

XR - INDUSTRY

12.12.2024

A futuristic meeting room with a man in VR glasses and two women examining a city model. The man is wearing VR glasses and gesturing towards a large, glowing digital city model on a table. Two women are seated at the table, looking at the model. The room is filled with digital data and network lines, creating a high-tech atmosphere. The word "MOTIVATION" is overlaid in white text on the left side of the image.

MOTIVATION

OVERVIEW

1. Mixed Reality Office System

- Motivation, Study, Results, Discussion

2. VR for Home Office

- Motivation, Study, Results, Discussion

3. VR in AEC Industry

- Motivation, Study, Results, Discussion

4. Summary

5. Selected Paper

6. References

Mixed Reality Office System Based On Maslow's Hierarchy Of Needs:

Towards The Long-Term Immersion In
Virtual Environments

Guo et al.



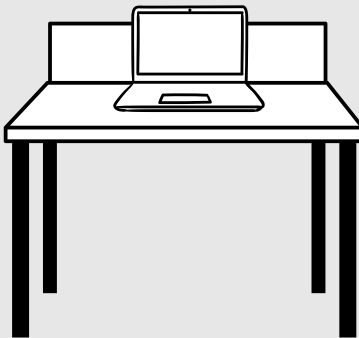
PAPER STATS

- Conference: ISMAR 2019
 - IEEE International Symposium on Mixed and Augmented Reality
 - Rating
 - A (ERA)
 - A2 (Qualis)
- Citations: 59

Which requirements are needed for long-term immersion in MR?



NEEDS FRAMEWORK FOR MIXED REALITY

Deficiency Needs	Specialized VR-Needs	Functional Needs
Maslow's Hierarchy of Needs	<ul style="list-style-type: none">• Spatial Presence• Temporal Presence• Self-Presence	<ul style="list-style-type: none">• Software/Hardware• Input/Output• Context-related
 <p>The image shows Maslow's Hierarchy of Needs as a pyramid with five levels. From top to bottom: 1. SELF ACTUALIZATION (green, person icon), 2. ESTEEM (blue, trophy and graduation cap icons), 3. LOVE AND BELONGING (purple, heart and people icons), 4. SAFETY (pink, shield and dollar sign icons), 5. PHYSIOLOGICAL NEEDS (orange, apple and house icons). A red rounded rectangle highlights the bottom three levels: SAFETY, LOVE AND BELONGING, and PHYSIOLOGICAL NEEDS.</p>	 <p>The image contains two illustrations. On the left is a white alarm clock with two bells and motion lines. On the right is a black and white illustration of a person with a question mark on their face, shrugging their shoulders.</p>	 <p>The image shows a simple line drawing of a desk with a laptop on it. The desk has four legs and a flat top surface.</p>

MIXED REALITY OFFICE SYSTEM



MIXED REALITY OFFICE SYSTEM



MIXED REALITY OFFICE SYSTEM

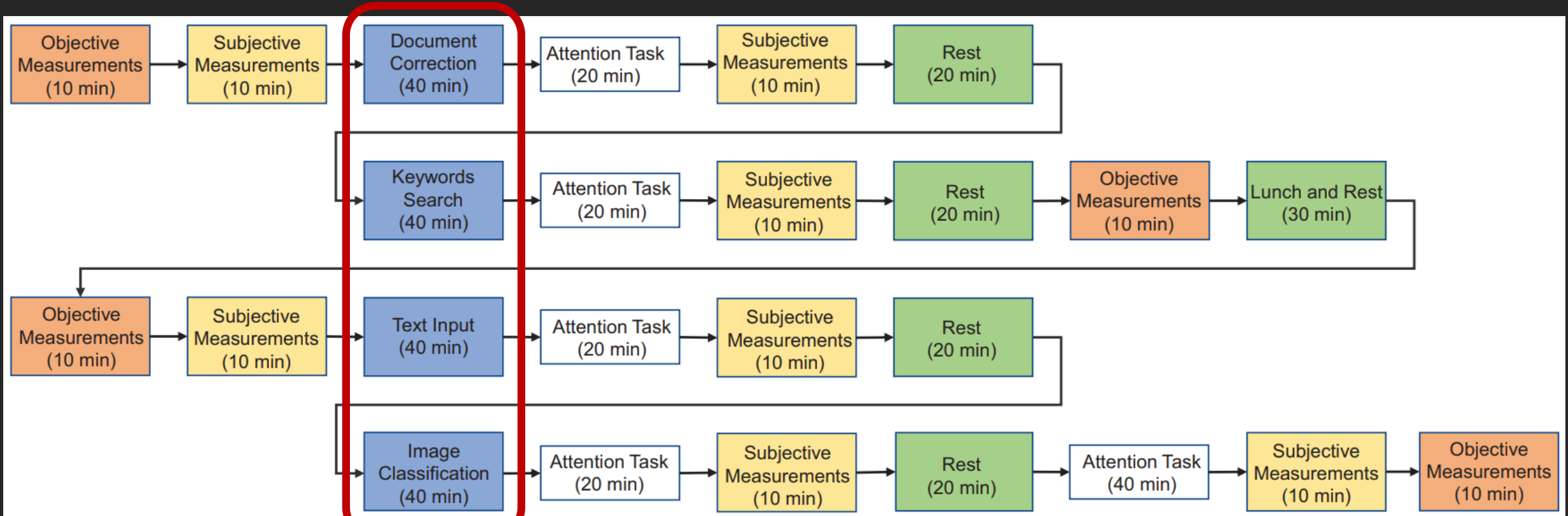
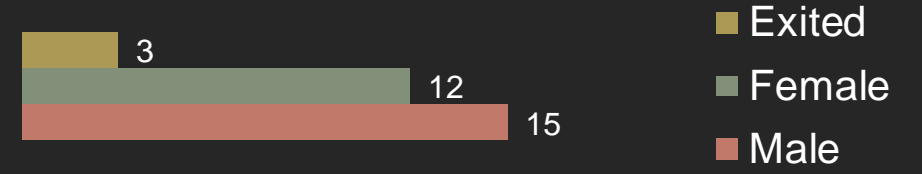


MIXED REALITY OFFICE SYSTEM



EXPERIMENTAL VERIFICATION

- 30 participants
- Real-World Office vs. Mixed-Reality Office



Tasks

RESULTS

Physiological Effects

- Increasing working time → participants felt more uncomfortable, regardless of office setting
 - *BUT* MR-Office induced significantly severer symptoms than RE-Office

Psychological Effects

- Long-term work reduced positive emotions, regardless of office setting

Sense of Presence

- Unfamiliarity → reduced sense of presence

System Usability

- No significant difference between MR and RE regarding usability

CONCLUSION: GUIDELINES

For short- and long-term immersion

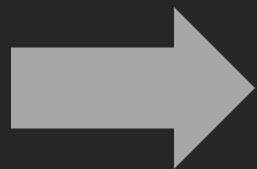
- Safety needs
- Relaxing environments
- Spatial presence

Only for long-term immersion

- Physiological needs
- Emotional needs (i.e. communication to real-world)
- Temporal presence
- Self-presence

DISCUSSION

Strengths	Limitations
Consideration for the participants' routine	Only covers limited physiological needs
Frequent measurements and appropriate questionnaires for respective need	Passive, non-customizable MR-Office
Evaluation of results after each stage	Evaluation of only one 8h-“work-day“



Helpful guidelines for future's design of long-term MR immersion systems

Ready Worker One?

High-Res VR For The Home Office

Ruvimova et al.

PAPER STATS

- Conference: VRST 2023
 - 29th ACM Symposium on Virtual Reality Software and Technology
 - Rating
 - A (ERA)
 - B1 (Qualis)
- Citations: 1

Can VR help combat space challenges in home offices?



DIGITAL ETHNOGRAPHY

- Collection of 430 images
- Online platform: Reddit
 - r/Battlestations
 - r/Workstations
 - r/Workspaces
- Focus on software developers
- What challenges are they currently facing in their home offices?



IDENTIFIED CHALLENGES

Challenge / Code	Description	Instances		Can Address with VR
(A) DESK SPACE	Desk with limited desk space, including smaller desks and larger ones that were clearly not large enough to hold all the user's equipment and supplies.	282	(66%)	Yes
(B) BACKLIT	Desk with window behind it, with the sun shining through, causing a back-lighting effect on the monitor. Back-lighting is known to cause eye strain [44].	106	(25%)	Yes
(D) SIDELIT	Desk with a window beside it, which can make it hard for developers to view their screen [44].	52	(12%)	Yes
(I) FOOTWELL	Desk with large equipment placed in the footwell, potentially causing ergonomic problems [65].	48	(11%)	Yes
(C) CLUTTERED	Desk with unorganized equipment and unrelated items. Clutter is known to increase stress [52].	33	(8%)	Yes
(F) PUBLIC SPACE	Workplace in a common space of the home, such as a dining room table used as a desk, often leading to a noisy environment and impacting productivity [30].	30	(7%)	Yes
(E) PET	Workspace shared with a pet. While pets can be a comfort, they can also be a distraction.	19	(4%)	Yes
(G) WIDTH OF ROOM	Desk in a small nook. Limited width causes various space challenges for equipment and supplies.	17	(4%)	Yes
(H) AWKWARD SPACE	Desk in an awkward, unsuited space for supporting work, such as an attic with a slanted ceiling.	15	(3%)	Yes
(I) BEDROOM	Workplace in the bedroom making the separation between work and life difficult.	15	(3%)	Yes
(J) FIXED CHAIR	Workstation with a fixed, not adjustable, chair, often leading to poor ergonomics [48].	10	(2%)	No
(K) SHARED SPACE	Two workstations for two people working side-by-side. Working in close proximity can lead to distraction and affect cognitive performance, especially with remote meetings [26].	9	(2%)	Yes
(L) CHAIR SPACE	Workstation with insufficient space to move the chair properly.	8	(2%)	Maybe

SPECULATIVE DESIGN OF WORKSPACES



(a) DESK SPACE (CLUTTERED, FOOTWELL)



(b) BACKLIT (SIDELIT, PET)



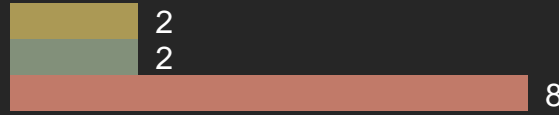
(c) SHARED SPACE (BEDROOM, FOOTWELL)



(d) PUBLIC SPACE (WIDTH OF ROOM, AWKWARD SPACE, CHAIR SPACE)

VR FIELD STUDY

- 12 participants



- Exited
- Female
- Male

- Virtual features

- Pass-through camera
- Ambient environments

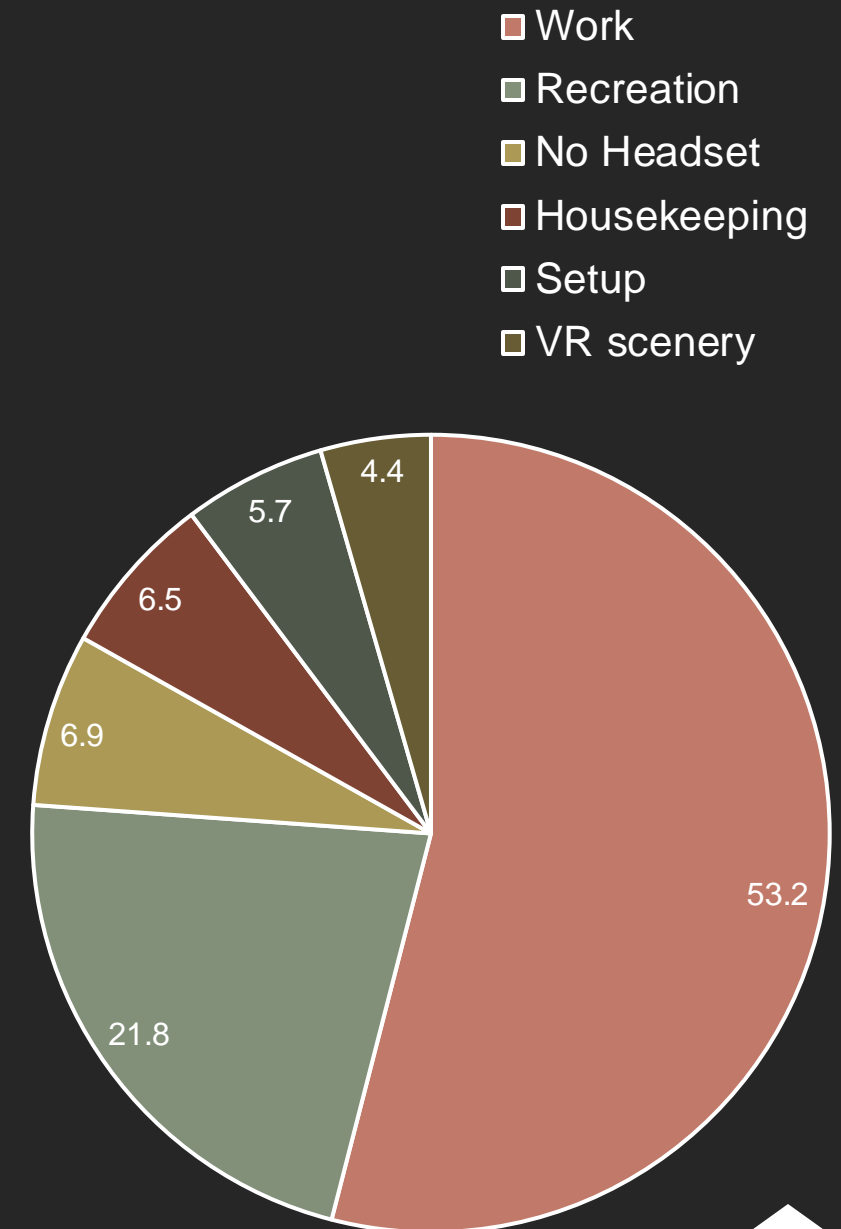
- Daily Sessions

- Use VR for 4 days
- ~ 2h per day
- Free choice of activity in VR



RESULTS

- Heightened flow due to minimized distractions
- Enjoyment of ambient setting
 - *BUT* desire for customizability
- Interaction between worlds
 - Some → decreased immersion
 - Some → enjoyment
 - Challenge → drinking water
- Time spend in VR (3rd session)
 - Participants had free choice over how they spend their time
 - Majority of the 2h spend on work



DISCUSSION

Strengths	Limitations
Consideration of guidelines for MR systems	Missing some participant data during 3rd session
Proposal of improved speculative design after evaluation	Possible sample bias in ethnography
Variety of data collection methods	Small sample size
	Some challenges (and their solutions) have already been discussed in the referenced studies: e.g. drinking water in VR

Evaluation Of Virtual Reality For Early-Stage Structure And Production Planning For Industrial Buildings

Podkosova et al.

PAPER STATS

- Conference: ISMAR-Adjunct 2023
 - IEEE International Symposium on Mixed and Augmented Reality Adjunct
 - Rating
 - A (ERA)
 - A2 (Qualis)
- Citations: 0

What are advantages and disadvantages of VR in building planning?



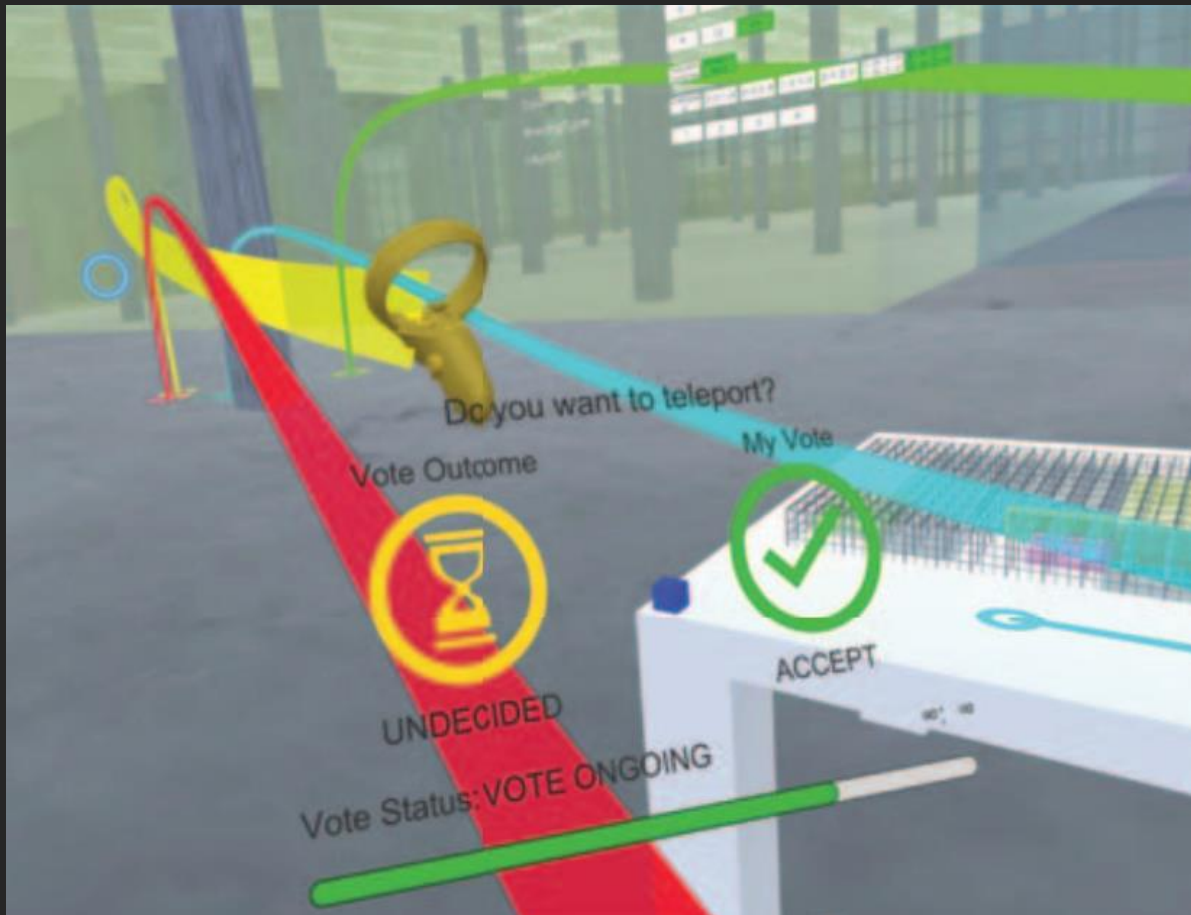
BIMFLEXI-VR

- Real-time visualisation of building structures
- Option to modify parameters and see immediate effect on building
- Users
 - Portrayed as avatars
 - Each with specific color

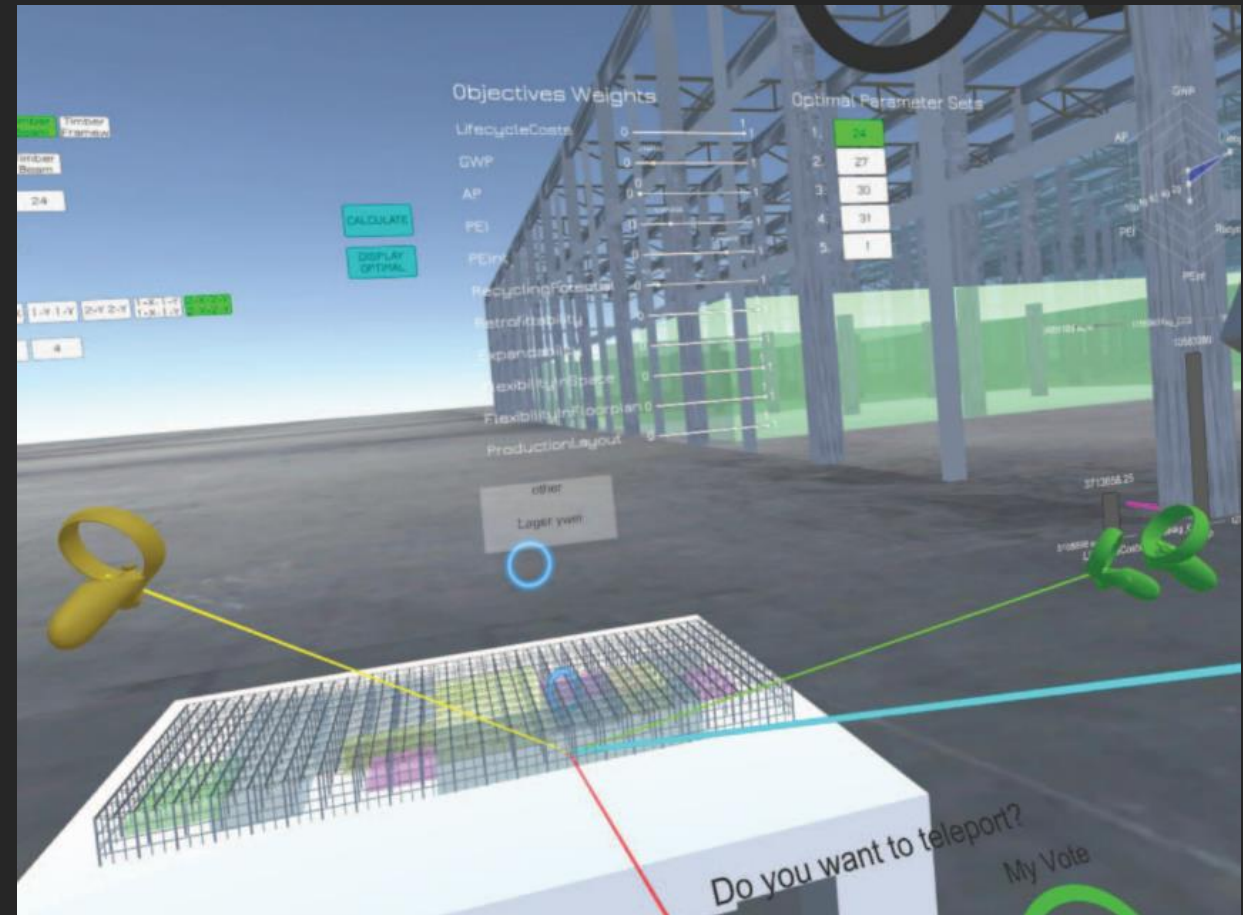


TRAVEL METHODS

Parabola Teleport

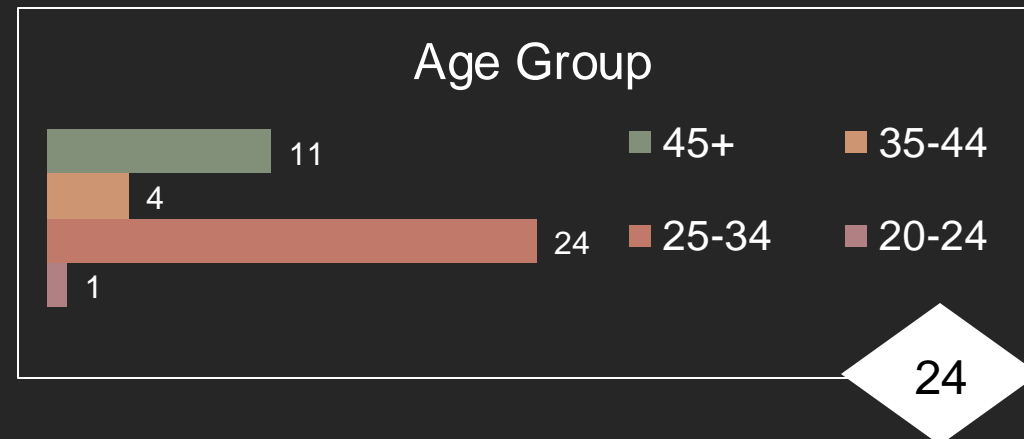
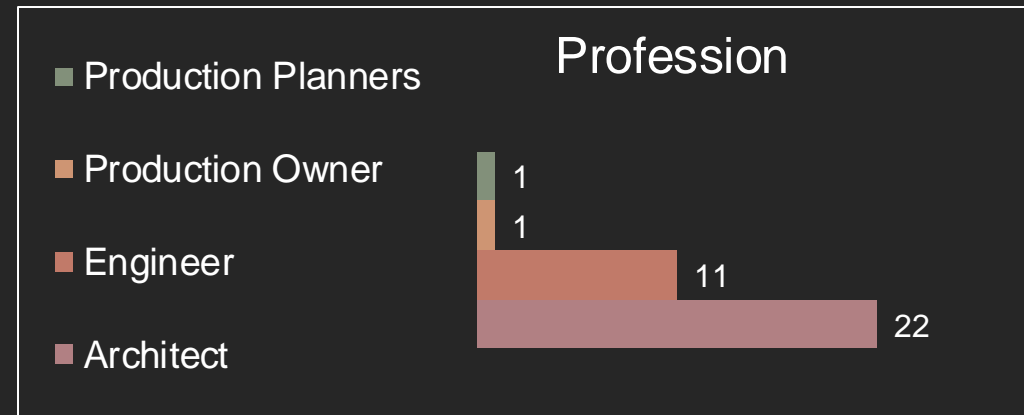
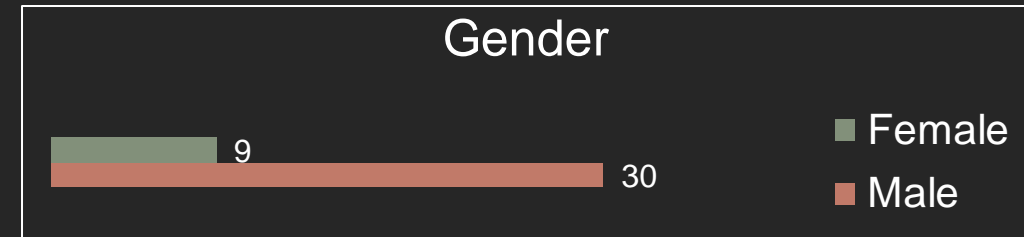


Mini-Model Teleport



EVALUATION METHODOLOGY

- BIMFlexi-VR vs Desktop-Version
- Guided trial through VR-buildings
- 39 participants (13 groups)
 - Predominantly architects and structural engineers
 - Most represented age group: 25-34
- Evaluation via questionnaire and interview



RESULTS

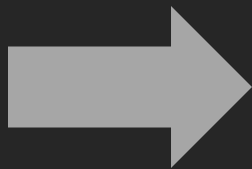
- Desktop-Version preferred for actual planning → more control, VR too time-intensive
- Benefits of BIMFlexi-VR
 - Visualization for production owners and customers
 - Communication platform for meetings
- VR-setting more intuitive for younger age group than for older age group
- Prior VR-experience → improved understanding in VR-setting
- Open wishes: Customizability of interface

DISCUSSION

Strengths	Limitations
Exclusion of under-represented groups in quantitative analysis	Results are exploratory
Sampling bias for profession	Sampling bias (age, gender, profession)
	Experiementer part of the group during walk-through

SUMMARY

- Framework → Home Office → AEC Industry
- Shared findings
 - Desire for customization
 - Potential for integration in respective industry
- Shared limitations
 - Sample bias and sample sizes
- VR applicable in different industries



Need for further studies

SELECTED PAPER

Paper 1

**Mixed Reality Office System Based on Maslow's Hierarchy of Needs:
Towards the Long-Term Immersion in Virtual Environments**

THANK YOU!

Questions?

REFERENCES

Motivation

- <https://www.simon-kucher.com/en/insights/metaverse-interoperability-avatars-trailblaze-new-business-model>

Paper 1

- https://ieeexplore.ieee.org/abstract/document/8943608?casa_token=L_pm1lgRjW8AAAAA:giV0RDFCPm2AXvk2wHuqbjxMD5q9A4jK-poG5TZLvYE2W82W0dAs8ENm7mJcjpIw-biCdGiD4tE
- <https://www.indeed.com/career-advice/career-development/maslows-hierarchy-of-needs>

Paper 2

- <https://dl.acm.org/doi/abs/10.1145/3611659.3615680>
- <https://klangbilder.net/2018/04/19/die-realitaet-ist-real-ready-player-one/>
- <https://github.com/vcuse/workstation-setups/tree/master/data/pictures/>

Paper 3

- https://ieeexplore.ieee.org/abstract/document/10322209?casa_token=oHW0HSCgxMUAAAAA:Wyc1MKRvmTq4r-cmljEt_SakPyHdCfL_hlyevBVPwwbSL_M6myp1p1GJ0S8A0VRKNOeib2YGhFI
- <https://treblehook.com/blog/aec-industry-trends/>