Understanding the Owner/Operator Perspective on Location-enabled Digital Twins for Operation & Maintenance in Transportation Infrastructure

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Abstract

Nowadays, infrastructure networks face numerous challenges that originate from the finite – but extensive - lifespan of infrastructure elements, the progressively reduced maintenance budget with the anticipation to provide better results and the environmental implications due to climate change. This puts a significant strain to the condition of the network with significant overrun operational expenditure attributed to poor maintenance of transportation infrastructure. Key in addressing the above challenges is more effective use of asset data and consequently the transition to lifecycle information models utilising the incremental progression of the technological advancements, such as O & M Digital Twin capabilities. However, literature suggests that asset data are not always fit for purpose and the lifecycle of the information from the stages of design and construction to handover and eventually asset management is fragmented, leading to ineffective use of data for decision-making. Additionally, the literature tends to focus on technical perspectives of the challenge, rather than seeking to explore the perspective of senior management - who are responsible for decisions around budgets, funding for data capture, curation and Twin development - on the problem. To address this gap, this paper presents the findings of semi-structured interviews with Subject Matter Experts from the Owner/Operator lens to capture and analyse their understanding of the importance of location-enabled data, and how and when information domains such as Geospatial and Building Information Modelling shall be integrated and utilised for long term asset management decision-making and progressive development of O & M location-enabled Digital Twins.

1. Introduction

Asset maintenance and management of current and future infrastructure networks, namely Highways and Rail, call for higher operational efficiency, improved end-user experience (i.e., road quality) and reduction of risk, delays and overrunning costs in designing, building and maintaining the asset portfolio (Popov et al., 2025). Additionally, the finite – but extensive - lifespan of such transportation infrastructure assets, the progressively reduced maintenance budget with the anticipation to provide better results as well as the environmental implications due to climate change (Yang et al., 2019), creates further pressure to owners and operators to deliver more with less.

Effective use of data during capital and operational project delivery is expected to improve decision-making, reduce errors, optimise operations and create digital representations of the transportation infrastructure assets (Highways and Rail) which are information-driven and integrated across the project lifecycle. Asset Information within Transportation Infrastructure shall be delivered following the Project and Asset Information Model development framework as outlined in BS EN ISO 19650 series (BS EN ISO 19650, 2018). Information domains such as Building Information Modelling (BIM) & Geographic Information Science (GIS) can assist in the production, storage and exchange of this data to enable enhanced decision-making and improved awareness during Operations and Management (O & M). Digital Twins (DT, see Section 2.2) built on GeoBIM data integration have increasing potential in this area as they given that they model both the infrastructure (and its engineering detail) and the surrounding context, once integrated can provide a full location framework for DT data integration. However, a reactive, rather than proactive approach is currently being implemented when operating and maintaining infrastructure elements which is attributed to the fact that the life cycle of the built environment consists of fragmented stages and is lacking data and systems interoperability among them (Sarigul and Gunaydin, 2025). Considering that up to 80% of the total life-cycle cost derives from the Operation & Maintenance (O & M) stage (Popov et al., 2025) it is essential to address and tackle these challenges, by implementing integrated and resilient infrastructure Asset Management Information Systems (AIMS) from the early planning stages, in order to eliminate risk, reduce cost and increase efficiency by introducing a holistic data-centric approach during the life-span of the asset (Munir, 2020).

While AIMS are heavily relied upon high-quality asset data using asset dictionaries as templates to standardise and document what information is needed and when, there are well established challenges regarding the quality of these asset dictionaries due to their extensive lifecycle of data engineering and curation and lack of interoperability between different AIMS (Floros and Ellul, 2021). Technical challenges to implementing AIMS and Digital Twins have been addressed extensively (Moretti et al., 2021). However, the perspective of senior management on these data related challenges has yet to be explored.

Within this context, this paper sets out to capture the industry perspective from a senior Owner/Operator lens regarding the asset data lifecycle, understanding and utilisation of Digital Twins as well as value and impact of location data and GeoBIM integration.

1.1 Purpose & Research Questions

The purpose of this paper is to document and present the asset data requirements through qualitative research and real-world industry experience. Consequently, this work aims to understand what O & M location-enabled Digital Twins means from an Owner/Operator management perspective and the challenges they face in realising O & M Digital Twins for long term decision making within Transportation Infrastructure and specifically within the Highways and Rail sectors. Therefore, the main research question this paper aims to address is:

"What opportunities and challenges do Senior Asset Managers see for location-enabled O & M Digital Twins?"

We consider two aspects of the problem – firstly, given that location-enabling data incurs additional expense both in terms of capture/positioning and in terms of storage:

1. *What is their understanding of the importance of location within AM?*

This more foundational question will further our understanding of the level of high-level support for location data within the Senior Management community who are responsible for budget requests and allocations. Secondly, to explore benefits and challenges relating to the implementation of the DT, we ask:

2. *What are their perceptions of the benefits and barriers to location-enabled GeoBIM DT for AIMS implementation?*

As well as a broad focus on information management, we focus in specifically on GeoBIM as this enables us to delve into challenges relating to data handover between construction and O & M.

2. Literature Review & Previous Work

2.1 Project lifecycle

In this work, the RIBA Plan of Work 2020 is utilised as the starting point to describe the project lifecycle within Infrastructure. Adopting RIBA to its full extent is challenging within infrastructure projects for two reasons: firstly, the O & M which is typically responsible for 80% of the project costs is simplified and secondly different organisations have set out their own project lifecycle stages that meet their strategic objectives, without facilitating a direct alignment with RIBA. For example, National Highways is introducing the Project Control Framework (PCF) to describe the project lifecycle, which is not directly aligned with RIBA, while Network Rail (NR) is implementing the Governance for Railway Investment Projects (GRIP) breakdown of the project lifecycle.

2.2 Approach to Digital Twins

This work considers five (5) fundamental elements that form a DT, as described by Tao (2019): physical part, virtual part, connections, data, and services. However, it should be clarified that there is not a universal DT for an asset, instead there is a collection of DTs which underpin the organisation's overarching DT strategy. This consequently means that data needs to be accessible and fit for purpose in order to drive the development of the multiple DTs during the asset lifecycle in the long term which is the focus of this research work (Miraj et al., 2025).

Digital twins link the digital and physical worlds. Multiple digital twins, focusing on different aspects, are required for infrastructure and a mechanism is therefore needed to link disparate data sources into a single system, i.e., to achieve data interoperability. Integrated data is not only required for analytics but also to ensure that data is not duplicated (which could in turn link to inconsistencies). Data from GIS and BIM are two information-rich domains that have the potential to be key contributors in linking the fragmented nature of the infrastructure lifecycle. Given that they model both the infrastructure (and its engineering detail) and the surrounding context, once integrated (as 3D or 4D GeoBIM), they can provide a full location framework for DT data integration.

2.3 Data-centric asset management

Asset Management (AM) assists the organisation in realising and maximising the value of its current assets by introducing an optimal strategy to balance cost, performance and risk across the asset's life cycle. To facilitate an efficient implementation of Asset Management, the organisation is setting up a set of tools, processes, procedures and documentation which form an Asset Management System (BS EN ISO 55000, 2014) with two key characteristics:

- **Data Intensive:** An Asset Management System is reliant upon data, which highlights the importance of proper data management and the contribution of Information & Communication Technologies (ICT).
- **Cross-functional:** An Asset Management System interacts with difference functions of the organisation. This interaction, when translated to exchanging information, is reliant upon different sources "talking to each other", underpinning the importance of data integration within the organisation.

2.4 Information management & standards

This section outlines key terms in alignment with BS EN ISO 19650 Information Management standard.

2.4.1 BS EN ISO 19650 series & Information Models: In alignment with BS EN ISO 19650, the Project Information Model (PIM) is the "federated set of information containers generated, managed, and used during a project delivery phase, from appointment through design, construction, and commissioning, up to practical completion". Consequently, the Asset Information Model (AIM) is the "structured repository of information required to support the operation, maintenance, and management of an asset throughout its operational life". BIM is defined as "a structured process for managing information over the whole life of a built asset, using agreed information requirements, defined roles, and a common data environment (CDE)". However, there is limited research on how project data flows to asset data in order to create and maintain the asset information model, with majority of publications focusing on distinct use cases of BIM implementation (Maletic et al., 2025).

2.4.2 Level of Information Need: ISO 7817:2024 provides additional guidance in extension to ISO 19650, regarding the Level of Information Need (LoIN), focusing on the specification of what information is needed, when and for what purpose, but there is little evidence investigating how the LoIN is aligned with asset data standards of transportation organisations.

2.5 GIS & BIM in Asset Management

Although BIM and GIS both engage with the built environment, they model it from a different perspective. BIM focuses on the engineering aspect by providing a detailed data representation of the physical assets that are to be built in the natural environment and ensuring that all the necessary information from an engineering viewpoint is stored in the model. On the other hand, GIS captures ground conditions, analyses geographic information and forecast scenarios, from a broader geospatial

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perspective. Therefore, their integration, typically referred to as GeoBIM has the potential to model the physical asset and its location context holistically and enable the creation of location-enabled O & M Digital Twins.

Implementation of GIS in linear Asset Management is well documented within the industry as standalone capability rather than an integrator catalyst, with BIM literature and use cases noted primarily within the Design & Construction stages. Integration of GIS & BIM for AM is limited (Abdelmoti et al., 2025), particularly in the context of information model integration rather than geometry and systems interoperability, however it is seen as a significant value-add opportunity as long as a lifecycle approach from Design and Construction to Operation and Maintenance is implemented (Maletic, 2025; Munir et al., 2020). Lastly, Miraj (2025) highlights the gap between the potential and actual use of Digital Twins and the importance of adopting an end-user-based approach.

2.6 Previous Work & Context

The research work that has been completed so far prior to this paper, has focused on investigating the potential of GeoBIM for Operation & Maintenance with the premise that the existing Asset Information Systems capture in detail the requirements of the Asset Managers. Work so far presents a study of the BIM process, relevant standards and their capabilities to model Asset Information, as well as on the understanding of Asset Information Systems for two types of Infrastructure: Highways and Rail, explores information loss and documentation. However, the case studies have been developed upon existing asset data standards, which are associated with numerous quality and functionality issues.

Therefore, in this paper, direct engagement with SMEs that are responsible for creating these standards, or use/produce its information, or drive the strategic direction of asset management within an organisation aims to contribute further to this ongoing work of proposing a data engineering framework for location-enabled Digital Twins for long-term O & M decision making.

2.7 Literature Gap Analysis

Table 1 summarises the literature gaps pertaining to the sections above and form the basis of the proposed methodology.

Nr.	Description	Source
1	Location data standardisation and downstream utilisation for O & M DTs	2.5
2	Lack of defined asset requirements and understanding of the BIM-GIS potential within O & M	2.5
3	Limited research on how the project information model flows to asset information model	2.5
4	Limited research on aligning LoIN with asset data dictionaries	2.4

Table 1. Summary of literature gaps

3. Methodology

Fig. 1 presents the methodology applied in this paper in order to address the research questions of section 1.1, following the previous research findings as discussed in section 2.6.

The first step of the methodology is focusing on understanding, analysing and discussing the lifecycle of design, construction, handover and eventually asset data, within transportation infrastructure from an Asset Manager perspective through semi-structured interviews.

The second step is processing the qualitative results of the interviews through Thematic Analysis, focusing on the category of integrating the Geospatial and BIM domains to address current AM requirements and capture how location-enabled Digital Twins can address future requirements.

The last step of the process is linking the findings of existing literature with real-world practice as produced from the interviews and the thematic analysis of step 2 in order to provide recommendations and steps for future research work.

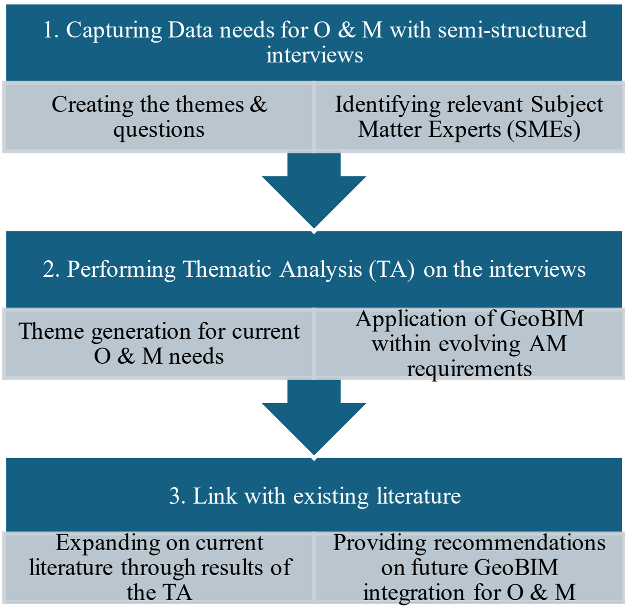

Figure 1. Methodology

3.1 Methodological Background

This paper focuses on qualitative research to capture and analyse Asset Management requirements in relation to location-enabled O & M Digital Twins. In order to capture these requirements, an interview-based approach has been selected, as a recognised method of in-depth data collection from Subject Matter Experts (SMEs) (Chand, 2025).

3.1.1 Type of Interview: Typically interview types are: (i) structured, (ii) semi-structured, (iii) unstructured. Based on literature findings, a semi-structured interview approach has been selected, due to the following benefits (Chand, 2025):

- capture in depth experience and insights by allowing follow-up questions and discussion to explore specific themes during the interview process
- combination of depth and comparability: there is a baseline set of questions that every participant is asked, and subsequent focus to their subject matter expertise

3.1.2 Thematic Analysis: Thematic analysis (TA) has been selected to process the results as is one of the most widely used methods for analysing qualitative data, offering a structured and flexible approach to identifying, analysing, and reporting patterns or themes within a dataset (Chand, 2025).

3.2 Topics for the Semi-Structured Interviews

In order to capture the industry perspective, a semi structured interview approach has been implemented, focusing on two key topics:

The first topic covered the role of location enabled data within Existing & Evolving AM requirements, – specifically looking at current practice relating to if/how assets are localised, the importance of knowing where assets are located, the importance of visualisation and – as a detail within this – the importance of 3D and 4D visualisation.

The second topic related to the role of ICTs and DTs in AM, with a data-centric focus, starting with specific focus on GeoBIM within an O&M DT, exploring potential benefits and challenges of this approach and finally concluding with a broader review of how the wider information management lifecycle should be improved to ensure that the required data is available for the DT.

These topics formed part of interviews with a wider overall scope, which included understanding the level of engagement across the construction/contracting/O&M boundary, identifying issues with current AIM approaches, identifying challenges and opportunities for O&M DT and discussions around fitness for purpose of data.

3.3 Formulating the interview questions & preparing the interview process

The interview process is presented schematically in figure 2:

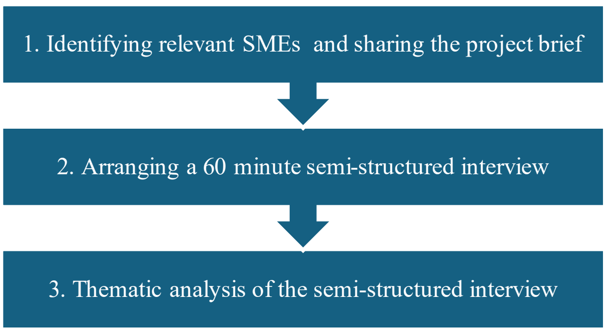

Figure 2. Interview process

3.4 Identifying relevant participants

To identify the relevant SMEs for the purposes of this research, the following criteria have been established. The chosen SMEs meet one or more of the following criteria. All results are anonymised for data protection purposes.

- Experience (Technical, Consulting or Strategic management) in asset management or operations within Highways and Rail sectors or,
- Experience in creating or leading asset and project information management capability within Highways and Rail sectors or,
- Experience in the creation, management or utilisation of asset data dictionaries within the Highways and Rail sectors or,
- Experience in the implementation of data-centric & artificial intelligence strategies for transportation organisations in the UK or,
- Experience with asset management processes from the wider industry and understanding of how these apply within Highways and Rail.

In addition, the relevant participants shall ideally hold varied corporate positions within their relevant organisations. Specifically, the following SME types have been identified:

- Technical SME: relevant SME that is directly using asset data for day-to-day asset operation decision-making
- Information Manager/Lead: relevant SME that is responsible to create, maintain and validate the asset information model and asset information requirements
- Asset Manager/Lead: Management & Leadership position looking at the creation and execution of asset management strategies across a portfolio of assets

3.5 Interview questions

Table 2 highlights the relevant questions which have been formulated and asked during the interviews regarding the use of GeoBIM for location enabled O & M Digital Twins.

Cat.	Question	Gap Analysis
1	How important is it to you to know the location of your assets? (1-5 Scoring) 2.1 Follow up: if/how do you define location?	1
	If/How do you currently capture and visualize location in your AMS?	1
	How useful is it to you to view your asset in 3D/4D within a geospatial context? (1-5 Scoring)	2
2	Where do you see the role of ICTs such as GIS and BIM fitting into the O & M DT?	2, 3
	What benefits do you see in the GIS-BIM integration for an O & M Digital Twin?	3
	What would your recommendations be to improve the Information Management Lifecycle and Level of Information Need prior to O & M for O & M?	4

Table 2. Summary of the interview questions regarding GeoBIM, relating them to specific gaps in Table 1

3.6 Thematic Analysis

As explained in section 3.1, TA and a 6-step process have been chosen to process and analyse the data from the semi-structured interviews, as shown in figure 3:

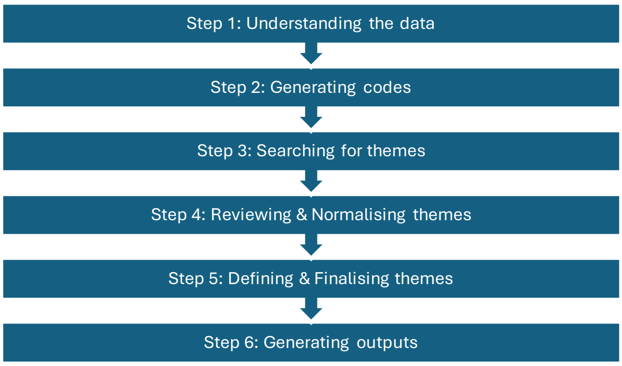

Figure 3. Thematic Analysis implemented workflow (Braun and Clarke, 2006)

- Step 1: Understanding the data - involves familiarisation with each interview through note-keeping and iteration of the interview audio and transcription.
- Step 2: Generating codes - involves the systematic iteration of the data to detect and capture meaningful patterns and summarise key data segments. This step has been performed manually, without the use of external software, to improve further the familiarisation with the data.
- Step 3: Generating initial themes - involves the preliminary grouping of codes and data patterns within themes related to the research question.
- Step 4: Reviewing & Normalising themes - involves reviewing and normalising themes through methods of aggregation, splitting or discarding overlapping themes.
- Step 5: Defining & Finalising themes - the penultimate step of the process, defining the final themes and the relation to the research question.
- Step 6: Generating outputs - the final step involves the production of the report including a detailed account of themes, data extracts and linking with existing literature.

3.7 Data & Software

The interviews have been performed online using Microsoft Teams and the associated recording and transcription capability. The codification and theme generation of the interviews has been performed within Microsoft Excel to enable machine-readable outputs. The production of the visual outputs and reports of results has been performed using the Mural software, which has been connected to the underlying Microsoft Excel document.

4. Results

A total of 13 semi-structured interviews has been completed and the selected participants fulfil different personas, to capture a widespread view of the challenges and opportunities within the asset management space. Thematic saturation and repeatable themes are noted after the 10th interview, particularly focusing on the suitability and limitations of current Asset information libraries, as well as the use-case dependent integration for GeoBIM solutions. In addition, due to the requirements around the identified participants (as presented in 3.4), the available interviewing pool is not particularly large but captures a wide representation of the multiple stakeholders involved in the project lifecycle. Lastly, due to the absence of a second coder, table 3 presents the original codes under the relevant tab for better visibility and interpretation.

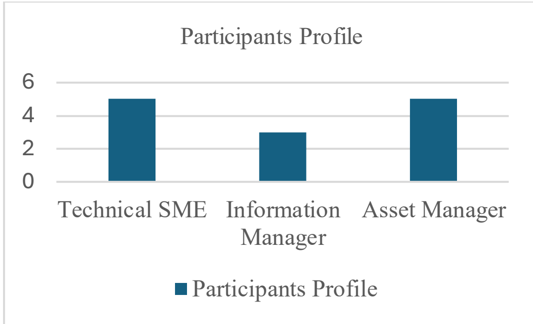

Figure 4. Profiles of the participants

The interview included participants with varying backgrounds: operational experience, asset information management experience and asset management & strategy experience. Fig. 4 presents the profiles of the participants:

The results of the TA are presented following the recommended approach from Braun and Clarke (2006). More specifically, the following considerations are considered:

- R1: Results are organised by themes
- R2: Each theme is presented with an analytic narrative and an associated code sample to demonstrate the TA process
- R3: A thematic map to visualise the structure of the analysis

R1 and R2 are presented in Table 3, enhanced with samples from the codes that have been generated as part of the TA, link to the relevant literature gap analysis and how they contribute to responding to the research questions of this paper.

The thematic map process (R3), which is presented in Fig. 5, provides the visualisation layer of the table, closely linking the main research question, with the final themes and an expanded sample of the codes utilised to generate the themes.

Figure 5. Thematic map generation process

Lastly, figure 6, presents the quantitative analysis of the results regarding the importance of Location intelligence and GeoBIM within asset information libraries & systems.

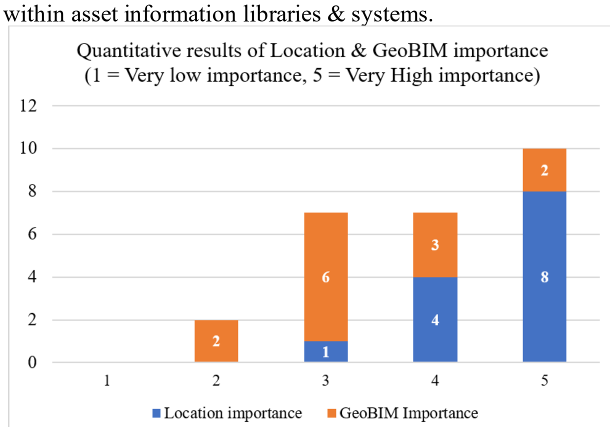

Figure 6. Quantitative Analysis of Location and GeoBIM importance

Theme	Analytic narrative	Original Codes	Benefit or Challenge	RQ
Value of geospatial data	The value of location data has been varying, with most participants mentioning the importance of geospatial reference to drive better asset management decision-making and mitigating project and programme risks	*"Value of location depends on the asset, its function and the risk it manages"*	Benefit – the importance of location is well understood within senior management.	1
Geospatial Data Granularity	Location has been defined in numerous formats, such as co-ordinates, use of spatial breakdown structures such as what3words, linear referencing and asset hierarchy, depending on the asset representation.	*"Use of w3w as location reference"*	Challenge – how to model location (related also to LoIN)	1
Geospatial data as contextual integrator catalyst	Geospatial data is being described as an integrator catalyst across numerous asset management systems and as-built 3D models.	*"Asset of low priority but adjacency to asset of high priority"*	Benefit for RQ 1 and 2 - the importance of geospatial and BIM – both forms of location data – as integrators	1 & 2
GeoBIM as conditional integration	Participants have described numerous use cases where the integration of Geospatial & BIM data can enable location intelligent O & M Digital Twins. Use cases include asset inspections, management of maintenance schedules and crews, digital asset inventories.	*"View legacy of the 3D model, associated repairs and metadata for O & M"*	Benefit for RQ 1 – location is understood to be important beyond just knowing where assets are located Benefit for RQ2 – it is understood that GeoBIM can provide a very good location framework	1 & 2
Cost of capturing and maintaining data	Most participants have raised the need to properly define value of asset data and its attributes, including location characteristics and proposed an outcomes-based approach to calculate and understand the value of data across its lifecycle.	*"Value based business case for every asset attribute"*	Challenge – identifying and defining the value of data	2
Limited value of current Asset Information	Most participants have questioned whether current asset dictionaries and asset information are fit for purpose and have a positive return on the investment of collecting and maintaining this information in the long term.	*"Lot of data is unused due to not fit for purpose or digestible by current systems"*	Challenge – clarifying the cost/benefit of data collection and maintenance	2
Decision-Centred location enabled Digital Twins for O & M	Participants repeatedly linked DTs with the ability to make decisions, instead of current industry trend which focuses on 3D model or data visualisation, highlighting that DT term is not aligned with practice. Participants highlighted the need to link DTs with risk-informed decision-making.	*"DTs shall enable medium & long-term AM decision making"*	Benefit – it is understood that DTs go beyond visualisation and can support decision making Challenge – understanding what a DT is in practice and exactly what it can support	2
More dimensions do not always equal more value	Participants are not convinced that additional dimensions (from 3D Modelling onwards) will deliver more value out of the box. However, during the interview processes, mainly from the technical SME user group, they were articulating and presenting numerous use cases where integration of BIM, GIS & temporal data can have significant benefits to their day-to-day decision-making. Participants provided varying levels of understanding and awareness of 3D Models, & BIM processes, primarily linking 3D Models with visualisation aid.	*"3D & 4D Models do not necessarily translate into O & M decision making and use, unless they focus on a specific challenge. 3D models are mainly utilised for visualisation"*	Challenge – justifying higher dimensions of geospatial data capture and storage	2
Data-centric understanding of BIM	Several participants are moving from using the term BIM to describe a process to using the term of "Information Management", to deconflict the model-centric perception of BIM, towards use of data and information	*"BIM shall start focusing on its underlying information model that transitions information from the project phase to the O&M phase"*	Benefit – there is a good understanding of the importance of moving from BIM towards information management	2
Connecting Digital Twin lifecycle with Information Models	Participants have repeatedly highlighted the need to align DT capability with the maturity and purpose of the Information Models (Project & Asset)	*"DT needs to be aligned with the project and asset information model"*	Challenge – aligning DT with standards	2

Table 3. Themes generated from the Thematic Analysis

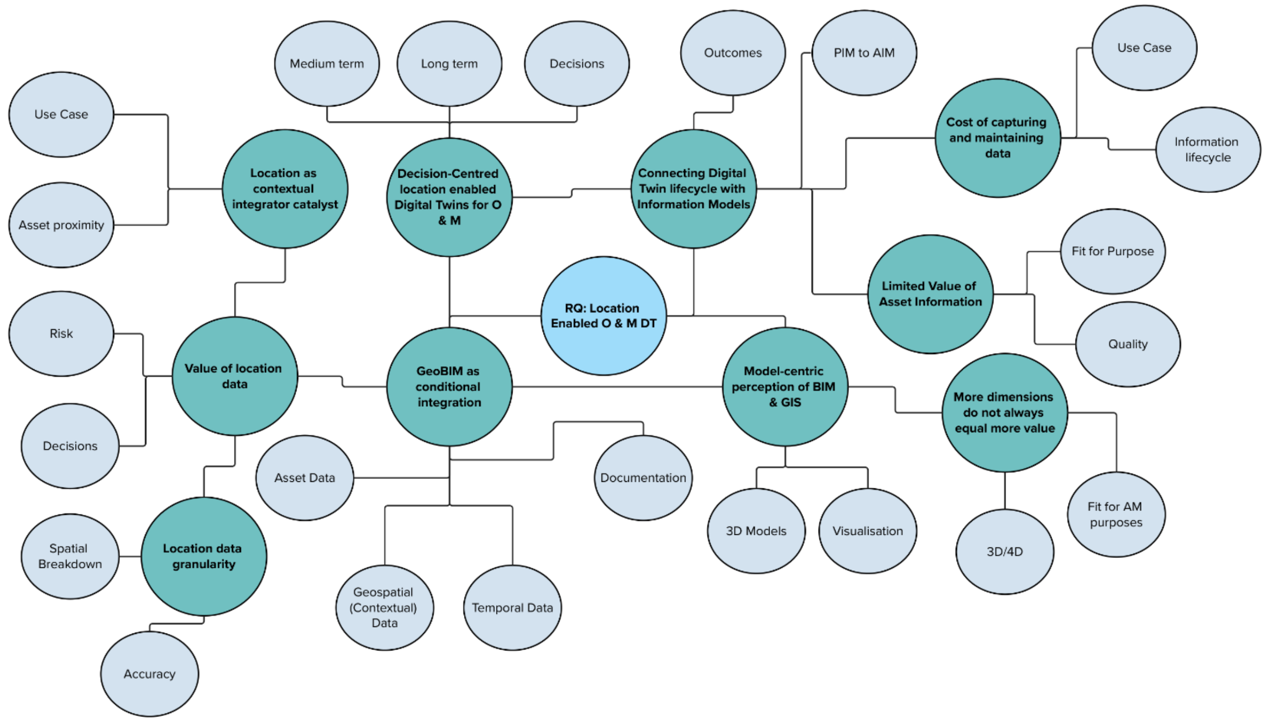

Figure 7. Thematic Map of the Analysis

5. Discussion

This paper aims to address the following research question:

"What opportunities and challenges do Senior Asset Managers see for location-enabled O & M Digital Twins?"

Based on the results in Table 3, location-enabled Digital Twins demonstrate the opportunity to address holistically current and evolving O & M requirements for Transportation Infrastructure from an end use-case perspective. Opportunities lie in the consistent messaging around the use of geospatial data as an integrator catalyst of multiple AIMS and asset data. Additionally, the value of GIS & BIM integration is amplified when it is tailored to deliver a particular AM use case. However, there is considerable scepticism regarding additional data dimensions such as (3D & 4D) as shown in figure 6, with value-add identified primarily in asset visualisation and simulation of the maintenance schedule. Further challenges lie in the lack of asset data quality, systems interoperability and current level of industry perception on Digital Twin, BIM & GIS terminology. Specifically, there are significant association of BIM with 3D Modelling and geospatial data with GIS technology, highlighting the continuous effort needed to communicate the need for underlying, connected information models across the project lifecycle.

The main RQ is further broken down to two research sub-questions:

1. *What is their understanding of the importance of location within AM?*

Most participants have identified the need for location-enabled asset data as critical requirement to enable day to day and strategic AM decision-making as shown in figure 6. However, this comes with the associated challenge of identifying how shall location reference be documented and captured within an Asset Management System. Location data is seen as an integrator catalyst, especially as Owner/Operators have numerous siloed asset management systems within their organisation. There has been consistent messaging from the participants regarding the costs of capturing and maintaining data, with particular focus on location data. Considering the continuously challenging fiscal environment in asset management, data maintenance is associated with significant costs, without clear justification regarding the return on investment. Participants have discussed the need to link better data needs with risk management to quantify the benefits of a data-centric organisation.

2. *What are their perceptions of the benefits and barriers to location-enabled GeoBIM DT for AIMS implementation?*

Participants have highlighted the importance of understanding and defining the value of what asset data needs to be collected and when, due to expensive acquisition, maintenance and overall management of asset information. They also highlight that the key to address future requirements is to align the information lifecycle with the Digital Twin capability that is needed at the right point in time. They describe interoperability challenges regarding the consumption and utilisation of 3D Models and questioning whether additional dimensionality of data is necessarily more useful. Lastly, participants have described use cases regarding asset management and operations that can benefit from GeoBIM data, without directly referencing the integration of Geospatial and BIM domains, illustrating the potential of location-enabled O & M Digital Twins if they are able to generate outcomes that support risk-based decision-making.

5.1 Further Work

Building on the challenges identified in Table 3, a key recommendation for further work relates to the exploration of the

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specific level of geometrical detail required for asset modelling in infrastructure AIMs. This relates directly to the broader question of LoIN outlined in Section 2.4.2, with future work focusing on the creation and definition of LoGGIN (Level of Geometric and Georeferencing Information Needed). Identifying and justifying specific LoGGIN may also help address the challenges relating to data and systems interoperability, cost of data capture and maintenance and feeds into the broader discussion around value of data and Digital Twins for AM, with the identified need to investigate the extent that the above findings could be generalised beyond the UK Highways and Rail sector.

A second key challenge relates to the understanding of DT how DT align with current standards and approaches to AM – in other words, integrating the Asset Information lifecycle with the Project Information lifecycle and the DT framework of the Owner/Operator. The move from interpreting BIM as 3D Modelling to Asset Management outcomes that Information Models can help deliver will support this task, with the next step focusing on the validation of these findings through the development of technical case studies.

6. Conclusion

This paper aims to document and analyse the industry perspective on the potential of location data, BIM-GIS integration and key benefits and barriers to unlocking location-enabled O & M Digital Twins. A particularly positive outcome is the level of understanding of the importance of location, beyond simply ‘mapping assets. Industry encouraging insights focus on shifting from a “model-centric” approach to information management and modelling, whilst describing challenges of integration which is mainly attributed to the poor quality of current asset data dictionaries and to the importance of being able to articulate value for any data capture, curation or Twin implementation.

As mentioned above, this paper presents components of a wide-ranging interview conducted with the stakeholders, with further analysis planned to focus on aspects relating to information management across the entire construction/O&M lifecycle and on the use of GeoBIM and of standards to enable this task. The final output of this research work is GeoBIM data management framework which shall inform stakeholder decision-making on what data to collect, maintain, and dispose of within Highways and Rail. The framework will enable the utilisation of the collected construction data for the O & M stage, within a location-enabled DT environment.

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