

The “Boat Anchor Effect”: How Hardware First XR Strategies Kill Innovation in Higher Education

Dawn T. Gresham

Marymount University, Arlington, VA, USA, d0g71557@marymount.edu

Abstract: Higher education institutions continue investing in immersive technology (XR), yet adoption remains uneven and often unsustainable. This paper introduces the “Boat Anchor Effect,” a phenomenon identified in a focus group of XR-active faculty and staff across U.S. institutions. Participants described how rapid hardware obsolescence, content-development lag, and administrative bottlenecks create structural barriers that paralyze innovation. Drawing on a phenomenological analysis of transcript data, this study connects the “Boat Anchor Effect” to established theories of facilitating conditions, perceived usefulness, and organizational support. The results suggest that hardware-centric approaches are fundamentally misaligned with the pace of XR evolution. Sustainable adoption requires platform-agnostic skill development, cross-departmental XR “guilds,” and institutional support structures that prioritize pedagogy over devices.

Keywords: XR Adoption, Hardware Obsolescence, Immersive Learning, Facilitating Conditions, Organizational Support

1. Introduction

Universities increasingly view XR as a pathway to innovation, yet faculty adoption remains inconsistent. Prior research shows that innovation requires behavioral change, new responsibilities, and strong institutional support (Kopcha et al., 2016; Castelló-Mayo et al., 2019). In a focus group with XR-engaged faculty and staff, participants repeatedly described a barrier that has received little attention in the literature: the fear of rapid technological obsolescence. One participant summarized the issue succinctly: “Once-revolutionary hardware, like the Quest 1, quickly becomes a boat anchor—expensive equipment that no longer supports current software.”

This paper expands the initial framing of the “Boat Anchor Effect” into a theoretically grounded analysis of how hardware-first strategies impede XR adoption in higher education.

1.1 Contribution Statement

This study contributes to XR adoption research by identifying a structural barrier—hardware obsolescence—that is not captured in existing models of facilitating conditions, perceived usefulness, or organizational support. The “Boat Anchor Effect” explains why institutions struggle to scale XR initiatives despite faculty interest and available funding.

2. Methods

A qualitative focus group was conducted with five XR-active faculty, staff, and administrators from U.S. higher education institutions. Participants were recruited through targeted outreach based on their involvement in XR programs, labs, or partnerships. The 90-minute session was held via Microsoft Teams, audio-recorded with permission, and transcribed verbatim, producing 24 pages of data.

A phenomenological approach (Creswell & Poth, 2018) was used to capture participants’ lived experiences with XR implementation. Analysis proceeded through multiple stages:

- Initial reading to gain familiarity with the transcript
- Topical coding to identify recurring concepts
- Sentiment analysis to assess emotional tone around barriers and enablers
- Theme development linking participant experiences to XR adoption literature

- Cross-checking themes against theoretical priors (e.g., facilitating conditions, perceived usefulness)

Ten XR concepts mapped to four first-order themes and six subthemes. These themes form the analytic foundation of the “Boat Anchor Effect”.

Limitations include the small sample size, the focus on XR-active institutions, and the possibility that participants’ enthusiasm for XR may not reflect broader faculty sentiment across institutions with minimal XR investment.

To get more in-depth insights on participant views, the focus group protocol included questions on faculty interest, internal and external XR relationships, variables contributing to program success, barriers to expansion, enablers experienced, and institutional rationales for the adoption of XR. They detailed the XR equipment they utilize at their universities, the maturity of their XR programs and the organizational structures supporting XR projects.

The phenomenological approach was used because it helps researchers to identify discrepancies, failures, favorable judgments and various situational dynamics in organizational environments (Groenewald, 2004). This approach proved especially appropriate for analyzing the experiences of teachers, staff, and administrators with implementing XR in higher education institutions. Summary tables and in line quotations in the analysis, following the work of Bhattacharyya & Berdahl (2023) and Pratt (2008), were used to reduce distortion of participant narratives.

Coding was carried out in several steps. After initial transcript review, comments were classified into topical categories and examined for common experiences (Gibbs, 2007). Ten XR concepts were theoretically mapped to four first-order themes and six subthemes. Sentiment analysis was conducted on one of the themes to assess emotional tone around barriers and enablers. A detailed codebook was developed to define themes and subthemes and to ensure analytic consistency. These themes suggested strong commonality of lived experience among participants.

3. Findings

3.1 Rapid Shelf-Life Creates Organizational Paralysis

Participants emphasized that XR hardware evolves at a pace that outstrips institutional procurement cycles. Beyond incompatibility across headsets, several participants noted failures of social VR spaces, inconsistent vendor support, and the lack of reliable long term hardware partnerships.

One participant described the experience as “keeping pace with technology while everything around you becomes obsolete,” highlighting the emotional fatigue associated with constant adaptation. Another participant noted that institutions “need better partners in the education space,” underscoring that hardware volatility is compounded by vendor instability and inconsistent support models. Participants described XR hardware as uniquely volatile: “Keeping pace with technology... different headsets where things don’t cross across each other.” Procurement cycles often outlast hardware relevance, creating institutional hesitation and undermining long-term planning.

3.2 The Content Gap

Participants described a persistent tension between the desire to build validated academic simulations and the rapid discontinuation of hardware platforms. Several noted that XR content creation requires specialized skills, long development timelines, and cross department collaboration. As one participant explained, “the desire to build content in VR versus the desire to build experiences” often leads to stalled projects, especially when faculty lack technical support or instructional design resources.

Validated academic simulations require long development timelines. By the time content is ready for deployment, the hardware platform may be discontinued: “By the time a validated academic simulation is built and tested, the hardware it was designed for is often discontinued.” This mismatch discourages investment in curricular XR content.

3.3 The MDM Bottleneck

Participants described device management as one of the most significant hidden labor costs. Beyond onboarding emails and account creation, they noted challenges with risk management, student troubleshooting, and maintaining compatibility across device generations. One participant described having students “solve XR issues” as an informal workaround, illustrating how institutions rely on ad hoc labor to compensate for inadequate administrative infrastructure. Participants described significant administrative overhead: “Getting individual emails for each headset to work on... onboarding space.” Manual device management creates hidden labor costs that prevent small pilots from scaling.

3.4 Misaligned Incentives and Faculty Barriers

Faculty incentives were also described as poorly linked with XR innovation. Promotion and incentive systems favor traditional scholarship more than experimental instruction, creating a contradiction between the adoption of XR and career development. Participants said XR engagement has to be “credited in a way that’s meaningful for tenure and promotion” to keep professors involved. Faculty interest exists, but structural barriers dominate: “Many are interested but deterred by barriers, and don’t know where to start... silos where various faculty are utilizing VR in different ways.” Without facilitating conditions (Gupta et al., 2026; Vongkulluksn et al., 2018), adoption stalls despite enthusiasm.

3.5 Enablers of XR Adoption

Participants identified several enablers that reduce barriers to XR adoption. These ranged from AI tools that reduce the technical hurdle of content creation, to cross-departmental partnerships that enhance resilience in an institution, to introductory XR spaces with gear from startups. Facilitating conditions identified included incentives such as training, scholarly reputation, and grant writing support. The need of “finding the right people and the correct focus for acquisition and grant writing” was highlighted by the participants. This implies that strategic leadership is a key issue in maintaining XR projects.

3.6 Success Factors in XR Implementation

Participants highlighted several success factors that contribute to sustainable XR adoption. These included leadership support from presidents, deans, and CIOs; building communities of XR users; developing in house skill databases; and making XR content freely available. One participant noted that “building a community of virtual reality users” was essential for reducing redundancy and fostering innovation. These success factors align with broader research on facilitating conditions and organizational support.

4. Discussion

The “Boat Anchor Effect” is not simply a hardware problem—it is an organizational misalignment. XR evolves faster than higher education procurement, risk management, and content-development cycles. This creates a predictable pattern:

1. Institutions buy hardware
2. Hardware becomes obsolete
3. Faculty lose trust
4. Innovation stalls.

The “Boat Anchor Effect” also speaks to deeper psychological and organizational factors. Faculty who exhibit strong information seeking behavior (Korobili et al., 2011) are more apt to stick with XR adoption despite the instability of hardware, but this reliance on genuinely motivated innovators leads to inequitable patterns of adoption. As Lu (2014) states, information seeking directly affects perceived usefulness (PU) and perceived ease of use (PEOU), which suggests that the acceptance of XR could be more reliant on faculty with specific psychological characteristics.

4.1. Theoretical Integration

These findings extend existing XR adoption models in three ways:

- Facilitating Conditions (FCs): Prior research emphasizes training, support, and resources. The “Boat Anchor Effect” adds *hardware volatility* as a structural FC barrier.
- Perceived Usefulness (PU): When hardware becomes obsolete before content is ready, PU collapses—even if the content is pedagogically strong.
- Organizational Support: Hardware-first strategies undermine faculty confidence, weakening the organizational support mechanisms needed for adoption.

Thus, the “Boat Anchor Effect” represents a missing link in XR adoption theory: the temporal mismatch between hardware evolution and academic implementation cycles.

5. Implications for Higher Education

5.1 Shift from Hardware-Centric to Platform-Agnostic Strategies

Focusing on skills rather than devices reduces long term risk. Building platform agnostic competencies allows institutions to adapt to hardware changes without losing pedagogical momentum. Participants emphasized focusing on skills rather than devices: “Focusing on the skills early on and less so on the technology.”

5.2 Build XR Guilds and Skill Databases

Cross-department XR communities reduce redundancy and increase resilience. Building a community of immersive technology or an XR guild reduces silos, increases knowledge sharing, and creates institutional memory.

5.3 Invest in Sustainable Support Structures

Critical facilitating conditions highlighted by participants were professional development, risk management, and instructional design support. These structures increase perceived abilities and value beliefs (Vongkulluksn et al., 2018) transferring availability of XR technology into classroom practice. Professional development, risk mitigation and centralized XR labs reduce faculty burden and increase adoption.

5.4 Redesign Procurement for Rapid Tech Cycles

Shorter purchasing cycles and modular hardware strategies reduce Boat Anchor risk.

6. Conclusion

The “Boat Anchor Effect” is a structural barrier to XR adoption in higher education. Hardware-first strategies are incompatible with the pace of XR evolution. Sustainable innovation requires institutional support, platform-agnostic skill development, and faculty-centered facilitating conditions. Without these shifts, XR programs will remain dependent on individual innovators rather than broad faculty engagement. This study also points out the importance of teacher perspectives in shaping XR acceptance. According to Rogers (2003), the perceived qualities of the invention, individual attitudes and organizational setting are all factors upon which the diffusion of innovation depends. Faculty judgments on the shelf life, compatibility, and

support mechanisms for XR significantly impact adoption trajectories. The findings imply that adopting XR in higher education involves not only technological investment but also a strategic alignment of incentives, support structures, and organizational procedures.

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