Umar, T., Chun, K. and Smith, J., 2026. Enhancing High-Performance Computing adoption in the built environment: A user-centred approach to inclusive digital innovation. In: Waidyasekara, K.G.A.S., Jayasena, H.S., Chandanie, H. and Tennakoon, G.A. (eds). *Proceedings of the 14th World Construction Symposium*, 10-11 July 2026, Sri Lanka. pp. 672-685. DOI: https://doi.org/10.31705/WCS.2026.50. Available from: https://ciobwcs.com/papers/

ENHANCING HIGH-PERFORMANCE COMPUTING ADOPTION IN THE BUILT ENVIRONMENT: A USER-CENTRED APPROACH TO INCLUSIVE DIGITAL INNOVATION

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ABSTRACT

High-Performance Computing (HPC) is increasingly recognised as a critical enabler of advanced modelling, simulation, and data-intensive research. However, its adoption within the built environment remains limited compared to more established computational domains. This paper presents a user-centred investigation into the barriers and opportunities associated with HPC adoption in the built environment, drawing on qualitative data from a stakeholder workshop involving 20 participants, supported by Mentimeter-based interactive polling and analysis of workshop discussions. The findings reveal a persistent gap between the perceived relevance and practical use of HPC. While participants recognised its potential for applications such as digital twins, infrastructure simulation, and data-driven design, adoption was constrained by complex access processes, limited training, and poor interoperability with tools such as Building Information Modelling (BIM), Geographic Information Systems (GIS), and Computer-Aided Design (CAD). Additional barriers included data governance challenges, intellectual property concerns, and limited trust in shared computational environments. The findings demonstrate that HPC adoption is not solely a technical issue, but a socio-technical challenge shaped by organisational practices, institutional structures, and user capabilities. In response, the paper proposes a user-centred roadmap for inclusive HPC adoption in the built environment. Key priorities include simplifying access pathways, developing domain-specific training, improving interoperability, and strengthening governance frameworks. The study contributes practical insights to support more accessible and inclusive digital research infrastructure and informs the development of the National Federated Compute Services (NFCS) roadmap for interoperable HPC adoption within the built environment sector.

Keywords: *Built Environment; Digital Infrastructure; Digital Transformation; High-Performance Computing (HPC); User-Centred Design.*

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1. INTRODUCTION

HPC is widely recognised as a critical enabler of digital transformation, supporting large-scale simulation, artificial intelligence, and data-intensive research across diverse disciplines (Dongarra et al., 2020). HPC has played a central role in advancing scientific discovery in areas such as climate modelling, genomics, and physics, where computational demands exceed the capabilities of conventional desktop systems (Yousaf & Khan, 2022). As analytical complexity and data volumes continue to increase, HPC is increasingly positioned as essential digital research infrastructure within national and international research ecosystems (Asch et al., 2018).

In the United Kingdom, this strategic importance is reflected in initiatives such as the National Federated Compute Services (NFCS) NetworkPlus programme, which aims to develop a coordinated and federated approach to digital research infrastructure. The programme focuses on community, technology, and governance to support a more accessible, interoperable, and inclusive HPC ecosystem. A key ambition is to broaden participation beyond traditional computational domains and address persistent inequalities in HPC access and use. Despite these developments, HPC adoption remains uneven across sectors (Kumar et al., 2025). While computationally intensive disciplines have long integrated HPC into their workflows, many applied and interdisciplinary sectors, including the built environment, have yet to fully realise its potential (Aghimien et al., 2021). This disparity highlights a critical challenge: the availability of advanced computational infrastructure does not automatically translate into widespread or equitable adoption.

The built environment sector, encompassing architecture, engineering, construction, and urban planning, is undergoing rapid digital transformation through technologies such as Building Information Modelling (BIM), digital twins, and sensor-based monitoring systems (Bolton et al., 2018; Succar & Kassem, 2015; Hosseini et al., 2026). These technologies generate increasingly large and complex datasets and create opportunities for HPC-enabled applications including infrastructure simulation, climate resilience modelling, materials analysis, and real-time decision-making. However, HPC adoption within the sector remains limited and fragmented (Usman et al., 2019). Existing workflows continue to rely heavily on desktop-based environments, while many commonly used tools are not readily compatible with HPC systems (Piane et al., 2024). Consequently, a disconnect persists between the computational potential of HPC and the practical realities of built environment workflows.

Emerging evidence suggests that this disconnect is not solely technical. Users frequently encounter barriers related to access procedures, limited awareness, insufficient training, inconsistent software environments, and concerns regarding data governance and security (Gamblin & Katz, 2023). These challenges are particularly significant in the built environment, where workflows are often time-sensitive, collaborative, and dependent on domain-specific data ecosystems. Data governance represents an additional challenge because built environment data is frequently proprietary, commercially sensitive, and distributed across multiple organisations (Berlato et al., 2025). This limits data sharing and collaboration while raising concerns regarding trust, privacy, and regulatory compliance.

Socio-technical perspectives provide an important framework for understanding these challenges. Socio-technical systems theory emphasises that successful technology adoption depends on alignment between technological systems, organisational structures, and user practices (Baxter & Sommerville, 2011). Similarly, sociomaterial perspectives highlight that technologies are shaped through dynamic interactions between users, tools, and institutional contexts (Orlikowski, 2007). From this perspective, HPC adoption cannot be understood solely in terms of computational capability, but also in relation to usability, accessibility, workflow integration, and governance.

Additional barriers arise from the structural characteristics of the built environment sector, including fragmented supply chains, conservative practices, and resistance to technological change (Oesterreich & Teuteberg, 2016). Unlike BIM adoption, which benefited from policy mandates and coordinated implementation strategies, HPC adoption currently lacks equivalent institutional or regulatory drivers. As a result, uptake remains dependent on individual initiative rather than system-level support. Against this background, there is a clear need for research that bridges the gap between HPC infrastructure and built environment practice. Although previous studies have examined digital transformation in construction and the technical development of HPC systems, there remains limited empirical research exploring HPC adoption from a user-centred perspective within the built environment. This paper addresses this gap using qualitative data collected through a UKRI-funded project under the NFCS NetworkPlus programme. Drawing on stakeholder workshop discussions and interactive engagement methods, the study investigates barriers and enablers influencing HPC adoption across the user journey. Accordingly, this study aims to investigate the barriers and enablers influencing HPC adoption within the built environment from a user-centred and socio-technical perspective. The specific objectives are to: (1) examine stakeholder awareness and perceptions of HPC; (2) identify barriers related to access, workflows, governance, and skills; (3) explore how organisational and institutional contexts influence adoption; and (4) propose a user-centred roadmap to support more inclusive and accessible HPC adoption.

2. LITERATURE REVIEW

2.1 HPC AND DIGITAL TRANSFORMATION IN THE BUILT ENVIRONMENT

HPC has become a key component of digital research infrastructure, supporting large-scale simulation, advanced modelling, and data-intensive analysis across diverse disciplines (Dongarra et al., 2020). Traditionally associated with computationally intensive fields such as climate science and physics, HPC is increasingly relevant to interdisciplinary and applied domains due to the growing importance of data-driven research (Hey et al., 2009; Yin & Shi, 2022). However, existing HPC systems have historically been designed around specialist computational users and prioritised performance, scalability, and efficiency over usability and accessibility (Carver et al., 2019). Consequently, many non-expert users face barriers related to complex software environments, command-line interfaces, and limited workflow integration (Adimora et al., 2025). While recent policy initiatives increasingly emphasise inclusive and accessible digital research infrastructure (Gadam, 2025), there remains limited empirical research examining how these objectives can be achieved in applied sectors such as the built environment.

The built environment sector has undergone rapid digital transformation through technologies such as BIM, digital twins, and Internet of Things (IoT) systems (Succar &

Kassem, 2015; Bolton et al., 2018). These technologies generate large and complex datasets, creating opportunities for HPC-enabled applications including infrastructure simulation, climate resilience modelling, and real-time decision-making. However, adoption remains constrained by interoperability challenges, organisational readiness, fragmented supply chains, and reliance on established desktop-based workflows (Oesterreich & Teuteberg, 2016; Tran & Nguyen, 2024). Although digital twins align closely with HPC capabilities, implementation remains limited due to difficulties related to data integration, interoperability, and computational infrastructure (Boyes & Watson, 2022). This suggests that digital transformation challenges in the built environment are not solely technical but also organisational and socio-technical in nature.

2.2 DATA, GOVERNANCE, AND INTEROPERABILITY

Data management and interoperability represent major challenges for HPC adoption in the built environment. The increasing availability of data from sensors, monitoring systems, and digital models has expanded opportunities for data-driven analysis yet introduced significant governance and integration challenges (Kosicki et al., 2021). The FAIR principles Findable, Accessible, Interoperable, and Reusable—provide an important framework for improving data practices (Wilkinson et al., 2016), yet implementation remains uneven due to fragmented and proprietary data ecosystems (Jacobsen et al., 2020). Interoperability extends beyond technical compatibility to include semantic and organisational dimensions (Mistry et al., 2022; Pauwels & McGlinn, 2022). While HPC systems may provide significant computational capability, the effort required to prepare, integrate, and manage heterogeneous datasets can limit practical adoption (Reuther et al., 2024). Governance and trust further complicate implementation, particularly where concerns regarding intellectual property, commercial sensitivity, and regulatory compliance restrict data sharing and collaboration (Roski et al., 2021). Existing governance approaches are often designed for academic rather than industry-oriented environments and may not adequately address these concerns (Besednjak Valič et al., 2023). These challenges are intensified by the long lifecycle of built assets, which creates additional requirements for long-term data continuity and accessibility (Hernández-Moral et al., 2021).

2.3 SOCIO-TECHNICAL PERSPECTIVES ON HPC ADOPTION

Socio-technical systems theory provides a useful framework for understanding HPC adoption in the built environment (Brackley et al., 2024). Rather than viewing technology as an isolated artefact, socio-technical perspectives emphasise the interaction between technical systems, organisational practices, and institutional structures (Baxter & Sommerville, 2011). Successful adoption therefore depends on alignment between technological capability and user needs (Lukyamuzi et al., 2026). Orlikowski's (2007) concept of sociomateriality further suggests that technologies are shaped through ongoing interaction between users and systems rather than through straightforward implementation processes. These perspectives highlight the importance of user-centred design in digital infrastructure development (Peltonen & Nieminen, 2025). Traditional HPC systems often prioritise computational performance at the expense of usability, creating barriers for non-specialist users. In contrast, user-centred approaches focus on accessibility, workflow integration, and alignment with real-world practices. This is particularly important within the built environment, where diverse stakeholders, fragmented workflows, and project-based delivery structures complicate technology adoption.

2.4 SYNTHESIS AND RESEARCH GAP

The literature demonstrates that HPC has significant potential to support data-intensive and interdisciplinary applications within the built environment. However, adoption remains constrained by interoperability challenges, governance concerns, skills gaps, and organisational barriers. Existing HPC research predominantly focuses on computational performance and technical architecture, while built environment research largely concentrates on digital tools such as BIM and digital twins. Consequently, there is limited integration between these domains and relatively few empirical studies examining HPC adoption from a user-centred perspective within the built environment.

This paper addresses this gap by applying a socio-technical framework to empirical data collected through a UK Research and Innovation (UKRI)-funded project under the NFCS NetworkPlus programme. By focusing on user experiences, workflow integration, governance, and institutional challenges, the study contributes to a more nuanced understanding of how HPC can be made accessible, inclusive, and aligned with real-world built environment practices.

3. RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

This study adopted a qualitative, user-centred research design to investigate barriers and enablers influencing HPC adoption within the built environment. The approach reflects the socio-technical nature of HPC adoption, recognising that engagement with digital infrastructure is shaped by interactions between technological systems, organisational practices, and user capabilities (Raybourn & Muollo, 2023; Frericks et al., 2018). Rather than focusing solely on technical performance, the study explored the broader user journey, including awareness, access, practical use, and long-term engagement with HPC systems. A qualitative approach was selected to capture context-specific insights into user experiences, workflow constraints, governance concerns, and organisational practices that are difficult to examine using quantitative methods alone. The methodology combined a stakeholder workshop with interactive polling using Mentimeter, enabling collection of both in-depth qualitative insights and broader patterns of participant responses. This approach aligns with broader calls for more inclusive and accessible digital research infrastructure and the objectives of the wider NFCS NetworkPlus project (Almusaed et al., 2025).

3.2 ETHICAL CONSIDERATIONS

Ethical approval was obtained from the University of the West of England (UWE) Research Ethics Committee. Participants received information regarding the purpose of the study, the voluntary nature of participation, and the intended use of data. Informed consent was obtained prior to participation, and all data were anonymised before analysis. Data were stored securely in accordance with institutional data management procedures and relevant data protection regulations. Attention was given to confidentiality where participants discussed commercially sensitive practices and organisational challenges.

3.3 WORKSHOP DESIGN AND PARTICIPANT RECRUITMENT

A stakeholder workshop was used as the primary data collection method. Participants were recruited through an Expression of Interest (EOI) process circulated through professional networks, email invitations, and NFCS NetworkPlus events. More than 50 responses were received, from which 30 participants were selected to ensure diversity in professional background, sector representation, and experience with digital and data-driven practices. Ultimately, 20 participants attended the workshop. Although participant attrition may have influenced the breadth of perspectives represented, non-attendance was not concentrated within a specific professional group. As recruitment was voluntary, the sample may have been biased towards participants with greater interest in HPC and digital infrastructure. The findings should therefore be interpreted as indicative rather than statistically representative. The workshop included researchers, industry practitioners, and technical specialists from the built environment sector. Activities included expert presentations, facilitated breakout discussions, plenary sessions, and interactive polling. Discussions focused on three themes: (1) barriers to HPC adoption, including workflow and infrastructure challenges; (2) trust, governance, and data-related concerns; and (3) future priorities for more inclusive HPC adoption and roadmap development.

3.4 MENTIMETER INTEGRATION

Mentimeter was used during the workshop to capture real-time and anonymised participant responses. Interactive polling tools such as Mentimeter are increasingly used in participatory research to support engagement and rapid collection of stakeholder perspectives (Khan, 2026). The integration of Mentimeter enabled broader participation, including from individuals less comfortable contributing during group discussions, while also reducing participation bias. The polling questions aligned with the workshop themes and explored issues including access barriers, workflow integration, governance concerns, and skills gaps. Combining polling outputs with facilitated discussion enabled corroboration of findings across multiple forms of participant engagement.

3.5 DATA ANALYSIS

Data analysis was conducted using qualitative thematic analysis supported by descriptive interpretation of Mentimeter responses. Thematic analysis was selected because it enables systematic identification of patterns within qualitative datasets while remaining sufficiently flexible to capture context-specific insights (Ahmed et al., 2025). Workshop notes, transcripts, and Mentimeter outputs were first reviewed to achieve familiarity with the data. Initial codes were then generated and grouped into broader themes relating to HPC adoption, including access barriers, workflow integration, governance concerns, and skills gaps. Themes were refined through iterative comparison across data sources to improve consistency and depth of interpretation. To enhance analytical rigour, preliminary themes were revisited multiple times and informally discussed among members of the research team to challenge interpretations and reduce researcher bias. Although formal inter-coder reliability testing and member-checking were not undertaken due to the exploratory nature of the study, efforts were made to maintain transparency and consistency throughout the analytical process. The combination of workshop discussions and Mentimeter responses supported convergent validation of findings.

Several limitations should be acknowledged. The workshop sample was relatively small and based on voluntary participation, which may have resulted in greater representation from participants already interested in HPC-related topics. Consequently, the findings may not fully represent the diversity of perspectives within the wider built environment sector. Nevertheless, the participatory and user-centred design enabled the collection of rich qualitative insights into real-world barriers and opportunities associated with HPC adoption.

4. DATA ANALYSIS AND RESULTS

4.1 OVERVIEW OF FINDINGS

The findings are based on qualitative data collected through a stakeholder workshop involving 20 participants from academia, industry, and technical domains within the built environment sector, supported by Mentimeter polling. The analysis identified a series of interconnected barriers influencing HPC adoption, including limited awareness, access difficulties, workflow incompatibility, governance concerns, skills gaps, and institutional constraints.

4.2 AWARENESS, USE, AND ACCESS BARRIERS

Participants generally recognised the potential relevance of HPC for applications such as digital twins, infrastructure simulation, climate modelling, and data-intensive analysis. However, HPC was frequently perceived as a specialised resource rather than a practical tool for routine use. One participant noted that "HPC still feels like something designed for computer scientists rather than built environment professionals." Mentimeter responses indicated that approximately 70% of participants considered HPC highly relevant to future built environment applications, while fewer than 30% reported confidence in independently accessing or using HPC systems. Despite recognising potential benefits, participants reported limited practical engagement with HPC and continued reliance on local computing resources or simplified models. This suggests a clear gap between perceived value and practical adoption. Access and onboarding barriers were identified as major challenges, particularly within time-sensitive project environments. Participants highlighted difficulties in identifying suitable HPC resources, navigating access procedures, and obtaining timely system access. One participant explained that "the process of identifying the right HPC resource and obtaining access can take longer than the project timeline itself." More than half of participants identified onboarding complexity and access procedures as significant barriers to adoption.

4.3 WORKFLOW, GOVERNANCE, AND TRUST CHALLENGES

Workflow incompatibility emerged as a major obstacle to adoption. Participants relied heavily on domain-specific tools such as BIM, GIS, CAD, and statistical software, many of which are designed for desktop-based environments and are not easily integrated into HPC systems. Participants reported difficulties related to software compatibility, licensing, and workflow adaptation. As one participant observed, "most of our existing workflows are built around BIM and desktop-based tools, and moving these into HPC environments requires significant adaptation." These findings indicate that HPC systems often prioritise computational performance over usability and workflow compatibility. Data governance and trust-related concerns were also consistently identified. Participants raised issues relating to intellectual property, commercial sensitivity, data ownership, and confidentiality, particularly within industry–academia collaborations. One participant stated that "sharing data across external computational environments raises concerns about intellectual property and client confidentiality." Participants expressed concerns regarding transparency, reliability, and accountability in high-stakes applications such as infrastructure design and safety analysis. These findings highlight the importance of governance frameworks capable of supporting secure and trusted collaboration.

4.4 SKILLS, TRAINING, AND INSTITUTIONAL FACTORS

Limited skills, training, and technical support were identified as additional barriers to HPC adoption. Participants reported low confidence in using HPC systems and highlighted the lack of accessible, application-focused training opportunities. Mentimeter responses indicated that many participants had received little or no formal HPC training. One participant explained that "there is a lack of practical guidance showing how HPC can actually support day-to-day built environment tasks." Participants emphasised the importance of ongoing technical support and guidance to facilitate workflow integration and experimentation with HPC platforms. Beyond technical barriers, participants identified broader institutional and cultural challenges. Resistance to change, fragmented supply chains, risk-averse decision-making, and the absence of strong policy drivers were all perceived as limiting adoption. Unlike BIM, which benefited from regulatory mandates, HPC adoption remains largely voluntary and lacks coordinated implementation strategies.

4.5 SYNTHESIS OF FINDINGS

The findings reveal a consistent pattern of interconnected socio-technical barriers affecting HPC adoption within the built environment. Although there is clear demand for advanced computational capabilities, adoption is constrained by challenges relating to access, workflow integration, governance, skills, and institutional practices. These barriers are mutually reinforcing; for example, limited training reduces the ability to adapt workflows, while governance concerns restrict collaboration and data sharing. Overall, the results demonstrate that improving HPC adoption requires more than technological advancement alone. Effective implementation depends on aligning infrastructure, governance, workflows, and user practices to ensure that HPC systems are accessible, usable, and relevant within real-world built environment contexts.

5. DICUSSION

The findings of this study demonstrate that the adoption of HPC in the built environment is fundamentally a socio-technical challenge rather than a purely technical one. Consistent with socio-technical systems theory (Baxter & Sommerville, 2011), successful adoption depends on alignment between technological capabilities, user practices, and institutional contexts. While HPC infrastructure is increasingly available, its integration into built environment workflows remains constrained by a combination of access barriers, workflow misalignment, governance challenges, and skills gaps.

A key insight is the persistence of an awareness–adoption gap. Although stakeholders recognise the potential relevance of HPC, this awareness does not translate into routine use. This finding aligns with broader research on digital infrastructure adoption, which highlights that awareness alone is insufficient without improvements in accessibility and usability (Hey et al., 2009). In the built environment, HPC is often perceived as a specialised or peripheral resource rather than an integral component of everyday practice.

This perception is reinforced by limited visibility within organisational workflows and the absence of clear entry points for engagement.

The findings reveal a significant mismatch between HPC systems and established built environment workflows. Practitioners rely heavily on domain-specific tools such as BIM, GIS, and simulation software, which are typically designed for desktop environments. The difficulty of integrating these tools with HPC systems creates a substantial barrier to adoption. This reflects observations from BIM adoption literature, where interoperability challenges and workflow disruption hinder digital transformation (Succar & Kassem, 2015). These findings suggest that efforts to promote HPC adoption should prioritise integration rather than replacement. Expecting users to abandon established tools is unlikely to be effective in a sector characterised by complex, collaborative, and time-sensitive practices. Instead, HPC systems must support and extend existing workflows, reflecting a shift from technology-driven approaches to user-centred design focused on compatibility and usability.

Access and onboarding processes represent another critical barrier. Although HPC resources may be technically available, they are not easily accessible in practice. Complex procedures, unclear pathways, and delays reduce usability, particularly in time-constrained environments such as consultancy and project delivery. These findings align with broader critiques of digital research infrastructure, which emphasise the need for more user-friendly and responsive access models (UKRI, 2022). Without streamlined access, HPC remains impractical despite its potential benefits. The concept of "right-sized computing" provides a useful framework for addressing these challenges. Rather than assuming universal reliance on large-scale HPC systems, the findings suggest that many applications in the built environment would benefit from flexible and scalable solutions. This includes hybrid models combining local, cloud, and HPC resources, allowing users to select appropriate computational capacity based on project needs. Such approaches align with federated infrastructure models, including those promoted by the NFCS NetworkPlus programme, which aim to provide more adaptable and user-oriented access to computational resources.

Data governance and trust emerge as particularly significant challenges. Built environment data is often proprietary, commercially sensitive, and distributed across multiple stakeholders, creating barriers to sharing and collaboration. Effective HPC use requires balancing openness with control, highlighting the need for governance frameworks that address intellectual property, security, and regulatory concerns. The findings also show that trust extends beyond data to include confidence in computational outputs, particularly in high-stakes applications such as infrastructure design and safety analysis. This underscores the importance of governance models that not only protect data but also build user confidence.

Skills and training represent another critical dimension of the socio-technical challenge. Many users lack the knowledge and confidence required to engage with HPC, and existing training provision is often insufficient or poorly aligned with domain-specific needs (Carver et al., 2019). The findings emphasise the importance of practical, application-focused training that supports integration into existing workflows. In this context, support structures such as Research Software Engineers (RSEs) play a key role by bridging the gap between domain expertise and computational infrastructure.

However, access to such support remains uneven, particularly outside research-intensive institutions.

Beyond technical and operational barriers, cultural and institutional factors significantly influence adoption. The built environment sector is characterised by fragmented supply chains, project-based organisation, and risk-averse practices, all of which can inhibit the uptake of new technologies. The absence of strong policy drivers further limits adoption. Unlike BIM, which has been widely adopted following regulatory mandates, HPC remains largely voluntary and lacks systemic incentives. This suggests that policy interventions may be necessary to encourage adoption, particularly where HPC can contribute to broader goals such as sustainability and digital transformation.

Taken together, these findings highlight the need for a holistic, user-centred approach to HPC development. Improving adoption requires coordinated interventions across multiple dimensions. Simplifying access pathways is essential to reduce barriers to entry, while domain-specific training can improve user capability and confidence. Enhancing interoperability with commonly used tools is critical for workflow integration, and the development of communities of practice can support knowledge sharing and peer learning. Finally, robust governance frameworks are needed to address issues of trust, data ownership, and security.

Based on the identified barriers and enabling factors, Figure 1 presents a proposed user-centred roadmap for improving HPC adoption within the built environment sector.

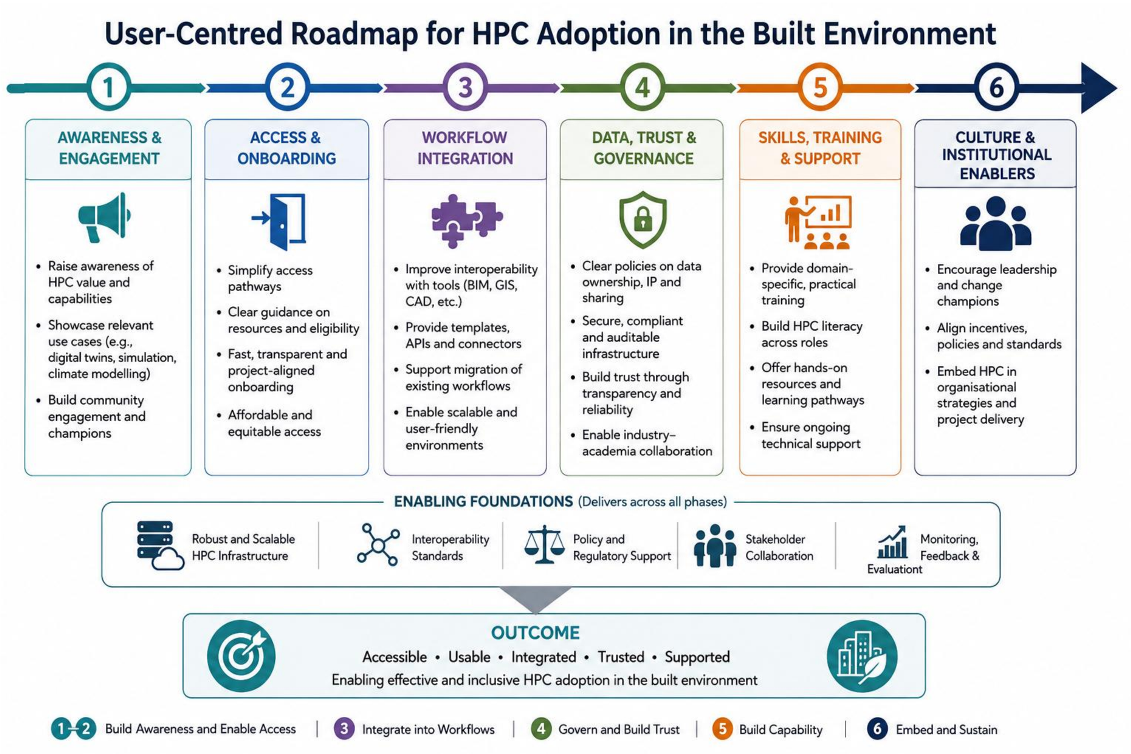

Figure 1: User-Centred roadmap for HPC adoption in the built environment

The roadmap highlights the interconnected technical, organisational, and institutional interventions required to support accessible, trusted, and workflow-integrated HPC adoption across the built environment.

6. CONCLUSIONS

This study investigated the barriers and enablers influencing HPC adoption within the built environment through a user-centred and socio-technical lens. Drawing on stakeholder workshop discussions and interactive engagement activities, the findings reveal a persistent gap between awareness of HPC potential and its practical adoption. The study makes three principal contributions. First, it provides empirical evidence on HPC adoption within the built environment, a domain that has received limited attention in existing research. Second, it demonstrates how socio-technical factors—including access, workflow integration, governance, skills, and institutional contexts—collectively shape adoption outcomes. Third, it proposes a user-centred roadmap to support more inclusive, accessible, and interoperable HPC adoption aligned with the objectives of the NFCS NetworkPlus programme. Collectively, these contributions advance understanding of how advanced computational infrastructure can be better aligned with the needs and practices of built environment stakeholders. From a practical perspective, the findings support the development of inclusive and flexible HPC ecosystems, such as those envisioned by the NFCS NetworkPlus programme. The concept of "right-sized computing" offers a pathway for making advanced computational resources more accessible by enabling users to engage with local, cloud, and HPC resources according to project requirements and organisational capabilities. The proposed roadmap provides actionable priorities for infrastructure providers, policymakers, researchers, and industry stakeholders seeking to broaden participation in HPC-enabled innovation. Several limitations should be acknowledged. The study was based on a relatively small workshop sample and focused primarily on UK-based stakeholders. As participation was voluntary, the findings may over-represent individuals already interested in digital innovation and HPC-related technologies. Future research could expand the evidence base through larger-scale surveys, longitudinal studies, and comparative investigations across different sectors and national contexts. Additional research is needed to evaluate the effectiveness of specific interventions, including training programmes, governance models, interoperability solutions, and federated computing approaches. In conclusion, unlocking the potential of HPC in the built environment requires a shift from a technology-centric to a user-centred approach. By prioritising usability, accessibility, trust, and integration with existing practices, HPC can evolve from a specialist resource into a practical enabler of innovation, sustainability, resilience, and data-driven decision-making. Such a transformation is essential if advanced computational capabilities are to be effectively and inclusively leveraged across the built environment sector.

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