

Explaining underlying causes for degradation of handover information for commercial building owners

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Evaluating possible causes of building handover information degradation is critical to asset owners because the handover information is the foundation for generating a thread of reliable asset information to minimise risks associated with operating commercial buildings. However, very little is known about possible explanations of asset information degradation, particularly during the operation phase of the commercial buildings. This study aims to assess the reasons for the quality of handover information deterioration by conducting semi-structured interviews with asset management professionals of five major organisations in the US and UK. The findings of this study suggest fragmented processes for managing handover information are one of the leading causes of diminishing the information quality instead of a series of events like renovations during the operation phase. Moreover, leadership support is crucial to establishing robust information management processes to sustain information quality. The identified causes of handover information degradation will en-

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able asset owners to make decisions on improving existing asset information management processes and feasibly leverage emerging technologies like cloud computing to address the information management dilemma.

1 Introduction

Quality handover information is pivotal for managing complex-built assets like commercial buildings. Reliable handover information provides guidance and instructions for the required routine maintenance at the operational level. For effective asset management, credible handover information is indispensable for developing a recurring investment plan because up to 85% of the total investment of a building occurs during the operation phase (Thabet and Lucas, 2017). At the strategic level, valid handover information helps establish long-term goals for the development while optimising the use of buildings to minimise potential environmental impacts (Roberts *et al.*, 2018). Additionally, the recent investigation of the Grenfell Tower fire showed that accurately updated and readily accessible handover information must be compulsory for managing risks involved in operations of the building, notably fire-, life-, and safety-related issues (Hackitt, 2018). To date, the building industry has accepted ineffective ways of managing handover information as a norm. Yet, limited knowledge in this area has neither examined nor explained information degradation, its causes and sources.

This study, therefore, aims to systematically assess the causes of handover information erosion using a two-way approach to critically identify the underlying reasons. For this study, the pertaining building handover information includes but is not limited to: (1) as-built drawings, (2) a list of the installed products, (3) updated health and safety files, (4) O&M manuals, (5) warranties, and (6) testing and commissioning report (Bayar *et al.*, 2016). The findings of this study offer insights into probable causes, enabling asset owners to prevent information deterioration. Moreover, this study yields evidence for seeking possible remedies and future research topics.

2 Literature Review

This section discusses the relevant studies in the management of handover information for post-construction support. Given that handover information is generated during the project delivery phase, Zhu, Shan and Zhao (2019) presented an overview of the current research trend based on a review of construction and facility management journals. The same authors identified the inferior quality of handover information and the poor interoperability between Building Information Modelling (BIM) and Asset Management Systems as key to recurring problems, but their study provided insufficient explanations for each specific cause. Therefore, an additional empirical approach is needed to establish a practical foundation for thoroughly addressing these challenges.

A recent study discovered that the BIM approach projects suffer from design deficiencies, negatively impacting the quality of the handover information (Zadeh *et al.*, 2017). To enhance the quality of information, Thabet and Lucas (2017) explored methods for adopting a BIM-based facility management approach to minimise data loss during the handover phase. However, the proposed information gathering model misrepresented multi-dimensional information flow during the project phase, which would result in collecting inaccurate handover information. Finally, Sadeghi *et al.* (2019) proposed an automated verification process for BIM-intensive projects to enhance the quality of handover information, but their study is limited to the non-geometric information verification at the handover phase.

After studying the transportation sector, Aziz (2016) argued that handover information starts degrading early on because the asset owners lack the intended use of the handover information. The same author further disputed that infrequent asset surveys, using different data formats, legacy data, and employee turnover causing loss of tacit knowledge contribute to diminishing the quality of handover information. Supporting Aziz's findings, Bayar *et al.* (2016) further suggested supplementary studies are needed to understand the possible causes of handover information degradation to improve the quality of handover information in supporting the operations of commercial buildings.

3 Methodology

This section describes the methodology espoused to elicit the possible significant events and activities that trigger degrading handover information, particularly during the operation phase. Due mainly to the limited studies done in this area, this study adopted an inductive approach, exploring a phenomenon through data collection, identifying themes, and building a theory based on the themes. In addition, this study used semi-structured interviews with participants purposefully to gain the best answers to meet the objective of this study.

The research began with reviewing journals, conference papers, and industry publications focusing on three primary areas – handover information management, asset management activities, and asset management systems – to establish a predetermined list of themes while developing interview questions. Then, to corroborate the quality of interview data, the researcher conducted pilot interviews to confirm that each interview question was clearly articulated to capture the relevant data.

This study reached data saturation after interviewing twenty-five asset management (AM) professionals from five organisations that manage multiple portfolios of commercial buildings in the US and UK. The participants comprised asset managers, senior management, building service managers and asset information managers. Though the professional background of each participant varied, the average years

of experience in the AM field were about 12 years, ensuring to provide credible answers that best meet the objective of this study.

4 Data analysis and findings

This section explains and discusses the interview findings and data analysis. Figure 1 illustrates the summary of the interview findings following the data analysis procedure suggested by (Gioia, Corley and Hamilton, 2013). The purpose of creating the structure of findings is to analyse the results of interviews systematically. First, the researcher developed six groupings of the first-order findings after comparing similarities and differences among the 200 attributes. Then, the evaluation of the first-order classifications was further classified into three theoretical second-order themes, which served as the basis for the emergent theory on the underlying causes of the handover information deterioration during the operation phase. Finally, the emergent second-order themes were further refined into second-order aggregate dimensions for discussion.

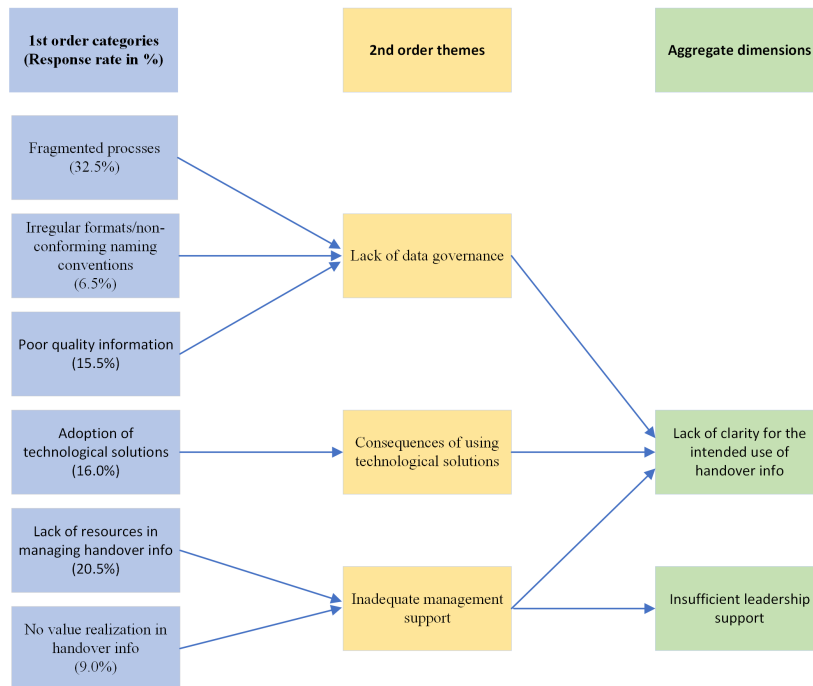


Figure 1. The data structure of the interview findings

The interviews produced 200 attributes for the causes of handover information breakdown during the operation phase. After classifying the participants' terms, phrases, and codes, the study discovered that fragmented handover information management processes are the leading cause of deficient information. Additionally, inadequate resources for managing handover information contribute to the continuing erosion of information quality. Finally, some participants believed that insufficient management oversight and support might arise from dismissing the value of trustworthy handover information. Moreover, adopting technological solutions without understanding the information management processes can further diminish handover information quality. Finally, poor quality of the handover documents, loss of information, nonstandard formats, and inconsistent naming conventions may add to all probable reasons.

5 Discussion

The data structure of the interview findings uncovers the fundamental causes of handover information degradation in two areas: (1) a lack of clarity on the intended use of handover information and (2) inadequate leadership support. Despite agreement on the importance of handover information, ambiguity about the utility of handover information persists and leads to the absence of data governance, which easily generates sub-standard information causing flawed and incomplete information management processes. The deficiencies in handling the handover information often persuade asset owners to adopt technological solutions. Most participants agreed that adopting technological solutions is inevitable, though utilising such an approach does not resolve information management process concerns. To prevent information degradation, the participants agreed that top-down leadership support, one of the guiding principles of asset management, is obligatory for establishing robust handover information management processes, which are essential for alignment with asset management activities.

6 Conclusion

The study assessed possible causes for the degradation of handover information during the operation phase. This study produced six categories of findings based on the 200 attributes collected from the interviews. After evaluation, these attributes were further refined to identify two ultimate reasons for the information deterioration. An unexpected finding is that a lack of clarity of the intended use of the handover information led to creating subsequent activities that trigger handover information degradation instead of key events like renovations. The study findings present one of the building blocks for future studies on this topic. Using this finding as a basis, asset owners can improve the existing information management processes after clarifying the intended use of the handover information. Further, it is

possible to gain maximum benefits from using technological solutions once the existing information management processes are clearly understood and implemented.

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