

Designing a Strategic Planning Method for Digital Transformation Initiatives in Natural History Museums: Methodological Reflections from an Industrial Doctorate

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Abstract

Digital transformation (DT) in Natural History Museums (NHMs) goes beyond the adoption of emerging technologies, as it requires a strategic rethinking of institutional processes, structures, and full alignment with the organisation's overarching strategy. This paper explores the methodological challenges encountered in designing a method for the strategic planning and deployment of DT initiatives in NHMs, in the context of an ongoing industrial doctoral research conducted by the corresponding author under academic supervision. The project is approved and funded by the Industrial Doctorates Programme of the Generalitat de Catalunya and carried out through a collaboration agreement between the Universitat Politècnica de Catalunya (UPC) and the Museu de Ciències Naturals de Barcelona (MCNB). The research is situated in a real institutional setting that presents unique complexities, including the museum's current transition toward becoming a national museum and recent changes in its executive leadership. These dynamics add additional layers of complexity to the research process, particularly in balancing the academic rigour required by the Design Science Research (DSR) methodology with the demand for practical relevance expected by the host institution. This paper reflects on how the doctoral candidate, with the guidance of academic supervisors, has addressed these challenges, highlighting key strategies and lessons learned. By sharing this experience, the work aims to contribute to the broader discourse on applied research in complex organisational environments, offering insights relevant to other applied researchers and industrial PhD candidates working at the intersection of academia and practice.

Keywords

digital transformation, natural history museums, strategic planning, design science research, institutional complexity, industrial doctorate, IS/IT

1. Introduction

Digital transformation (DT) has emerged as a strategic priority across sectors [1,2], including cultural and scientific institutions such as Natural History Museums (NHMs). Yet, these institutions often face distinctive challenges, such as constrained resources, historically layered governance, and diverse technological infrastructures, that complicate the development of structured, strategic approaches to DT [3].

This paper presents methodological reflections from an ongoing industrial doctorate project focused on designing a strategic planning method for DT initiatives in NHMs. Since DT must be fully aligned with the institution's overall strategy as a whole, including its long-term direction and institutional priorities [4], its strategic planning becomes essential, especially in public and cultural organisations like NHMs [5,6]. The research is grounded in the real-world context of the Museu de Ciències Naturals de Barcelona (MCNB), a public institution undergoing a process of strategic transformation. Carried out in collaboration with the Universitat Politècnica de Catalunya (UPC)

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and framed within the Design Science Research (DSR) methodology, the project seeks to bridge academic rigor with institutional relevance.

By articulating the process, challenges, and decisions involved in designing a context-sensitive method for DT planning, this work aims to contribute both theoretically and practically to the field of Information Systems. Furthermore, it offers insights into how applied research can navigate institutional complexity, produce transferable knowledge, and promote innovation in the cultural heritage domain.

2. Project Background and Context

This applied research emerged from the concrete needs of the Museu de Ciències Naturals de Barcelona (MCNB) to enhance the strategic management of its information systems and technologies (IS/IT), a need initially identified within the Collections Area due to its close interaction with diverse databases and the management of high volumes of data. Despite being recognized as a reference (NHM) in Southern Europe, the MCNB faces limitations in human and financial resources, as is often the case in public institutions [7]. The project has been accepted and co-financed by the Industrial Doctorates Plan, promoted by the Generalitat de Catalunya [8]. Accordingly, the thesis is being developed within the framework of a cooperation agreement between the Universitat Politècnica de Catalunya (UPC) and the MCNB, where the corresponding author has been working as a doctoral candidate since July 2021.

The proposed industrial doctorate project was submitted in the first call of April 2021, approved in June 2021, and officially launched in July 2021. The full project description is available on the official Industrial Doctorates Programme website [8]:

<https://doctoratsindustrials.gencat.cat/doctorats/disseny-dun-metode-integral-de-planificacio-estrategica-i-desplegament-de-projectes-de-transformacio-digital-per-a-museus-de-ciencies-naturals/>.

The research is being carried out by Cristabel Evelia Alvarado Pérez, the industrial doctoral candidate and corresponding author, under the guidance of her thesis supervisors, Dr Joan Antoni Pastor Collado, acting as academic co-director on behalf of the UPC, and Dr Eulàlia Garcia Franquesa, acting as academic co-director on behalf of the MCNB, the host institution.

3. Research Approach

The project is framed within the methodology of Design Science Research (DSR), which offers a solid foundation for addressing the methodological challenges of applied research in real institutional settings [9]. Particular attention is paid to balancing academic rigor with practical relevance, especially in a host institution currently undergoing internal transformation. As the research progresses, the collaboration continues to yield insights that may be valuable for other institutions and researchers operating at the intersection of academia, culture, and technology.

Design Science Research (DSR) was adopted as the core methodology for this project due to its dual capacity to address practical challenges while generating theoretical contributions [10]. Rooted in a real-world problem within the cultural heritage sector and a clear gap in academic literature, the project aligns with DSR's goal of bridging relevance and rigor. Using Hevner's framework [11], the research is structured around three components: the environment, the DSR process, and the knowledge base (Figure 1). The MCNB serves as the environment, providing a representative case to understand the broader context, challenges, and operational realities of NHMs in the face of digital transformation, while the knowledge base includes the scientific foundations. Central to the methodology is a deep and sustained understanding of the problem to ensure the designed artefact remains both context-sensitive and academically robust throughout the research process.

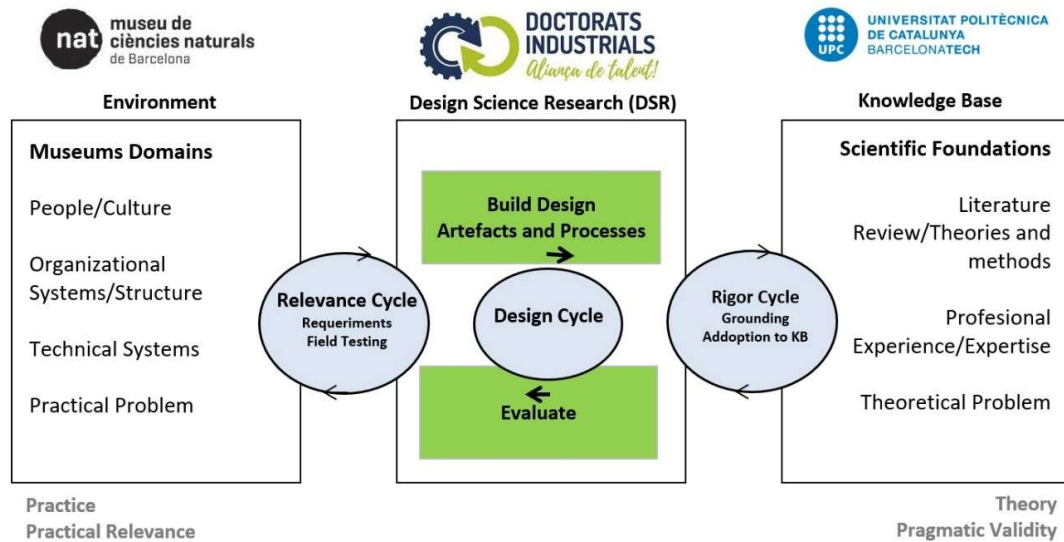


Figure 1: Adaptation of the Design Science Research (DSR) framework to the context of the industrial doctorate project. The environment is represented by the museum domain (MCNB), the design cycle is informed by field requirements and institutional experience, and the knowledge base includes scientific foundations and institutional environment. Source: Author's own elaboration based on Hevner [11].

4. Research Design and Objectives

This applied research aims to structure the key problems, questions, and methodological considerations surrounding the strategic planning of digital transformation (DT) in Natural History Museums (NHMs). Accordingly, the main research question guiding the project is: **how to design and describe** a comprehensive strategic planning method for digital transformation initiatives and their deployment within NHMs? In addition, the primary goal is: **to design, generate and describe** a domain-specific and comprehensive strategic planning method for DT initiatives and their deployment, aimed at supporting the specific needs of NHMs. The expected tangible outcome of this work is the creation of a new methodology to support strategic digital transformation (DT) planning in such institutions.

To guide the development of the artefact, the overall goal has been broken down into several specific objectives using the Manson methodology within the Design Science Research framework [12]. These objectives include: (O1) identifying and understanding the problem; (O2) proposing a potential solution; (O3) developing the artefact; (O4) evaluating the artefact; and (O5) drawing conclusions. Each of these objectives is further supported by a set of sub-tasks that contribute to their fulfillment, as for example, active participation in DT projects inside the museum in the phase O1 [13,14]. See figure 2.

Moreover, following Manson's model [12], emphasis is placed on the cycles of circumspection and operational and goal knowledge. The first promotes a deep understanding of the problem and its context, while the second ensures that the artefact remains actionable and aligned with the problematic context. Hence, the method is developed inside a host institution (MCNB), but it is designed to be adaptable and relevant for other NHMs facing similar digital transformation challenges.

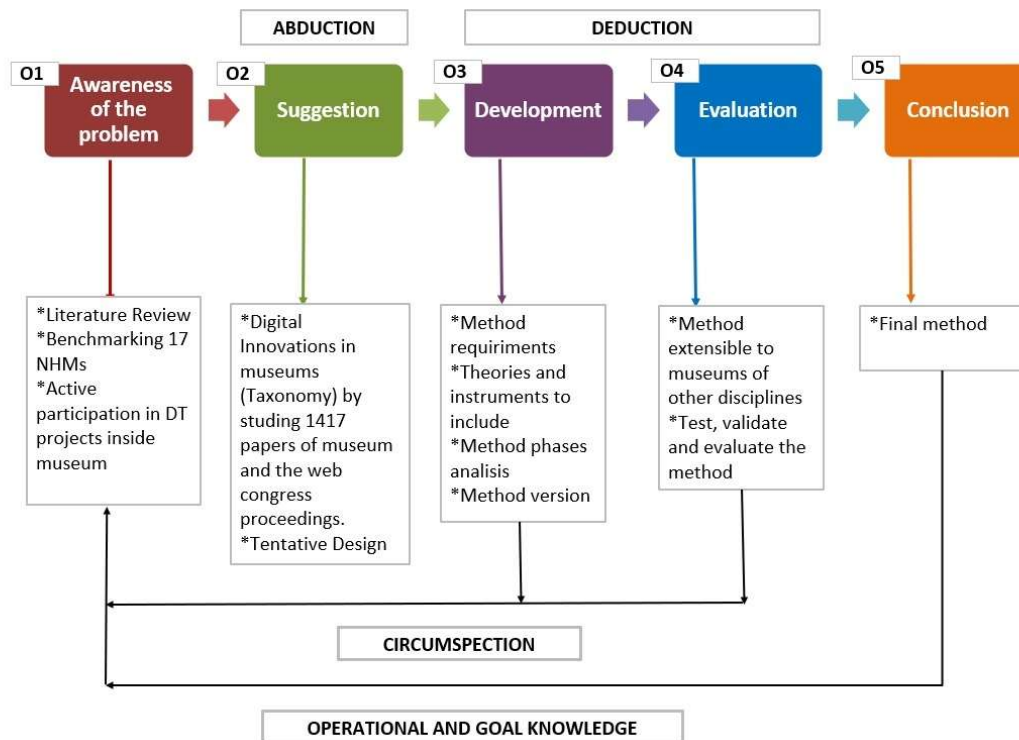


Figure 2: Structure of research objectives following Manson's Design Science Research cycle, highlighting the abductive and deductive logic that guides the development of the artefact. Source: Author's own elaboration based on Manson [12].

In the context of an applied research project like an industrial doctorate, where Design Science Research (DSR) is employed, it is important to clarify that the artefact is not meant to simply meet the operational needs or institutional requirements of the host organisation. This is not a consultancy project or a commissioned solution. Instead, the artefact must address the research problem meaningfully and systematically, contributing to knowledge while also offering potential value to practice. As Manson suggests [12], the development of the artefact should be guided by a rigorous understanding of the problem and context, not by the pressure to deliver immediate or tailored institutional outputs. This distinction reinforces the scientific integrity and generalisability of the resulting method, allowing it to be transferred to other NHMs facing similar challenges.

5. Relevance of the Project to Research Challenges in Information Science

This project aligns strongly with several core research challenges outlined in the RCIS 2025 conference topics [15], particularly under the theme "*Advancing Information Science and Information Systems Quality in the Era of Complexity*."

Firstly, the project contributes to the domain of **Enterprise Management and Engineering**, as it tackles digital transformation (DT) in the context of a complex, historically layered public institution. The host organization, the MCNB, is embedded in a multifaceted governance structure that includes the Barcelona City Council and the Generalitat de Catalunya; and has undergone institutional transformations and leadership changes during the course of the research. These characteristics require the development of DT strategies that go beyond linear planning, embracing complexity management and contextual sensitivity, challenges that resonate with the need for robust IS/IT approaches in organisation environments.

Secondly, the research is situated within the category of **Reflective Research and Practice**, specifically engaging with topics such as **Research Methodologies in Information Science** and **Design Science and Rationale**. Throughout the development of the project, the doctoral candidate under academic supervision, has had to critically reflect on the methodological approach, adjusting and refining it to ensure both scientific rigor and practical relevance. This reflective process has led to important learnings on how to operationalize Design Science Research (DSR) in institutional contexts that do not behave like standard business environments. As such, the project offers methodological insights that may be of interest to the RCIS community, particularly to researchers working on applied research and method design in complex organisational settings.

5.1. Navigating Institutional Complexity: Contextual Challenges and Adaptation

The Museu de Ciències Naturals de Barcelona (MCNB) is a public institution with a long and complex trajectory, shaped by decades of scientific, educational, and curatorial work. Its administrative structure is defined by a consortium model that includes both the Barcelona City Council and the Generalitat de Catalunya, making it subject to multiple layers of governance and oversight. Over the years, the museum has also undergone a series of institutional mergers and restructurings (Figure 3), which have contributed to a historically rich yet organisationally intricate environment. [16]

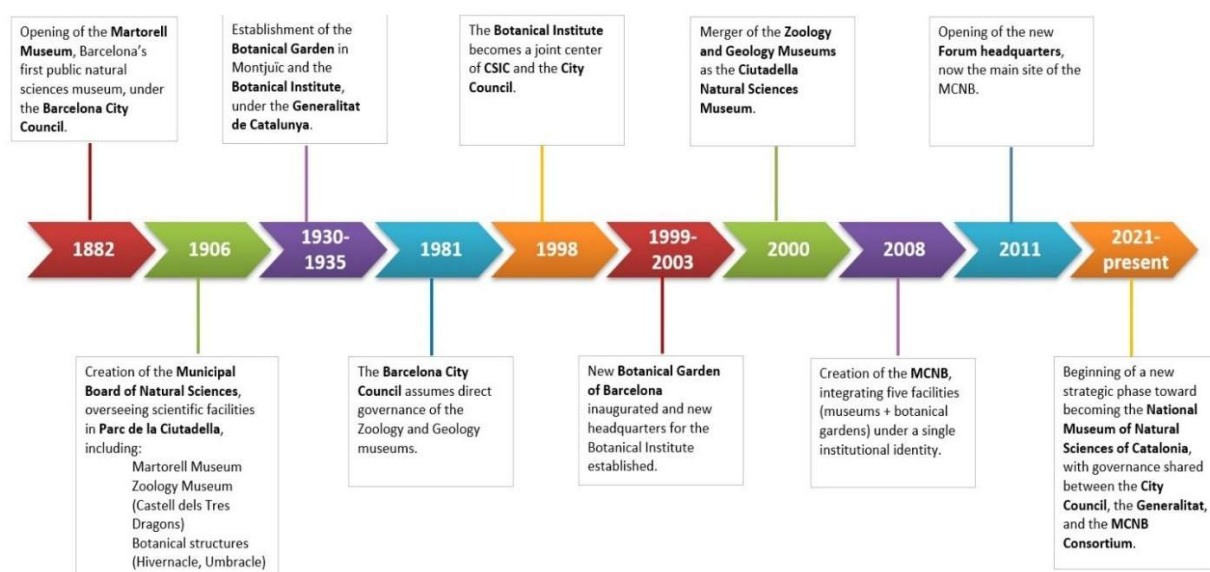


Figure 3: Institutional Evolution of the Museu de Ciències Naturals de Barcelona (MCNB). A chronological overview of key milestones in the development and governance of the MCNB, from its origins in 1882 to the present strategic transformation phase. Source: Author's own elaboration based on the history of museum [16].

During the first year of the industrial doctorate project, the MCNB experienced significant shifts in executive leadership and internal reorganisation, along with evolving strategic priorities that directly impacted the positioning of the project within the institution. At one point, the digital transformation initiative was deprioritized, resulting in the need for the doctoral candidate, under academic supervision, to reinvest time and effort into reintroducing and resituating the project. This process required building new alliances, explaining the project's scope and scientific value to a changing leadership, and navigating uncertainty regarding the project's institutional fit.

These challenges offer a valuable lens through which to understand institutional complexity; not merely as a circumstantial obstacle, but as a dynamic condition that must be factored into the design, deployment, and evaluation of applied research. In particular, this case underscores the importance of resilience, adaptability, and stakeholder communication in carrying out a Design Science Research (DSR) project within a public institution. It also illustrates how real-world complexity intersects with academic goals, reinforcing the need for design methods that are robust enough to accommodate shifts in context while still maintaining scientific integrity and methodological coherence.

Such dynamic organisational shifts represent a key example of the complexity that characterises many public institutions engaged in digital transformation processes. This case highlights the importance of managing institutional complexity not as a barrier, but as an integral part of the research context, especially in applied research projects situated in real-world settings. In this regard, the project contributes not only to the scientific discourse on digital transformation, but also to the methodological understanding of how to carry out DSR in environments where political, historical, and strategic factors evolve throughout the project lifecycle.

6. Current Project Results

To date, the project has advanced through several key stages of the DSR methodology. The problem domain has been thoroughly explored through extensive literature reviews and the completion of a benchmarking study involving 17 Natural History Museums (NHMs): the Natural History Museum of London, the Smithsonian, Naturalis, etc. This benchmarking process required the construction of an entire dataset, based on the deep analysis of more than 100 institutional websites, official reports, and publicly available resources. This dataset is currently being considered for open access publication, in line with open science practices, to increase transparency and academic rigour.

The main dimensions evaluated in the benchmarking study included the age of the institutions, the existence of strategic and digital transformation plans, the presence of IS/IT teams within the institutions, the current state of digitalisation, data sharing policies, and major digital innovations. Key findings revealed that many of the institutions studied date back to the 19th century and tend to be traditional in nature, often lacking a strong culture of strategic planning or publicly available digital transformation strategies. Although various digital innovations have been incorporated, most still lack dedicated IS/IT teams within their organisational structure, which has delayed their digital maturity. These findings shed light on the broader context in which the artefact (the method) is intended to operate.

In parallel, it has also undertaken a comprehensive review of over 1,400 academic papers from the Museum and the Web conference series, the leading global forum on digital innovation in museums. This effort is part of the ongoing second phase (O2) of the project, focused on generating a well-grounded taxonomy of digital innovation. Together with the benchmarking, this serves as the empirical foundation for the preliminary design of the proposed method.

Currently, the project is concluding the (O2) phase and progressing through the development phase (O3), which includes outlining and refining the method's structure, phases, and theoretical foundations. This work will support subsequent phases (O4 and O5), in which the method will be further developed, tested, and evaluated in relevant institutional contexts.

In completing phase (O2), it became evident that there are significant structural and operational similarities between natural history museums (NHMs) and museums of other disciplines. While NHMs face specific challenges, particularly in the area of data management due to the vast amounts of biodiversity and geodiversity data they handle, their overall organisational architecture tends to mirror that of other museum types. Most are public institutions with local governance and similar organisational charts and departments (e.g. exhibitions, education, collections, research). As a result, the potential for extending the methodology beyond NHMs is being actively considered. Hence, to ensure the wider applicability of the artefact, its evaluation must remain objective and independent of the particular needs of the host institution. For this reason, the doctoral candidate,

under academic supervision, is exploring external validation strategies, including expert reviews from professionals in the Catalan Museum Sector who are experienced in digital transformation and knowledgeable about different types of museums. This approach aims to reduce institutional bias and ensure that the methodology is not overly tailored to the specifics of the MCNB, but rather adaptable to other museum contexts.

Preliminary results have already been disseminated through various academic forums, including international and national conferences such as CIMED 2022, CAISE'23, JCIS 2023, SPNHC 2023, MCIS and MENACIS 2023. These contributions have helped to situate the research within discussions of cultural heritage, IS/IT management, digital transformation and innovation in NHMs, and continue to shape the development of a generalisable and transferable methodological contribution to the field of information science.

7. Conclusions and Lessons Learned

This paper has presented the methodological foundations and early findings of an industrial doctorate project focused on the strategic planning of digital transformation (DT) in Natural History Museums (NHMs). By applying a Design Science Research (DSR) approach, the project addresses a real institutional context while contributing to the academic understanding of method design in complex organisational environments.

The research highlights the importance of aligning DT initiatives with the broader institutional strategy, especially in public organisations where governance, priorities, and resources are subject to continuous change. In this context, institutional complexity is not simply a barrier, but a defining characteristic of the research environment; one that requires resilience, adaptability, and methodological clarity.

Although the project is ongoing, the steps taken so far have provided valuable insights into the interplay between practical relevance and academic rigor. As the artefact continues its development, the final research phases will include the exploration of its applicability to other types of museums beyond the natural sciences. This will help assess whether the resulting method can be adapted for broader use across cultural institutions, contributing further to the field of Information Systems and digital transformation in heritage contexts.

Throughout this process, several lessons have emerged. First, institutional complexity should be embraced as a fundamental design condition, not just a contextual limitation. Second, navigating real-world shifts in leadership, priorities, and resource allocation requires not only methodological adaptability but also communication and advocacy skills. Third, the use of Design Science Research (DSR) in applied settings must be constantly recalibrated to maintain its balance between relevance and rigor. Fourth, establishing collaborative trust between academic and institutional actors is essential to sustain progress across different phases of research. Finally, acknowledging the evolving nature of the research environment enables the researchers to approach challenges not as disruptions but as learning opportunities that can inform and strengthen the artefact under development.

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Declaration on Generative AI

During the preparation of this work, the corresponding author used GPT-4 and DeepL in order to: support grammar and spelling checks and improve linguistic clarity. After using these tools, the

corresponding author, under academic supervision, reviewed and edited all content as needed and took full responsibility for the publication's content.

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