. These findings highlight key TAM3 interactions influencing metaverse acceptance, as summarized in Figure 2.

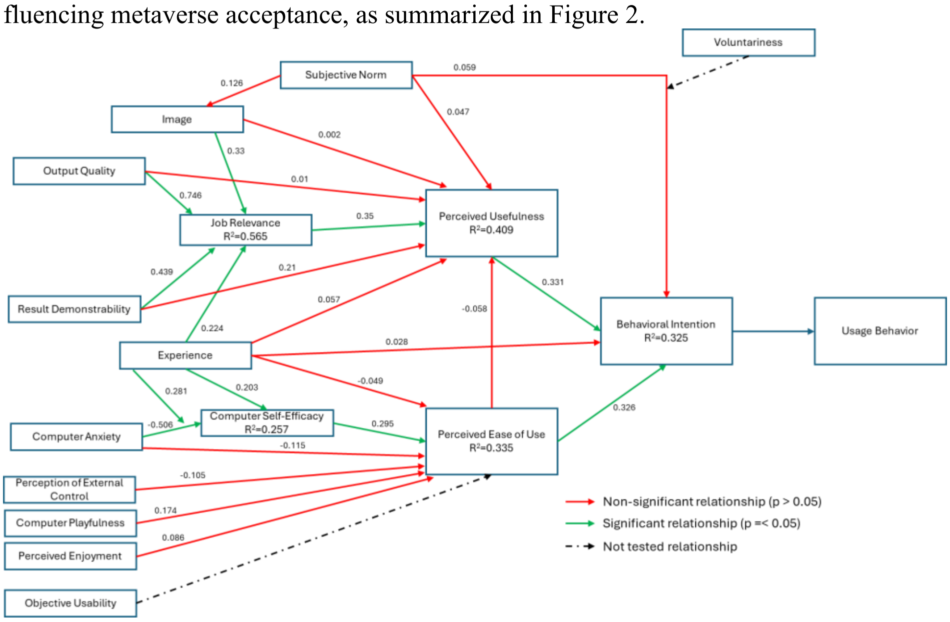

Figure 3. Acceptance model and variable influences

Both qualitative and quantitative analyses confirm PU and PEU as primary drivers of BI to use metaverse within the TAM3 framework, with JR (for PU) and CSE (for

PEU) emerging as key secondary predictors. The findings indicate ambivalence toward metaverse adoption. Based on the regression model:

$$BI = \beta 0 + \beta 1 \times EXP + \beta 2 \times SN + \beta 3 \times PU + \beta 4 \times PEU + \varepsilon$$

Plugging in the 5-point Likert scale means, the beta values and assuming zero standard error:

$$BI = 0.954 + 0.028 \times 1.74 + 0.059 \times 3.02 + 0.331 \times 3.66 + 0.326 \times 3.72$$

$$BI = 3.61$$

On a 1–5 scale, this reflects a moderate acceptance to adopt metaverse in the organization.

6 Discussion

The results of this explorative study confirm an ambiguous acceptance of the metaverse (score of 3.61 out of 5) at Klingele, a company in the paper and packaging industry, and provide a nuanced perspective on how this technology is perceived in a working and collaboration context. These findings offer both theoretical and practical implications for HCI research. The findings carry both theoretical and practical implications for HCI research by highlighting context-specific adoption, user diversity, adaptive interaction, symbolic meaning, and the need to evolve existing theoretical models.

In line with Li & Zhang (2005), who stress the importance of considering work and cultural contexts in HCI, this study stresses metaverse use within operational routines of a traditional industry. It reveals the potential for workflow optimization and enhanced collaboration, while also identifying ergonomics and technological familiarity as key influences of acceptance. The contrast between positive perceptions in collaborative tasks and hesitation in physically demanding roles underscores the need for context-sensitive HCI approaches. Individual characteristics such as EXP and cognitive comfort play substantial roles in metaverse acceptance, echoing Li & Zhang's (2005) framework on user-centric interaction.

Supporting this, Gerlach & Kuo (1991) highlight the need for adaptable interfaces to accommodate users with varying skill levels. This study suggests that metaverse applications should incorporate customizable interfaces to balance complexity and ease of use, particularly in training and collaborative settings where skill levels often vary (Gerlach & Kuo, 1991). The study’s findings extend HCI theories by challenging traditional assumptions about user-system interaction.

Schuetz & Venkatesh (2020) highlight the shift from passive to adaptive systems, as seen in cognitive computing systems, which parallels the interactive dynamics of the metaverse. Unlike conventional software, metaverse platforms demand active user engagement, and the system’s real-time feedback dynamically influences user EXP (Singh & Vanka, 2023). This study positions the metaverse as an adaptive environment in which user interaction continuously reshapes both interface and functionality, suggesting that HCI frameworks should integrate adaptive feedback mechanisms that cater to real-time needs (Schuetz & Venkatesh, 2000), thus fostering responsive and intuitive metaverse applications. Furthermore, this research demonstrates that metaverse adoption is both a technological and symbolic shift.

Gopal & Prasad (2000) emphasize that technology adoption is influenced by the diverse symbolic meanings users assign to it, shaped by their roles and experiences. In the metaverse context, professional users interpret its utility variably—from collaborative benefits to ergonomic constraints and familiarity concerns. This multiplicity of meanings underscores the complexity of metaverse adoption, indicating that its success hinges on tailoring the technology to align with specific roles and organizational culture. This study thus aligns with and expands upon symbolic interpretations in HCI, highlighting the necessity of adapting metaverse technology to meet diverse user expectations and work requirements (Gopal & Prasad, 2000). Interaction mode and agent embodiment also play a crucial role in user EXP within immersive environments (Besson & Gauttier, 2023).

Diederich et al. (2022) discuss how virtual agents' interaction modes and embodiment affect user engagement, emphasizing that high social presence—such as avatars in the metaverse—can foster increased user involvement and acceptance. This study extends this understanding, revealing that metaverse's potential for enhancing collaboration and training lies in providing immersive environments that enhance presence and realism. However, task-driven design is essential; users in roles focused on design or prototyping benefit from virtual embodiment, while more administrative functions may find limited utility. Thus, HCI frameworks emphasizing task alignment are critical for metaverse applications to effectively serve diverse professional needs (Gerlach & Kuo, 1991). Finally, this study suggests adapting traditional HCI and technology acceptance models, such as TAM, to accommodate the unique demands of immersive environments.

7 Limitations and Future Work

This explorative study investigates metaverse acceptance in the paper and packaging industry in a work and collaboration context using a living lab approach. While the integration of quantitative and qualitative analyses provided valuable insights, certain limitations exist. One limitation of this study is the relatively small sample size (n=53), which may impact the stability of the regression model (Starbuck, 2023). A larger sample would enhance the reliability of the findings by reducing standard errors and increasing statistical power (Field, 2018). Future studies should consider expanding the sample size to improve the robustness of the analysis and to allow for subgroup comparisons. In combination with a larger sample size, the use of common hypothesis tests to check the overall relevance of the model and the dependencies of several relationships could make this study's results and future studies more representative and significant (Starbuck, 2023). Another limitation is the narrowly focused literature review, which was conducted in only two databases. Future research should expand the literature search to offer a more comprehensive and contextualized understanding of the topic. Moreover, alternative statistical techniques, such as bootstrapping or variance-based analytic procedures could be employed to verify the consistency of the findings in smaller samples, as those have greater statistical power in this situation (Hair et al., 2021) Secondly, the survey design could be refined by incorporating Likert-scales paired with open-ended questions to capture a broader range of participant opinions (Swamy, 2007). Furthermore, constraints in the lab setting, such as time limitations and software constraints, impacted the exploration depth, suggesting the need for extended lab studies with greater technological stability. Future research should expand the analysis to include customer and stakeholder perspectives, capturing external attitudes toward metaverse integration. Comparative studies across similar industries or with alternative TAM frameworks may reveal additional adoption factors (Wiangkham & Vongvit, 2023).

Appendix

Table 2. Questionnaire to the living lab

Number	Question	Measured Item
1	What is your age group?	Demographics
2	How much experience did you already have with metaverse technology (VR, AR, MR)?	EXP
3	How useful do you find the metaverse for your business activities?	PU
4	How strongly do colleagues or other departments influence your decision to use the metaverse?	SN
5	How do you think using the metaverse improves your professional image?	IMG
6	How applicable are the functions of the metaverse for your work tasks?	JR
7	How do you rate the quality of the work you can produce in the metaverse?	OQ
8	How good can you demonstrate the results of your work with the metaverse to other people?	RD
9	Please explain why you chose the answers you did to the questions on perceived usefulnes. What experiences in relation to the real-world laboratory have influenced your opinion?	Reasons for opinions
10	How easy is it to use the metaverse?	PEU
11	How confident are you in your personal ability to use the metaverse effectively in a work context?	CSE
12	How do you assess the availability of technical and organizational resources in your company for the use of the metaverse?	PEC
13	How uncomfortable (anxiety, stress or nervousness) do you feel when using the metaverse?	CA
14	How interested are you in testing metaverse functions yourself?	CP
15	How much pleasure (enjoyable usage) do you get from using the metaverse?	PE
16	Explain why you chose the answers you did to the questions on perceived ease of use. What experiences in relation to the real-world lab have influenced your opinion?	Reasons for opinons
17	Would you use the metaverse in your business environment?	Behavioral Intention

Link to shots from the living lab: https://www.linkedin.com/posts/klingele-group_klingele-wellpappe-innovation-ugcPost-7224403492247846914-81Rc?utm_source=share&utm_medium=member_desktop&rcm=ACoAADosRvo-Brt6d29pX4UuTnsXN9ujcvT6dwT4

References

Acharya, A. S., Prakash, A., Saxena, P. & Nigam, A. (2013), 'Sampling: why and how of it?', *Indian Journal of Medical Specialities* **4**(2), 330-333.

Anduschus, P. O., Bienzeisler, B. & Prochazka, V. (2023), Innovationsmethode Reallabor, Research Paper, Fraunhofer Institute for Industrial Engineering IAO.

Ball, M. (n.d.), https://www.matthewball.co/all/forwardtothemetaverseprimer/. Accessed: 26.10.2024.

Besson, M. & Gauttier, S. (2023), 'Business meetings in the metaverse: stakeholder views evolve', *Journal of Business Strategy* **45**(3), 178-189.

Clemens, A. (2022), https://www.mckinsey.de/news/presse/2022-06-21-metaverse/. Accessed: 27.10.2024.

Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1989), 'User acceptance of computer Technology: A comparison of two theoretical models', *Management Science* **35**(8), 982-1003.

Destatis (n.d.), https://www.destatis.de/EN/Themes/Labour/Labour-Market/Quality-Employment/Dimension3/3_11_homeoffice.html. Accessed: 27.10.2024.

Diederich, S., Brendel, A. B., Morana, S. & Kolbe, L. (2022), 'On the Design of and Interaction with Conversational Agents: An Organizing and Assessing Review of Human-Computer Interaction Research', *Journal of the Association for Information Systems* **23**(1), 96-138.

Field, A. (2018), *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). Sage Publications.

Gerlach, J. H. & Kuo, F. (1991), 'Understanding Human-Computer Interaction for Information Systems design', *MIS Quarterly* **15**(4), 527-549.

Gopal, A. & Prasad, P. (2000), 'Understanding GDSS in Symbolic Context: Shifting the Focus from Technology to Interaction', *MIS Quarterly* **24**(3), 509-546.

Haan K. & Main, K. (2023), https://www.forbes.com/advisor/business/remote-work-statistics/. Accessed: 27.10.2024.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P. & Ray, S. (2021). Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R. Cham.

Herzwurm, G. (2000). Kundenorientierte Softwareentwicklung. Wiesbaden.

Hölzle, K., Neuhüttler, J., Wenzel, G., Gladilov, N.C., Rasztar, L.A., Rose, R., Bauernhansl, T., Falkenau, F., Schrader, P., Schöllhammer, O., Arment, J., Runde, C. & Alexiadis, I. (2023), Cyberländ. Potenziale des Metaverse für Unternehmen in Baden-Württemberg, Management Summary, Fraunhofer Institute for Industrial Engineering IAO.

Jeong S. & Kim, H. (2023), 'Effect of Trust in Metaverse on Usage Intention through Technology Readiness and Technology Acceptance Model', *Tehnicki Vjesnik - Technical Gazette* **30**(3), 837-845.

Li, L. & Zhang, P. (2005), 'The Intellectual Development of Human-Computer Interaction Research: A Critical Assessment of the MIS Literature (1990-2002)', *Journal of the Association for Information Systems*, **6**(11), 227-292.

Lim, D. H., Lee, J. Y. & Park, S. (2023), 'The Metaverse in the Workplace: Possibilities and Implications for Human resource development', *Human Resource Development Review* **23**(2), 164-198.

Mackenzie, S. (2022), ‘Criminology towards the metaverse: cryptocurrency scams, grey economy and the technosocial’, *The British Journal of Criminology* **62**(6), 1537-1552.
Mayring, P. (2015). *Qualitative Inhaltsanalyse* (12th ed.). Beltz.
Mayring, P. & Fenzl, T. (2022), Qualitative Inhaltsanalyse, *in*: *‘Handbuch Methoden der empirischen Sozialforschung* (3rd ed.)*‘*, Springer, pp. 691-706.
Ng, D. T. K. (2022), ‘What is the metaverse? Definitions, technologies and the community of inquiry’, *Australasian Journal of Educational Technology* **38**(4), 190-205.
Norman, D. A. (1988). *The Design of Everyday Things*. Basic Books.
Park, H., Ahn, D. & Lee, J. (2023), Towards a Metaverse Workspace: Opportunities, Challenges and Design Implications, *in:* ‘CHI '23: Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems’, Association for Computing Machinery, pp. 1-20.
Park, S. & Kim, Y. (2022), ‘A Metaverse: Taxonomy, Components, Applications, and Open Challenges’, *IEEE Access* **10**, 4209-4251.
Porsche Consulting (2016), https://newsroom.porsche.com/dam/jcr:44c0a8a1-1bf0-41eb-8b1c-b7d387106696/161124_Digitalisierung%20Verpackungs-branche_Studie%202016-Doppelseiten.pdf. Accessed: 17.06.2025.
Riihiaho, S. (2018), Usability Testing, *in:* ‘The Wiley Handbook of Human-Computer Interaction’. Wiley, pp. 255-275.
Rockwell Automation (2023), https://packagingeurope.com/what-does-the-digital-transformation-mean-to-packaging-manufacturing/9817.article. Accessed: 17.06.2025.
Rogers, E. M. (2003), *Diffusion of Innovations* (5th ed.). Free Press.
Rosenstand, C. a. F. G., Brix, J. & Nielsen, C. (2023), ‘Metaverse and Society 5.0: Pivotal for Future Business Model Innovation’ *Journal of Business Models* **11**(3), 62–76.
Schuetz, S. & Venkatesh, V. (2020), ‘The Rise of Human Machines: How Cognitive Computing Systems challenge assumptions of User-System Interaction’, *Journal of the Association for Information Systems* **21**(2), 460-482.
Singh, S. & Vanka S. (2023), ‘Metaverse and Future Work: Avenues and Challenges’, *IUP Journal of Organizational Behavior* **22**(2), 107-118.
Starbuck, C. (2023), *The Fundamentals of People Analytics*. Springer.
Sutcliffe, A. G. & Gault, B. (2004), ‘Heuristic Evaluation of Virtual Reality Applications’, *Interacting with Computers* **16**(4), 831-849.
Svensson, J., Eriksson, C. I. & Ebbesson, E. (2010), User Contribution in Innovation Processes – Reflections from a Living Lab Perspective, *in:* ‘2010 43rd Hawaii International Conference on System Sciences’, IEEE, pp. 1-10.
Swamy, S. (2007), How Should You Frame Questions to Measure User Attitudes Accurately? An Experimental Study, *in*: ‘Usability and Internationalization. Global and Local User Interfaces’, Springer, pp. 496-505.
Taherdoost, H. (2022), ‘Designing a questionnaire for a research paper: A comprehensive guide to design and develop an effective questionnaire’, *Asian Journal of Managerial Science* **11**(1), 8-16.

Venkatesh, V (2000), ‘Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model’. *Information Systems Research* **11**(4), 342-365.

Venkatesh, V. & Bala, H. (2008), ‘Technology Acceptance Model 3 and a research Agenda on interventions’, *Decision Sciences* **39**(2), 273-315.

Venkatesh, V., Morris, M.G., Davis, G.B. & Davis F.D. (2003), ‘User Acceptance of Information Technology: Toward a Unified View’, *MIS Quarterly* **27**(3), 425-478.

Vig, S. (2023), ‘Preparing for the new paradigm of business: the metaverse’, *Foresight and STI Governance* **17**(3), 6-18.

Wiangkham, A. & Vongvit, R. (2023), ‘Exploring the Drivers for the Adoption of Metaverse Technology in Engineering Education using PLS-SEM and ANFIS’, *Education and Information Technologies* **29**(6), 7385-7412.