Exploring a Holistic Framework for Digital Transformation in the AECO Industry

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Abstract
This study investigates the phenomenon of Digital Transformation (DT) in the Architecture, Engineering, Construction and Operations (AECO) industry and the impact of the adoption of digital technology. It explores the viability of a holistic framework to guide the development, integration and implementation of DT strategies for products and services in the delivery of projects and assets in the AECO industry. The study adopts an abductive and qualitative approach to data collection and analysis. A review of 78 journal articles and four semi-structured interviews with AECO experts were carried out. The findings suggest that transitioning from siloed to systems-based thinking, shifting from push to pull service models, and moving from product-focused to integrated stakeholder-driven approaches would facilitate the strategic and effective utilisation of digital technologies in the AECO industry. The study presents a preliminary conceptual framework that advocates for a platform perspective in implementing DT strategies to integrate digitally-enabled deliverables in the provision of products and services. An original contribution of the study is in the improvement of understanding of factors that facilitate the successful implementation of DT initiatives in the AECO industry, paving the way for better utilisation of machine-readable and interpretable building information.

Keywords: Digital Transformation, Information Management, Data Integration, Implementation, BIM, Platforms

1 Introduction
The Architecture, Engineering, Construction, and Operations (AECO) industry has seen significant advancements, primarily driven by Building Information Modeling (BIM), Artificial Intelligence (AI), the Internet of Things (IoT), and Extended Reality (ER). These technological developments have enabled digitally-enabled approaches in the delivery of products and services in the AECO industry. However, the effective implementation and utilisation of structured data (raw, machine-readable and machine-interpretable data) by industry stakeholders remain challenging, and this has led to the limited value realisation of available data in project and organisational processes. This paper argues that the low utilisation of structured data for decision-making in the AECO industry is not only due to the diversity of digital tools and market fragmentation, but also in the approach to integrating these technologies into new and existing services. This is because organisations in the AECO industry often operate with disparate systems and siloed practices with pushed products and services that limit the value derived from the adoption of Digital Transformation (DT) strategies, products, and services. Also, AECO organisations lack holistic strategies for DT integration by overly prioritising quantitative metrics like time and cost and

ignoring qualitative measures that focus on value, user satisfaction, and quality. Hence, adaptive approaches are needed to consider theoretical insights and practical constraints from all stakeholder perspectives. This study seeks to draw insights from hospitality, management, and information systems to form a comprehensive framework guiding the AECO industry.

Building Information Modelling (BIM) can be defined as the digital representation of a facility that enables stakeholders to exploit building and construction-related data during the design, construction, operation and end-of-life of an asset. For example, one of the significant challenges in DT is the ability of the AECO industry to realise value from the BIM process (Munir et al., 2019a). To achieve this, stakeholders must look at the value of specific deliverables beyond the perspective of their immediate organisations. The AECO industry would only be able to exploit the potential of data by developing and understanding diverse stakeholder value streams mapped to intersect desired business objectives, models and supply chains. In this regard, this study argues that the AECO industry may require a guide similar to the "*Michelin Guide*" in the hospitality sector that could explicate to stakeholders how the integration and implementation of DT strategies, products, and services could derive value. The study also seeks to provide a novel purpose for improved information management and data utilisation, akin to the way the guide benefited *Michelin* and its products. Therefore, how can the AECO industry apply this approach to derive value by linking purpose to data-driven decision-making through a holistic framework?

Current approaches to delivering data, products and services in the AECO industry necessitate a paradigm shift from a siloed and linear approach to systems-based thinking that considers the constituent parts of a project as interdependent components. The justification for this study is rooted in the status quo of the AECO industry, which is characterised by the dominance of push strategies, where existing digital tools in the market define and drive the purpose of data and utilisation through silos within organisations, projects, and asset operations. In contrast, a practical approach would involve transitioning to a pull strategy, where project requirements are aligned to the intended use of digital tools that will guide their implementation.

The study is based on a four-part rationale. First, the imperative is to break down siloed-based thinking and transition to a more holistic, systemic, and integrated stakeholder approach that enhances communication and collaboration across various organisational levels, project lifecycle phases and supply chains. Second, the necessity to transition the AECO industry to a pull strategy based on specific stakeholder needs as opposed to pushing services based on assumptions of stakeholder requirements. Third, it is important to shift focus from mainly quantitative metrics to qualitative measures that focus on decision-making, value, user satisfaction, and quality delivery. Fourth, a need to address the inconsistencies in idealised academic models and transition to a pragmatic approach based on practical realities faced by practitioners. Therefore, the study seeks to address the following research questions: Q1 – What is the current perspective on BIM-based services in the AECO industry? Q2 – How can the situation around BIM-based services in the AECO industry be improved? Q3– What is the missing part in increasing the development and implementation of stakeholder-focused value delivery? Therefore, to address these questions, the study aims to propose initial ideas for a holistic framework to guide AECO industry stakeholders around the complexities of implementation and adoption of DT strategies.

2 Literature Review

2.1 Systems Thinking Perspective

Systems thinking conceptualises elements of a system with principles, procedures, and mechanisms for specific actions that highlight their interactions and are consistent with a collective purpose. In other words, a system is a set of interrelated components that are interdependent with others, making it an integral part of the whole. A system can be in one of four states: stasis (lack of activity), order (predictable behaviour), complexity (intermediate state), and chaos (random but ordered) (Tillmann et al., 2013). Also, a system could be loosely or tightly coupled (Arango-Vazquez and Gentilin, 2021). Therefore, systems within the AECO industry could be said to be mainly complex and have properties of loosely coupled systems. Additionally, Mumford (2000) suggests that human, organisational, and social factors directly influence

information systems, depending on how these variables interact during technology adoption. Organisational attitudes towards innovation are not only shaped by technical factors but also by social factors such as coercive (constraining), normative (learning), and mimetic (emulating) mechanisms (Powell and Di Maggio, 1992). Coercive mechanisms often make organisations conform to laws, rules, and sanctions set by institutional actors in seeking legitimacy and external validation. Normative mechanisms evaluate whether an organisation fulfils its role competently. Mimetic intuition drives organisations to emulate counterparts for positive evaluations. These social mechanisms could sometimes lead to the overshadowing of stakeholder needs in project delivery industry-wide, and there is a need to improve the understanding of socio-technical factors in implementing DT strategies.

2.2 Information Transactions in the AECO Industry

Traditionally, the AECO industry has mainly focused on design and construction, but there has been a recent shift towards emphasising asset operations and end-of-life. Information is defined as data that has been processed and organised into a format that is meaningful to the recipient or serves a specific purpose, thereby adding context and significance (Englesman, 2007). Knowledge, on the other hand, is the capability to utilise this information to accomplish a specific strategic goal. Data, information, and knowledge flow in the AECO industry across many different layers of business processes, including inter-organisational flows (design reviews), intra-organisational flows (design coordination meetings), inter-phase flows (design-construction-operations), and inter-market flows (sectorial interactions).

Therefore, effective information transactions are crucial, but the industry is fragmented into various disciplines and lifecycle phases. The information transactions (generation, analysis, management and use of data) in the AECO industry have never been more fuzzy, which has hampered the implementation of, for example, "as-a-service" innovative models that can improve data integration across project phases, addressing existing barriers (Wildenauer et al., 2022). As such, it is crucial to explore the integration of data, products, and services in the AECO industry.

2.3 Implications of Push-Pull Systems for Data, Products and Services

Push systems are rooted in traditional mass-production manufacturing techniques where products are manufactured based on forecasted demand and pushed through the production process to the customer or client. In contrast, pull systems are grounded in lean thinking and lean-production manufacturing techniques, which are based on actual customer demand (Womack and Jones, 2013). In a pull system, service delivery or production processes are prompted by actual customer demand rather than forecasted demand or predetermined schedules. This means that each activity produces exactly what is needed for the next stage, reducing the chances of overproduction and waste in the production process.

In context, current structures in the AECO industry are characterised by push-based business models that lack systematic feedback loops from stakeholders, leading to inefficiencies and data overload. The AECO industry mainly perceives data as a by-product of the project lifecycle process for realising the physical artefact rather than a prime deliverable that requires a multi-stakeholder approach to improve the quality of business processes and, in turn, the physical artefact. As such, data is pushed within the project environment as soon as it is available without considering the specific needs and preferences of all stakeholders, which often leads to ineffective data utilisation, information overload, and difficulty in extracting relevant insights. The oversight of the crucial role of data in information transactions in the effective delivery of products and services represents a significant blindspot within the industry. This challenge underscores the need to ensure data integrity by delivering the right data to the right stakeholder, of the right quality, at the right time, and in the right amount.

The implementation of information systems in the AECO industry has been chaotic and lacks strategic business alignment (Munir, 2019a). For instance, the 2011 UK BIM mandate was push-based and primarily driven by regulatory pressure rather than business needs. While push-based systems are not inherently negative, this mandate prompted significant progress in digital technology adoption and enhanced AECO industry capabilities. However, that created an

additional problem of lack of harmonisation as the industry tried to reach the plateau of productivity for BIM implementation across all project lifecycle phases, with design (Sandberg, 2015) and construction (Smits et al., 2017) phases ahead, but operations (Munir et al., 2019b) and circular economy (Banihashemi et al., 2024) processes lagging, as shown in Figure 1 based on the Gartner hype cycle (Fenn and Raskino, 2008). Consequently, technology adoption without stakeholder involvement can be a barrier to efficiency and collaboration. These push-based implementation strategies have eventually led to incongruities between human capability, process standardisation, technology maturity and business value realisation. On the other hand, evaluating strategies and processes prior to implementation would create a *"Pull"* impact that will align business processes and socio-technical infrastructure, thereby maintaining the coherence of DT initiatives across the project and asset lifecycles.

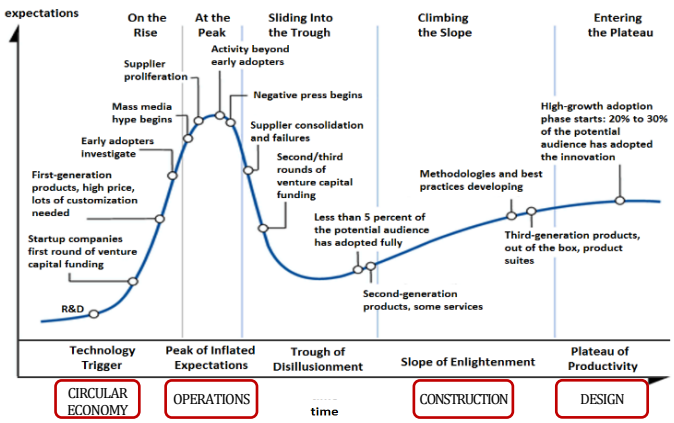

Figure 1: Gartner Hype Cycle Highlighting the Maturity of the different phases across the Project Lifecycle

In contrast, pull systems, driven by actual demand, enhance data quality and purpose through active stakeholder engagement. Currently, the AECO industry struggles to ensure sufficient and complete data requirements. Stakeholder interaction can foster innovative solutions that address the complexities of organisational and project dynamics in the AECO industry, resulting in improved project outcomes. However, the implementation of pull-based systems are not without drawbacks, as challenges still exist in supporting human capability, process standardisation and business process maturity. Currently, the AECO industry lacks consistent approaches for stakeholder engagement and interaction, including data customisation, requirements, and completeness to enable organisations and projects to *"Pull"* the right data. Thus, transitioning to a pull-based approach requires addressing factors that relate to human capability, process standardisation, and system maturity in the implementation of DT strategies and initiatives.

2.4 Model and Platform Based Systems in the AECO Industry

The AECO industry is primarily dominated by model-based systems that focus on specific data structures. However, platform-based systems have the potential to offer more flexibility, supporting different purposes for various stakeholders. The main difference between platform and model-based systems is the central emphasis given to the object-based definition of data structures in model-based systems (Estefan and Weilkiens, 2023). While both model-based and platform-based systems function as databases, model-based systems organise data around specific entities like construction products. In contrast, platform-based systems vary their structure based on intended use to support significant differentiation to meet the diverse needs of stakeholders across the project lifecycle. Platforms can improve efficiency, enhance productivity and reduce transaction costs, especially in multi-stakeholder business environments (Munir et al., 2019a). The AECO industry has experienced increased adoption of Common Data Environment (CDE) platforms alongside other systems that integrate diverse data perspectives.

The use of platform-based systems to deliver customer value is well-established, with some studies on their role in transforming inter-organisational networks and enabling value generation across various industries (Parker et al., 2016; Estefan and Weilkiens, 2023). Platforms can be in four different categories: organisational, product family, market intermediary, and platform ecosystem, all of which vary in terms of openness and purpose (Thomas et al., 2014). The platform ecosystem is the most open type, followed by market intermediaries, product families, and organisational platforms. As a network expands, the addition of new stakeholders to the market or platform creates a positive impact on the network, known as network effects (Katz and Shapiro, 1994). However, implementing platform ecosystems requires a gatekeeper to

engage stakeholders and harness network effects for value generation (Laine et al., 2017). This highlights the complexity of these systems, which necessitates a better understanding of the connections between the system model, purpose, transactions, and the data lifecycle.

Principally, platform and sharing systems have the potential to create new efficiencies by aggregating unorganised markets, such as the AECO industry, which typically lack structured and integrated approaches (Alhava et al., 2017). Platform-based systems excel in two-sided markets by enabling direct producer-consumer interactions that foster value creation. Their scalability could be facilitated by digital technology with near-zero marginal costs, offering a strong value proposition and the potential to impact market dynamics positively. The concept presented in this paper is broadly relevant and applicable to various data types contained within both model-based and platform-based systems. Therefore, it is crucial to develop improved awareness to overcome the barriers to the integration of data, products, and services in the AECO industry.

3 Research Methodology

The study utilised an abductive approach and exploratory research strategy. This approach and strategy are suitable for answering the "what" and "how" research questions (Patton, 2002). It also adopts a qualitative approach through extensive literature reviews and semi-structured interviews, which were carried out in two phases. The first phase is the literature review, where the study explores existing research on DT in the construction industry, with a particular focus on Building Information Modeling (BIM), Products, Services and Platforms and Lean principles (Pull-based approaches). The literature review was conducted with the following search criteria: "Data" AND "Integration" AND "Construction Industry" AND "BIM" AND "Framework". Categorisations were done by reviewing abstracts and titles (Table 1 and Figure 2).

A total of 78 journal articles were reviewed from Scopus, Web of Science, and Google Scholar, with titles, abstracts, and full texts screened for inclusion criteria. The selection considered research quality, impact, and diversity of model and platform-based perspectives. A thematic analysis of the data was done to identify themes, informing the development of the conceptual framework detailed in Section 4.1. The themes used in the categorisations are shown in Figure 2.

Table 1: Literature Search

Theme	Number Of Occurrences	% Of Papers (N=53)	% Total Number Of Occurrences (N=104)
Data	16	30.19%	15.38%
Data Service	13	24.53%	12.50%
Products	39	73.58%	37.50%
Transactions	18	33.96%	17.31%
System Models	6	11.32%	5.77%
Purposes	12	22.64%	11.54%

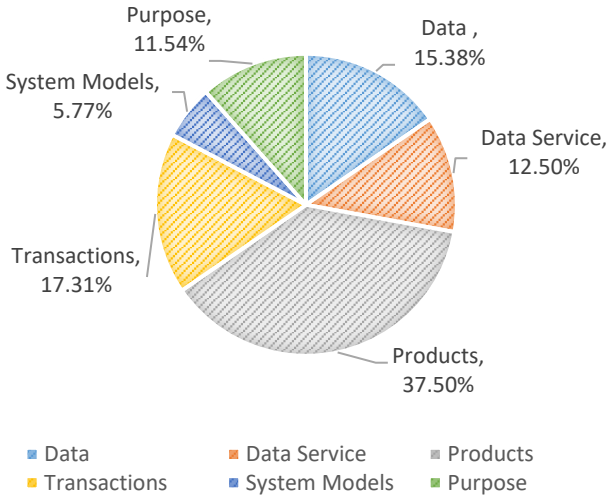

Figure 2: Literature Review Criteria-Themes

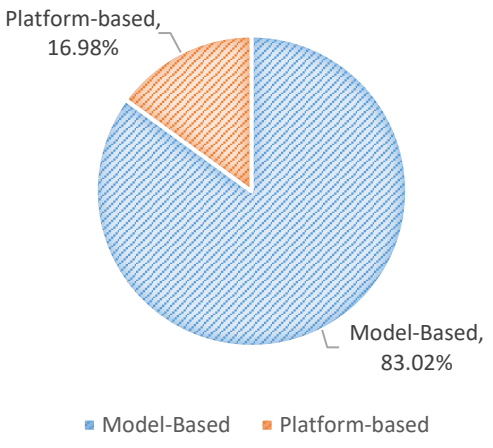

Figure 3: Literature Review Criteria-Perspectives

The second phase involved face-to-face semi-structured interviews with four construction industry experts. These interviews provided an in-depth understanding of current practices in the integration and utilisation of digital tools. The study utilised purposeful sampling to select a small, targeted group of respondents (Patton, 2002). Criteria for selection included BIM experience, expertise, management level, and involvement in DT implementation. The semi-structured interviews were analysed based on the themes established in the literature phase, which enabled further evidence to be collected. The research methodology is shown in Figure 4:

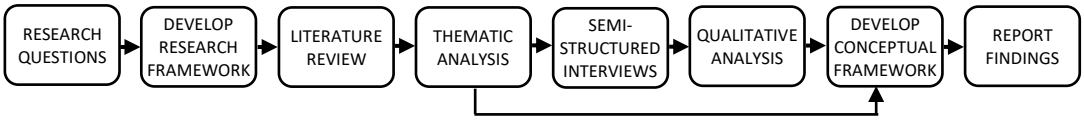

Figure 4: Research Methodology

4 Results and Discussion

4.1 Thematic Analysis

The thematic analysis of literature in the first phase identified six key factors influencing data-driven DT initiatives: purpose, system models, transactions, products, data service, and data.

4.1.1 Purpose

This theme addresses the overarching goals, standards, and regulatory requirements guiding processes in relation to data utilisation in the AECO industry. It includes the motivations and requirements of various stakeholders. The "purpose" theme was identified and is fundamental in any discussion of DT as it guides the strategies and technologies that stakeholders choose to implement. The "purpose" of DT initiatives often reflects the main goals of enhancing efficiency, reducing waste, improving safety, and increasing the quality of outcomes, including the growing need for a more sustainable AECO industry with data-driven decision-making (Sawhney et al., 2022). Similarly, the recent changes to the construction product regulations in the UK and EU represent an example of this growing need. Furthermore, understanding the "purpose" and developing requirements for data, products, and services is essential for effective utilisation. In addition, Wijekoon et al. (2020) highlight the misalignment between required and available information in the project lifecycle phase, suggesting that data and product requirements must align with the "purpose" to drive DT strategies adoption and integration in the AECO industry.

4.1.2 System Models

This theme consists of the frameworks and structures for organising, managing, and executing projects, including business models, contractual terms and procurement systems that impact the way stakeholders collaborate and exchange value in the AECO industry. It determines how operating models impact the adoption of traditional or innovative project delivery methods, such as BIM or Lean Construction. System models Systems models influence the use of digital tools by emphasising collaboration, early stakeholder involvement, and requirements for data integration (Mutis and Mehraj, 2022). These models impact project financing, delivery, and motivations, underscoring the need to align business models with technology use. Also, innovative business models could benefit stakeholders from improved data services (Wildenauer et al., 2022).

4.1.3 Transactions

This theme involves the collaborative interactions and exchanges of information, knowledge, and resources among stakeholders in the AECO industry that system models primarily influence. It emphasises information transactions and flows, including the roles of different parties in the project and asset lifecycle. The emergence of this theme is attributed to the dependence of DT initiatives on successful communication, data exchange, and information management. Samuelson and Stehn (2023) identify factors influencing DT, including structural and organisational changes that enhance knowledge, skills, and collaboration to leverage digitalisation. This highlights the importance of information flow, transaction nature, and stakeholder roles and relationships across all lifecycle phases as they impact project outcomes.

4.1.4 Products

This theme relates to the outputs and deliverables generated from data processing and analysis. This category includes products and services, as well as the various tools and technologies used to create, analyse, and manage project and asset related data. It includes typologies such as data authoring, data analysis, data federation, and generative data for AECO products and services as deliverables. Mutis and Mehraj (2022) suggest that BIM is not just a model-based tool but can also be utilised through a cloud-based platform for generating data, products, and services across project and asset lifecycle phases.

4.1.5 Data Service

This theme covers the infrastructure and frameworks for storing, managing, and processing construction-related data. It includes physical and digital resources like hardware, data lakes, data warehouses, data mesh, and data fabric. This theme emanated from the focus on the adoption of big data, cloud computing and data analytics in the AECO industry (Mutis and Mehraj, 2022; Larbi et al., 2024). The review found limited literature on data services in construction management, BIM, or built environment data, with only 15% focusing on these services. Additionally, the infrastructure for storing and processing the vast amounts of data generated by digital tools, including scalability, accessibility, and security, is crucial for the successful implementation of DT strategies (Parker et al., 2016).

4.1.6 Data

This theme represents the raw data collected, stored, and processed to support products and services. It distinguishes between different data formats and their accessibility and includes both open and proprietary data formats. The theme emerged from studies examining data formats and their impact on accessibility, interoperability, collaboration, and integration in contexts like blockchain and digital twin technology (Teisserenc and Sepasgozar, 2021), design and planning processes (Larbi et al., 2024) and organisational-level digitalisation (You and Wu, 2019). Also, standardising data formats is crucial for enabling interoperability and seamless integration of digital tools throughout the project lifecycle (Golzarpoor et al., 2018). Furthermore, Boiko (2024) highlights the impact of open and proprietary data formats on information transactions and management across different systems and stakeholders in the project lifecycle.

4.2 Semi-Structured Interviews

Identifying themes in the literature review enabled further exploration of their impact on DT implementation through semi-structured interviews. The data analysis is presented in Table 2.

Table 2: Summary of interviews

	Case - Interview	Purpose	System Models	Transactions	Products	Data Service	Data	Perspective
1	A senior leader of an organisation providing product information for mechanical, electrical and plumbing elements.	Reporting of production and specification of product performance	Organisational Platform	Industry/ Project specific	BIM objects	No CDE No Market Integration	Specifications Standards Compliance	Push The data services were developed for control in one part of production but were not reliable for scalability and often required manual processing.
2	An executive of an organisation providing products to integrate product information for various purposes	Ensuring reliable product information for the construction industry stakeholders	Market Intermediary Platform	Manufacturer	Data Dictionary	CDE and Market Integration	Standards	Push The software product development aimed to provide logistics information but faced scaling issues due to the lack of a unified language, resulting in the service being launched without harmonised data.
3	A senior leader of a large firm specialising in building products, standardised design, logistics operations, and in-house data service development.	Reliability of product information	Organisational Platform	Industry/ Project specific	Data Dictionary	CDE No Market Integration	Specifications Standards Compliance	Push Building kits and turnkey recreational homes, including building materials, are pushed to customers.
4	A senior leader of a roofing manufacturer aiming to develop in-house data service expertise.	Reliability of product information	Organisational Platform	Industry/ Project specific	Product Data	CDE No Market Integration	Specifications Standards Compliance	Push Insulation, energy efficiency and humidity protection materials are pushed to customers.

The interview data analysis suggests that data service providers employed a push-based strategy. One of the respondents highlighted that a push-based strategy limited scalability due to the lack of harmonised definitions of data structures. However, the interviewee realised the need to standardise data, which resulted in the reconsideration of their current approach to a new one facilitated by the use of data dictionaries. This underscores the major shortcoming of the push-based strategy, which is the constraint of not being able to provide a missing link between "Data" and "Purpose" in the delivery of products and services in the AECO industry. The industry focuses on generating an increasing amount of data. For example, this is demonstrated by the increased illustration of property sets, which leads to data either being in the wrong place or not being defined in a way that enables data utilisation. This limits data use to a single purpose, preventing its reuse for multiple purposes that serve a variety of stakeholders and market segments.

The push strategy assumes that creating more data will support better project delivery, and the final result will be multiple new data-driven services that may enhance collaboration. However, system models influence stakeholders, meaning that motivation does not align with the processes and value generated. In addition, the analysed data suggests that the push-based approach dominates the AECO industry, which validates the initial assumption of this study. Current processes in the AECO industry are characterised by the *"Data Services"* (available project infrastructure), which are pushed to an oversimplified and fragmented *"Purpose"* from the perspective of stakeholders (regarding data delivery and potential usage), leading to stakeholders identifying and determining the nature of *"Transactions"* (business processes for products and services) based on the limitations on the current *"System Models"* (business models) in the utilisation of *"Products"* (products and services through business and productivity tools). Therefore, this results in inaccurate, unscalable and inconsistent *"Data"* (raw, machine-readable and machine-interpretable data) generated in the project and asset lifecycle in a fragmented manner (Figure 5).

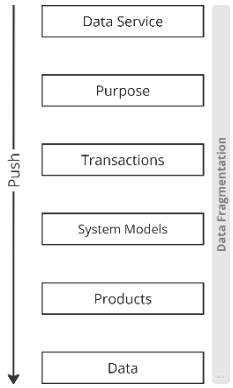

Figure 5: Current status of data integration

The push strategy means that data service providers develop their offerings by focusing on their technological developments and depending on assumed market segments and by some interactions with parts of the fragmented market, which results in simplified deductions of user data needs. In this regard, data service providers may engage with only one stakeholder type in the market with the assumption that they are solving the pain point of the market segment. However, in actual fact, the data that one stakeholder utilises is interdependent in a complex supply chain. For example, an architect typically finds product data online and integrates it into an information model before meeting a manufacturer, whereas, in autonomous driving, because there is a high degree of technological complexity and the supply chain is more straightforward, this makes it easier to make scalable developments. As such, the push strategy works in simpler supplier chains where the value that data brings to all stakeholders is more transparent.

4.3 Conceptual framework for data integration

Following on from the previous section, one could question why the push-based strategy remains dominant. The fundamental reason could be attributed to the prevalent mental models that employ a simplistic approach to managing complexity, which may seem effective, but only in the short term, and stakeholders interact based on their position in the supply chain. These have been proven in manufacturing literature by adopting the flow model from the transformation model, which is reductionist and focuses on breaking down an activity and analysing its parts. This logic is applied to Design for Manufacture and Assembly (DFMA), where a Lean approach is used for construction. In addition, the predominance of the push-based strategy might also be linked to the fact that private market forces primarily drive data service providers and lack the incentive to assess value from a holistic perspective that encompasses industry-level benefits.

In the AECO industry, there are still many opportunities to exploit data that can generate value for stakeholders that are not practically possible to answer. For example, if a new MEP maintenance provider is established in a new city, knowing which pump configurations are the

most common in the city would benefit their hiring strategy and ability to order parts in bulk and, therefore, apply economies of scale savings. Similarly, in terms of fire safety, if a faulty product is recognised, it would be valuable to be able to identify which buildings they are installed in within the city and where. The above underscores the necessity for stakeholders to communicate their requirements effectively across their value streams. From the analysed data, it can be deduced that successful cases of data integration often involved projects that emphasised asset owner-driven collaboration (finding new value), clear communication, open stakeholder engagement, and incremental adoption strategies beyond single projects. This has enabled the development and rearrangement of themes into a proposed conceptual framework for integrating data, products and services in the AECO industry based on a pull strategy (Figure 6). This approach suggests that the *"Purpose"* would drive the *"System Models"* (business models) to define their organisational, asset and project information requirements to guide the *"Transactions"* (business processes for products and services) to deliver the exchange information requirements, which determine the *"Products"* (products and services through business and productivity tools, for example, project and asset information models), linked to the *"Data Service"* (project infrastructure) and, the generation of *"Data"* (raw, machine-readable and machine-interpretable data) to be utilised across all project and asset lifecycle phases.

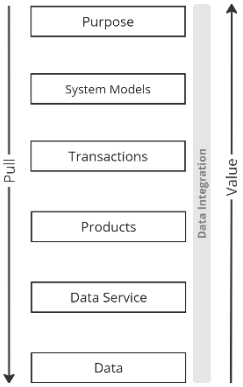

Figure 6: A Holistic Framework for Enabling in the AECO industry

5 Conclusion

The study aimed to propose a holistic framework for enabling the integration and implementation of DT strategies, products, and services in the built environment. This was achieved through exploratory research around the perceptions of stakeholders, suggesting the need to define a roadmap that provides the rationale for the adoption of digitally enabled data, products, and services in the AECO industry. The proposed conceptual framework provided both theoretical insights and practical challenges, offering propositions for a comprehensive approach to enhance DT strategies and implementation in the AECO industry. The study highlights the prevalence of push-based systems and the need to transform to pull and demand-based systems that focus on value creation. Investment in the development and implementation of DT strategies would require a better balance of perspectives, and the example of the *"Michelin Guide"* demonstrates the importance of a stakeholder-centric approach by considering the social and practical needs to create a valuable resource-based platform that enhances trust and reliability between stakeholders. However, stakeholders are required to communicate their requirements across their value streams, not only within the market segments from which they derive direct value. Also, there are currently not enough incentives to discuss value openly beyond a single market segment. As such, strategic alignment with stakeholder needs, societal needs and market trends is essential for successful technology diffusion and organisational business-process sustainability, which is effectively linked to its "purpose". This alignment would ensure that adopted technologies are cutting-edge to meet the practical needs of the broader market and facilitate wider adoption and integration in the AECO industry. Furthermore, emphasising practical needs over purely innovative solutions increases motivation among the early majority to adopt new technologies and processes, driving widespread DT and business value delivery. Lastly, as *Michelin* achieved systemic drivers, the AECO industry needs to mirror this at a larger scale between stakeholders across the project and asset lifecycle by identifying common goals.

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