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Institutional pressures and decoupling in projects: The case of BIM level 2 and coercive isomorphism in the UK's construction sector

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April 2021

This dissertation is submitted for the degree of Doctor of Philosophy

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Thayla Tavares de Sousa Zomer

Cambridge, April 2021.

Institutional pressures and decoupling in projects: The case of BIM level 2 and coercive isomorphism in the UK's construction sector

Thayla Tavares de Sousa Zomer

Abstract

Reform and modernisation of the construction sector are ongoing concerns to governments in numerous countries, due to the low rate of innovation and productivity in the sector. Policy interventions, particularly those associated with digital technologies, are being used to promote innovation and transformation of the sector. Digitising building information through building information modelling (BIM), for example, has been claimed to be transformative and has been mandated by governments in multiple countries. Institutional theorists would describe this as coercive isomorphism – encouraging firms across sectors to adopt the same practices. In the UK and many other countries, formal structures have been devised and imposed as part of these coercive efforts, including standardised processes for managing information on delivery, handover and throughout operation.

However, evidence suggests that these coercive pressures and the national BIM approaches have not produced the envisaged systemic change at the pace expected by institutional designers. The academic literature has also acknowledged that industry-wide implementation of BIM has progressed slowly despite constant claims that BIM is a vehicle for realising radical, transformational change in the construction industry. In reality, organisations and projects are not necessarily passive receptors of imposed policies; yet the project management and construction management literatures offer limited understanding of the effects 'within' projects when institutional pressures are applied. In the case of BIM, there is a shared and implicit assumption that a multitude of stakeholders will readily accept the BIM discourse and the prescriptions that follow it.

This thesis challenges such assumptions, arguing that the adoption and implementation of BIM through institutional pressure will not be straightforward. Project management scholars have cited a low level of concern for the internal processes of projects and how they interact with broader institutional issues as a major weakness of current theorising in project management in connection with actual practice. Thus, this research takes the perspective of projects as implementers of institutional pressures to explore how this interaction unfolds.

Specifically, it examines the case of the BIM level 2 mandate in the UK, which is considered a mature country in terms of BIM adoption, as well as the BIM policy approach as an example of an institutional (coercive) pressure. Based on insights from institutional and structuration theories, and through inductive and longitudinal case studies of eight projects from three settings with varying motivations for implementing the BIM level 2 mandate, this research identifies and conceptualises how projects might respond to an institutional pressure and the predictors of such responses. The findings reveal that hybrid responses can emerge when projects are faced with institutional pressures to impose a new structure, which are underlined by both coupling and decoupling from the imposed structure. Decoupling occurs in two main forms: decoupling from the 'what', or the content of the imposed structure; and/or decoupling from the 'how' of the imposed structure, or its implicit meaning. The rationale underlying coupling and decoupling responses involves both the willingness and the ability of projects to respond to the institutional environment. The findings also evidence that decoupling in projects takes place under conditions of complex causality and presents characteristics of conjunction and equifinality. These insights demonstrate that combinations of multilevel institutionalised structures and organisation-level variables shape how projects respond to environmental pressures.

By exploring how projects interact with institutional pressures and conceptualising decoupling in the context of projects, this research contributes to several streams of literature. First, it extends the current conceptualisation of policy-practice decoupling in the organisational theory literature by proposing a more fine-grained conceptualisation wherein decoupling occurs not only under the conditions of a lack of holistic adoption and/or implementation of structures or its content (the 'what') but also when the implicit meaning (the 'how') of the structure is not enacted. The findings further elaborate on the role of the imposed structure itself and a prior decoupling that might take place at the level of the imposed structure, which stresses the impact of the imposed rules on the mechanisms that lead to decoupling at the ground level. Second, from the project management and construction management perspectives, this study directly addresses recent calls for more research that theorises the interactions of projects with the wider environment through the lens of management theories, such as institutional theory. The findings suggest that the process of change and institutionalisation of new structures imposed by the environment is a process of structuration, influenced by structures from the multiple contexts in which projects are embedded.

Finally, from a BIM perspective, this study enriches debates that challenge perceptions of BIM enactment as a linear process of implementation. Although the existing literature has already

identified a range of factors that affect BIM adoption and implementation, this research highlights the combined influence of multiple factors within various project contexts on ‘how’ the implementation of a BIM mandate actually proceeds at the ground level.

To mum.

I wish you were here and could read this.

Acknowledgments

This PhD would not have been possible without the help, support and guidance of many people. I want to take this opportunity to acknowledge their support.

First and foremost, I am particularly grateful to my supervisor, Professor Andy Neely, for his excellent mentoring, guidance, patience, and confidence in my work. I am also very grateful to my advisor, Dr Ajith Parlikad, and my PhD mentor, Professor Rafael Sacks, for their knowledgeable advice and challenging comments.

I am especially grateful to the organisations and people who have supported me financially throughout this journey. I thank the Brazilian Government and the CAPES Foundation, and the Schlumberger Foundation Faculty for the Future Programme for giving me an opportunity and for their generous financial support over the years. My life's commitment is to provide others with the same opportunities and privilege of having access to higher education and study for a PhD degree.

Thank you to all my colleagues at the Institute for Manufacturing and at Churchill College for being part of my journey. I also would like to thank my colleagues at the Centre for Digital Built Britain, with special thanks to Nicola Pearson and Amelia Burnett, for their support in numerous ways, especially in getting access to case studies.

Above all, I thank my family and loved ones for making all this possible. Eu amo vocês, obrigada por me ajudarem a chegar até aqui, pois sem vocês, nada disso seria possível. A Olorum, agradeço pela graça da vida e por essa oportunidade. Epa Babá, Ora Yê Yê Ô Oxum.

Dissemination

Awards

ARCOM Best Paper Award for contributions to the digital transformation of the construction industry. 36th Annual Conference, Association of Researchers in Construction Management (ARCOM). Glasgow, UK.

Journal articles

Zomer, T., Neely, A., Sacks, R., Parlikad, A (2020). Exploring the influence of socio-historical constructs on BIM implementation: an activity theory perspective. *Construction Management and Economics*, in press, doi: https://doi.org/10.1080/01446193.2020.1792522

Zomer, T., Neely, A., Sacks, R., Parlikad, A (2020). Institutional pressures and decoupling in construction projects: The case of the BIM Level 2 mandate in the UK. *Construction Management and Economics* (under review, article invited by the journal).

Conference papers

Zomer, T., Neely, A., Parlikad, A (2020). Institutional pressures and decoupling in construction projects: an analysis of building information modelling implementation. In: Association of Researchers in Construction Management Conference, 2020, conference in the cloud (paper awarded).

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Zomer, T., Neely, A., Parlikad, A., Martinez, V (2019). Becoming Digital: Enacting Digital Transformation in Construction Projects. In: British Academy of Management Conference, 2019, Birmingham.

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Abbreviations

AIM	Asset information model
AIR	Asset information requirements
BEP	BIM execution plan
BIM	Building information modelling
BS	British standards
BSI	British standards institution
CAD	Computer-aided design
CAFM	Computer-aided facility management
CDE	Common data environment
CDM	Construction design and management regulations
CIC	Construction information council
COBie	Construction operations building information exchange
csQCA	Crisp set qualitative comparative analysis
EIR	Employer information requirements
H&S	Health and safety
LOD	Level of detail
LOI	Level of information
M&E	Mechanical and electrical services
MEP	Mechanical, electrical and plumbing services
MIDP	Master information delivery plan
MPDT	Model production and delivery table
NBS	National building specification
OIR	Organisational information requirements
O&M	Operations and maintenance
PAS	Publicly available specifications
PIM	Project information model
PIP	Project implementation plan
PLQs	Plain language questions
QCA	Qualitative comparative analysis
RIBA	Royal institute of British architects
SMEs	Small and medium-sized enterprises
TA	Technical advisor
TIDP	Task information delivery plan
WIP	Work in progress

Chapter 1 – Introduction

1.1 Research overview and chapter introduction

This research explores how construction projects interact with coercive pressures from the environment. Projects can be defined as complex systems consisting of interacting components arranged in a hierarchical and decomposable structure (Brady and Davies, 2014). The thesis departs from the assumption that projects, as complex systems formed by constellations of organisations, face pressures from the institutional environment in which they are embedded (Lundin and Söderholm, 1995). In other words, projects, as a temporary form of organising, face pressures from the environment similarly to permanent organisations. The thesis demonstrates that projects' responses to such pressures are shaped by the interaction between the pressure and the contexts in which projects are embedded and the agency of project stakeholders.

The need to explore and clarify how projects interact with institutional pressures has emerged from observations that projects have varied in their responses to coercive pressure in the form of a policy mandate that aims to transform the construction sector in the UK. Consequently, the coercive pressure has not achieved the intended goals at the pace initially envisaged by institutional designers. From a theoretical perspective, existing scholarly work has particularly failed to consider the role of the institutional environment in understanding project dynamics. There has been little investigation of how projects respond to institutional pressures (Soderlund and Sydow, 2019; van den Ende and van Marrewijk, 2019; Hetemi et al., 2020). A lack of advancement towards understanding the embeddedness of projects in contexts, including the institutional context, has been considered a major weakness of current theorising within the discipline of project management (Soderlund and Sydow, 2019).

This research takes the perspective of projects as adopters/implementers of institutional pressures and analyses how they interact with, and respond to, such pressures. The findings identify a hybrid response comprising four distinct ways that projects might respond to institutional pressure. The results provide a conceptualisation of a policy–practice decoupling phenomenon at project level (i.e. a 'gap' between the institutional pressure and its imposed structure and the real practice). In turn, this finding delivers new insights into variance in the implementation of a policy and achieving the anticipated goals. The decoupling phenomenon revealed by the empirical exploration in this thesis reflects a variance of decoupling from 'what' has been prescribed by the imposed structure (the content) and from the 'how' of the

structure of the institutional pressure (the meaning). The findings evidence that the rationale behind the hybrid response concerns both the willingness and ability of projects to respond, and the scope conditions under which projects are willing and able to implement the pressure are related to the multiple contexts in which projects are embedded.

By revealing the occurrence of a hybrid response to coercive pressures, identifying a decoupling phenomenon and highlighting the characteristics of decoupling at project level, this thesis contributes to multiple research streams. The core contributions are summarised in Section 1.5, after outlining the research motivations in Section 1.2, which are also related to research gaps from multiple literature streams, and then the research questions underpinning this study in Sections 1.3 and 1.4. The chapter concludes with a summary of the thesis structure in Section 1.6.

1.2 Research motivation

Project-based industries, such as construction, are among the largest industries in the global economy (Taylor and Levitt, 2004). When the use or occupancy phase is included, the construction sector has an enormous scope of approximately 20% of the gross domestic product (Barrett, 2007). Nevertheless, the slow rate of innovation and low productivity of this industry have historically been problematic (Hall et al., 2018). The construction industry has been extensively criticised for its reluctance to innovate, as well as the lag in improving its performance (Cao et al., 2014). Much of this underperformance can be attributed to the highly fragmented and loosely coupled delivery structure within zero-sum logics delivering at lowest-cost agendas (Dainty et al., 2017). Innovations are hindered by industry fragmentation, risk aversion, a culture of low-cost competitive bidding and broken agency in decision-making (Hall et al., 2018).

Scholars have argued that certain features make construction a unique and challenging context for innovation when compared to other industries. The number of possible permutations and combinations of specific places and entities in construction projects is enormous - from one project to another and even for the same project - shaping the industry's way of functioning and its performance (Dubois and Gadde, 2002). Firms usually play multiple roles; the activity scope of a firm tends to be broad, including design, production, and distribution in various combinations, which also vary between different projects (Dubois and Gadde, 2002). The division of labour among the actors varies greatly from project to project, and the role of the individual firm can be very different as well (Dubois and Gadde, 2002). The

disintegrated and fragmented industry supply chain hinder collaborative behaviour, making innovations of a systemic nature and that cross firms' boundaries more difficult to implement (Hall et al., 2018). As construction projects are usually framed by temporary coalitions that do not necessarily repeat from one project to another, a challenge for project organisations involved in a project is to transfer knowledge and the benefits achieved with innovation in one project network with a constellation of actors to a consecutive project network with another constellation of actors (Linderoth, 2010). Additionally, the proliferation of small firms in the construction sector supply chain is seen as making implementing innovative practices much more problematic than in other project-based contexts such as the aerospace industry (Harty, 2008).

Given the slow pace of innovation in the industry, change and reform of the construction sector have been an ongoing concern for governments in numerous countries (Smiley et al., 2014). Over the years, many nations have exhibited an accelerating trend of developing major initiatives to enhance the performance of the construction industry (Barrett, 2007). In view of the importance of the construction industry to the global economy and the need to accelerate change, innovation and transformation within the sector – especially given the potential of emerging digital technologies – governments have applied coercive isomorphism to promote and accelerate innovation and certain technological trajectories in this industry. Coercive isomorphism relates to organisational similarity and results from formal and informal pressures applied to organisations by other organisations upon which they are dependent and by the societal expectations under which the organisations function (DiMaggio and Powell, 1983). The digitisation of building information through the use of building information modelling (BIM), for example, has been perceived as transformative (Whyte and Hartmann, 2017) and mandated by numerous governments. BIM can be conceptualised as a set of interacting processes and digital technologies that enhance coordination between various project stakeholders, thus facilitating the digital capture of required information throughout the whole project life cycle (Succar, 2009; Sacks et al., 2010). It has increasingly been regarded as one of the most promising innovations for addressing the performance problems that have long plagued the construction industry (Cao et al., 2017).

Over the last decade, BIM policy approaches have been developed and mandated in public-sector projects in the US and several European countries, including the UK and Nordic nations, where these approaches have been central to industrial strategy. For instance, in the UK, BIM is both novel and vital to the industry reform discourse and practice (Smiley et al., 2014). In 2011 the UK government published a construction strategy document targeting a

reduction of up to 20% in the cost of public-sector assets by 2016 (The British Standards Institution, 2013). The goal was to significantly improve the relationship between public authorities and the construction industry while ensuring that the government would be able to produce lasting social and economic infrastructure at a reasonable cost. One means of achieving this objective was the development and imposition of national standards that would enable all members of the supply chain to work collaboratively through BIM and by introducing a requirement for fully collaborative three-dimensional BIM (level 2) in all government-funded projects by April 2016. This demand by central government represents an institutional isomorphic pressure that sought to drive construction firms and projects to make the necessary changes and, ultimately, to foster sectoral transformation. In the UK and many other countries these coercive efforts have involved the development of formal structures, such as standardised processes for managing information on delivery, handover and operations, a digital plan of work, and standard use of classification (Whyte and Hartmann, 2017).

However, evidence suggests that these coercive pressures and national BIM approaches have neither produced the envisaged systemic change nor progressed at the expected pace, as was the case in Finland (Aksenova et al., 2019). In the UK, surveys of industry practitioners have revealed that the increase in BIM awareness and adoption has not been accompanied by a similar rise in the implementation of standardised processes, which is a central aspect of the government's mandate for BIM implementation (NBS, 2019). According to empirical analyses of BIM adoption since the publication of the construction strategy in the UK, the overall trends of policy awareness and adoption advanced from 10% in 2011 to around 70% in 2019; yet, most firms that participated in one of the latest industry surveys (2019) believed that the industry was not yet delivering on the government's BIM mandate (NBS, 2019). The results of the most recent survey with industry practitioners in 2019 indicate that only around 35% of respondents were actually implementing the standards related to BIM level 2 (e.g. PAS 1192-2:2013, BS 1192:2007; NBS, 2019). The survey also revealed that not all clients across the industry recognised the benefits of BIM. Other industry analyses have yielded limited evidence of real progress and value creation of BIM level 2, even years after its introduction (Construction Manager, 2018; BIM Today, 2019). Moreover, in research on the current status of BIM implementation across the UK, more than 30% of respondents reported that they had not implemented any standard part of the mandate (Eadie et al., 2015). Thus, despite claims that adoption has increased and that BIM is becoming embedded in the UK construction industry, implementation of the structure imposed by the mandate seems limited or has not led to the envisaged outcomes.

This research is empirically motivated by this failure of the construction industry to achieve the transformation expected through coercive isomorphism at the pace that institutional designers originally anticipated. There is a clear need to better understand how projects interact with, and respond to, environmental pressure. In addition, as noted by Dainty et al. (2017), existing surveys on the status of BIM adoption and transformation of the sector are problematically based on opinions rather than evaluation of activities, and they do not indicate whether, or to what extent, changes are actually occurring. Therefore, to determine the reality of the situation, it is crucial to explore implementation in more detail. Diffusion does not necessarily equate to legitimation of practices (Scott, 2014). Organisational scholars have consistently acknowledged that, in practice, organisations mediate the impact of coercive pressure, such as mandates, and construct the meaning of compliance (Suchman and Edelman, 1996). However, within the construction management academic discipline and practice – and, specifically, regarding the case of the BIM mandate – there is a shared assumption that the BIM discourse and associated prescriptions will be readily accepted by a multitude of stakeholders (Smiley et al., 2014).

This research applies the perspective of implementers of built environment policy and more closely examines the interaction between institutional pressures and the internal processes of projects. Accordingly, it aims to explain why coercive pressure has not produced the envisaged change in the UK context, as well as addressing the relevant gaps identified in the literature in the next section.

1.3 Research gaps

Organisational scholars have long been interested in how organisations respond to environmental pressures. Still, this phenomenon has been under-theorised within inter-organisational and project contexts (Söderlund and Sydow, 2019; Hetemi et al., 2020), as well as in the construction management literature (Bresnen, 2017).

For more than a decade, scholars have highlighted that project management research has been dominated by a perspective based on the ‘lonely project’ (Engwall, 2003). Despite some recent advancements in research in rethinking the project management discipline and practice, scholars such as Soderlund and Sydow (2019) have emphasised that progress towards understanding the embeddedness of projects in organisational, inter-organisational and the wider institutional context remains limited. From the ‘lonely project’ perspective, projects have predominantly been framed and approached as separate islands with minimal interaction with

the environment, and academic work has continuously neglected the significance of the institutional environment for understanding the actuality and dynamics of projects (Soderlund and Sydow, 2019). The literature has persistently claimed that scholars have rarely studied projects within their institutional context (Tonga et al., 2019). One research direction that has been suggested to more fully understand projects and institutions is exploration of the institutional pressures applied to projects, including their requirements, and projects' responses to these pressures (Soderlund and Sydow, 2019).

From a construction management perspective, it has been posited in the literature that, despite the proliferation of work within construction management in recent years drawing upon management theories, there is still an under-use of dominant perspectives in business and management research, such as institutional theory (which is at the core of exploration of projects and their interactions with the environment), to frame construction management issues (Bresnen, 2017). For example, Volker (2019) has highlighted that the multiplicity in the organisational responses lens from institutional theory and interactions between institutional levels are relevant to understanding change, or the lack thereof, in the construction industry. Nevertheless, most applications of institutional theory in construction management research still revolve around the influence of different institutional pressures on the adoption and diffusion of innovations, and they largely disregard how the implementation of such innovations actually unfolds from the interaction between projects and environmental pressure.

From the perspective of built environment policy literature, most research has focused on how policy is framed, as opposed to how policy is actually used (Simmons, 2015). However, projects, as temporary forms of organising, composed of permanent organisations, are not necessarily passive receptors of imposed policies (Gondo and Amis, 2013), but current understanding of what happens 'within' projects when new practices are adopted as part of reform policies is still limited.

In the BIM literature scholars have advocated more critical perspectives of building information modelling to counterbalance claims around industry-wide integration and transformation (Dainty et al., 2017). The technological merits of BIM are mainly viewed as essential to industry transformation, and it remains necessary to analyse the diverse implications of BIM policy approaches (Aksenova et al., 2019). Some studies have investigated the impacts of various institutional pressures on BIM adoption (e.g. Cao et al., 2014) and found that coercive pressures, such as policy mandates, have substantial influence on organisational adoption and the extent of BIM adoption in projects (Cao et al., 2014; Ahmed and Kassem,

2018). Still, few studies have examined the process of implementation when projects experience institutional pressures, including those of a coercive nature.

Past organisational studies have asserted that decoupling from policy is more likely to occur when coercion is the diffusion mechanism (Weber et al., 2009; Ansari et al., 2014). Although some studies have proposed that coercive mechanisms impact the diffusion and adoption of BIM, this finding suggests that the impact of coercion on implementation warrants further analysis. Academic research on 'real-world' implementation of BIM processes in projects is still limited and has predominantly investigated adoption and implementation through surveys with industry practitioners. This method is not particularly effective for capturing actual practice, as it is primarily based on opinions rather than real-world evidence (Dainty et al., 2017). Although a range of studies on BIM adoption and implementation have been conducted, they have been criticised for their emphasis on mostly mechanistic conceptions of technology adoption (Dowsett and Harty, 2019).

By assuming the perspective of projects as implementers and assessing how implementation of the mandate unfolds through the institutional theory lens, this research provides novel insights into the interaction between institutional pressure and projects, thus addressing gaps in the aforementioned streams of literature. Accordingly, the findings contribute to the practice by shedding light on aspects of implementation identified from real practice and are relevant to policy-makers.

1.4 Research questions

Understanding the observed empirical phenomenon, whereby policy mandates might not produce the envisaged effects, requires a shift away from perspectives already employed in the literature (i.e. a focus on policy design) in favour of the perspective of those implementing those approaches on the basis of real-practice evidence. Therefore, the first research question of this thesis is as follows:

RQ1: How do projects interact with their environment and respond to institutional (coercive) pressures, such as policy mandates?

The answer to this question reveals aspects of the internal processes of projects and their interaction with broader institutional issues, which the project management literature has identified as necessary to enhance the project management discipline (Soderlund and Sydow, 2019). Furthermore, it provides novel insights into inter-organisational responses to

institutional pressures and enriches the organisational theory literature, which has focused mainly on the organisational level (Kern et al., 2018). However, to gain a holistic understanding of the phenomenon, it is imperative to determine why the identified interactions and responses emerge. Therefore, the second research question is as follows:

RQ2: What are the underlying conditions for such responses?

While RQ1 addresses the potential effects within projects when they experience institutional pressure, which attends to the gap between policy adoption and implementation and the realisation of the intended objectives, RQ2 considers the causes of the observed phenomenon. To answer these questions, the following six chapters of this research closely investigate the enactment of the BIM policy mandate in the UK. As summarised below, the findings extend the existing knowledge from multiple literature streams.

1.5 Contributions

The following six chapters of this thesis reveal that, when faced with coercive pressure from the environment, projects both comply or couple with the imposed structure that accompanies the pressure and decouple from it. Projects 'adopt' the pressure because of its coercive nature, the dependence of their existence on those who impose it or the societal expectations regarding its adoption. However, in the context of implementing an imposed structure involving change and new processes, it was observed that complete coupling might not be the immediate response. Projects may couple with certain aspects of the imposed structure while simultaneously decoupling from others, which represents a 'hybrid' response. Overall, projects could respond to the pressure in four ways: non-implementation, violation, assimilation and accommodation. The first three types of response characterise a policy–practice decoupling phenomenon in two main forms: decoupling from the 'what' of the imposed structure and decoupling from the 'how' of the imposed structure.

The hybrid response seemingly results from a combination of multiple conditions that relate to both the organisational context of project stakeholders and the industry context. Meanwhile, the two forms of decoupling depend on both the willingness and ability of projects to respond to institutional pressures. Causality in the decoupling phenomenon appears to be complex and is underlined by both conjunction, as it results from the interdependence of multiple conditions, and equifinality, which entails more than one pathway to the same outcome.

By characterising decoupling in the context of projects' interactions with coercive pressures through a lens of institutional and structuration theory, this thesis contributes to various literature streams. First, identification of the two variances of decoupling enhances the conceptualisation of policy–practice decoupling in existing organisational theory literature by proposing a more nuanced and refined conceptualisation involving coupling with both the 'content' and 'meaning' of practices. From a project management perspective, the findings conceptualise decoupling at project level and offer insights into the interactions between projects and the institutional environment. From the perspective of BIM literature, this research unpacks 'how' implementation of a BIM mandate, including its imposed structure and processes, may proceed. Previous research has recognised variation in implementations but mostly conceptualised it in terms of BIM uses. Consequently, studies have not explored 'how' variation can be characterised from a project perspective and by considering process implementation. The results of the present research therefore contribute to a discourse that challenges perceptions of BIM enactment as a linear process of implementation (Dainty et al., 2017). They additionally illustrate that implementation cannot be assumed to be straightforward even though mandates might indeed lead to widespread adoption.

The findings reveal that mandates, as coercive structures, might actually hinder holistic implementation and transformation in parallel with driving widespread adoption if there is also decoupling at the level of the imposed structure itself (i.e. between its 'saying' and intended 'meaning') and if the imposed structure is not comprehensive, as such elements might impede the necessary awareness to enact change and consequently influence projects' ability to respond to the pressure. Non-realisation of the promised benefits and non-achievement of transformation at the pace originally anticipated by institutional designers can be explained as resulting from decoupling at ground level from both the content and meaning of the imposed structure. As Dowsett and Harty (2019) have highlighted, despite the increase in adoption of BIM throughout the construction industry, important links between implementation and realisation of benefits have not yet been explored. The results suggest that non-realisation of the intended benefits could be an outcome of symbolic adoption or non-holistic implementation of the imposed structure or of symbolic implementation or decoupling from the 'how' or the meaning of the imposed structure. The findings evidence that the matter encompasses not only reconfiguring processes or adopting new processes but also 'how' they are enacted in practice.

With regard to the conditions leading to decoupling, the findings support that a hybrid response results from the combined effect of multiple factors, and various combinations of those factors induce decoupling (i.e. decoupling at project level is underlined by causal

complexity). From a project management perspective, this study formulates a conceptualisation of decoupling at project level by taking into account the embeddedness of projects in multiple contexts. The findings reflect that existing multi-level structures influence implementation of the imposed structure, as they might be reproduced by project stakeholders for conscious or unconscious reasons. In summary, institutionalisation is a process of structuration shaped by existing multi-level structures and agency.

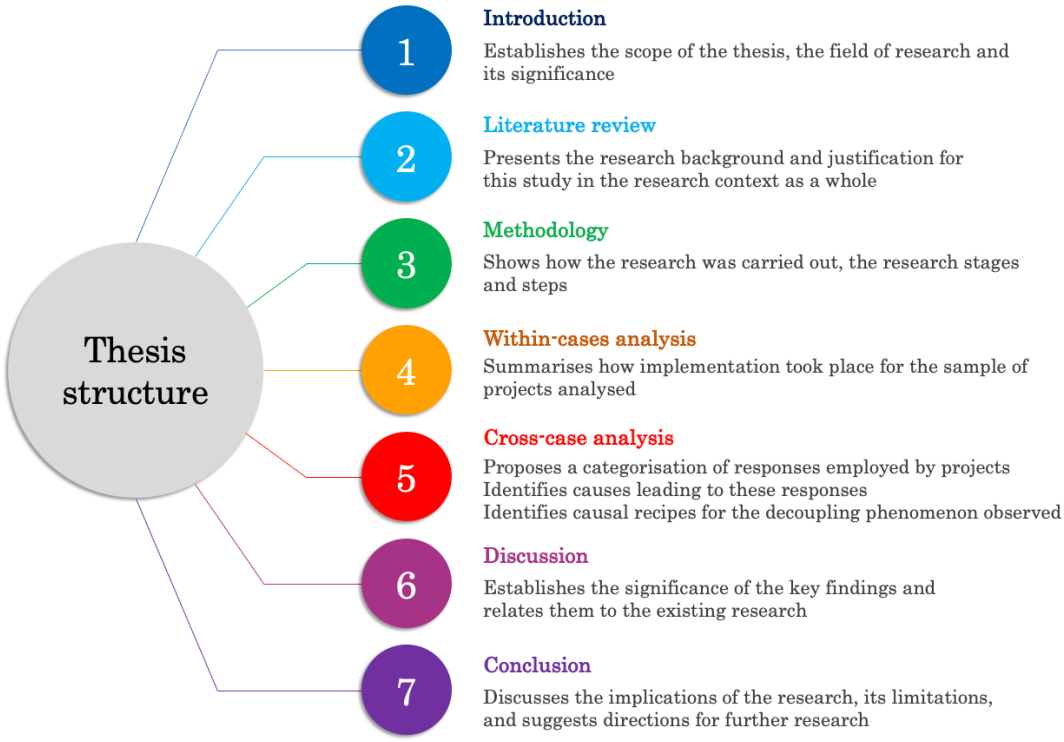
From the perspective of BIM literature, the findings confirm and extend previous research on the influence of factors on BIM adoption and implementation by demonstrating the combined effect of certain new and previously identified factors (relating to both the willingness and ability of projects to respond) on 'how' implementation of a coercive pressure and its processes unfolds at project level. Thus, this research builds upon previous studies of 'what' influences implementation by exposing 'how' implementation proceeds under the influence of combined factors, including existing structures, which have not yet been addressed. Most BIM research has adopted a quantitative approach and acknowledged the effects of individual factors on BIM adoption and implementation, as identified on the basis of individuals' opinions. However, the conventional correlation-based approaches of prior studies are not designed to address conjunctural and equifinal causal relations. The dominance of these approaches has culminated in theory on BIM implementation that is marked by a general linear reality or net effects thinking. Theory has been built and tested shaped by conceptions of independent, additive and mostly symmetrical causality. Yet, BIM implementation is carried out in projects that possess constellations of conceptually distinct, co-occurring, multi-level characteristics, and causality needs to capture this multi-dimensional nature. Chapter 6 contains a more detailed discussion of the research contributions to various literature streams.

1.6 Thesis structure

This thesis is structured in seven chapters (see Figure 1.1). Following the introduction, Chapter 2 presents the background research for this study and establishes its justification within the broader research context. Next, Chapter 3 outlines the research design, including the procedures for data collection and analysis. The subsequent two chapters present the results and summarise and comment on the findings. Specifically, Chapter 4 describes how implementation of the mandate progressed for sampled projects in terms of what was implemented, and how, as well as why, implementation took place as it did. Then, Chapter 5 identifies patterns in enactment and reasons for enactment based on a comparison of the

projects. In addition, it presents the results of causal analysis that employed a configurational approach to link project responses to the pressure and the underlying causes of those responses. Chapter 6 relates the key findings to existing research. Finally, Chapter 7 concludes with a discussion of the main implications and limitations of the study, as well as some directions for further research.

Figure 1.1 – Structure of the thesis



Chapter 2 – Background

2.1 Chapter introduction

This chapter summarises the literature that informs and underpins the central research question explored in this thesis. The review of the underlying literature provides a reference point for representing the field and forms the baseline for developing the theoretical contributions. The chapter starts with a review of the management literature on organisational responses to external pressures. This body of literature provides the theoretical framing for exploring how projects, as a form of organising, respond to external pressure. It proceeds by positioning research on the interaction between projects and the external environment as a nascent area of research within the vast body of project management literature and within the context of construction management.

As this study explores construction projects, and the research question emerged from the observation that a specific type of pressure has not had the envisaged impact, that is, coercive pressure in the form of policy, the literature on built environment policy is then reviewed to rationalise what is known in terms of policy design, adoption/implementation. Finally, the BIM literature is reviewed. The chapter concludes with an overview of the gaps from these multiple literature streams jointly addressed in this thesis.

2.2 Overall approach to the literature review

The review described in the following sections consists of critical analyses. As this research is exploratory and inductive, the review did not focus on identifying and establishing propositions to be tested afterwards.

Only peer-reviewed papers were sought out for all literature reviews. The Scopus database was selected as the primary source for articles. Scopus was chosen because it is a comprehensive database covering journals in a variety of research fields, including engineering, management and social sciences, and it has also been adopted as the main database for, for example, other construction-related literature reviews (e.g. Antwi-Afari et al., 2018; Oraee et al., 2019). Additionally, Scopus performs better in terms of accuracy and coverage than other databases (Falagas et al., 2008).

A range of search terms/strings were used to take stock of the available knowledge. Boolean operators were used to guide the search and the rule employed in the title/abstract/keyword field (described in Chapter 3). The research scope was restricted to journal articles published before February 2021. The identified publications were further screened and checked following a multi-stage process consisting of i) removing duplicates, ii) relevance check by reading titles and abstracts, and iii) checking the full papers. Papers were not excluded based on the journals' impact factor or the number of citations. This approach is consistent with the notion of fit-for-purpose evidence and the idea that the most crucial consideration is the selected publication's contribution to the larger understanding of a field (Adams et al., 2016).

2.3 Organisational responses to environmental pressures

In organisational theory the impact of the environment on organisations is a classical issue. Scholars have widely acknowledged that organisations adapt to not only technical pressures but also environmental and societal expectations (Boxenbaum and Jonsson, 2008). In other words, organisations conform to rationalised myths in society about what constitutes a 'proper' organisation (Boxenbaum and Jonsson, 2008), which leads to institutional isomorphism or organisational similarity based on institutional conditions (DiMaggio and Powell, 1983).

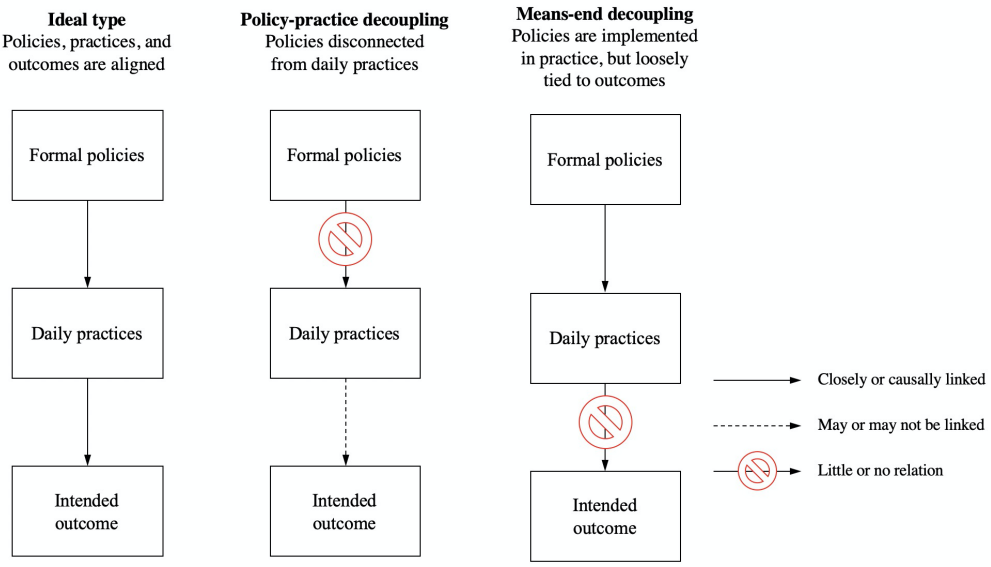
Institutional theory and institutionalisation are at the core of understanding the institutional processes that affect organisations and their internal change (Oliver, 1991). In one of the earliest contributions to institutional theory development, Meyer and Rowan (1977) asserted that organisations are deeply interpenetrated by their environment and respond to the environment, which became a shared assumption in organisational theory. Nevertheless, while organisations often adopt formal policies, plans and programmes from the environment that show conformity to socially sanctioned purposes, they may also 'decouple' these formal structures from ongoing practices to buffer internal routines from external uncertainties (Meyer and Rowan, 1977; Westphal and Zajac, 2001). In other words, organisations are not passive receptors of environmental pressures and employ strategic behaviour to respond directly to the institutional processes affecting them (Oliver, 1991).

In recent decades a considerable body of research has been built around this argument, and a range of studies have been conducted looking at organisational responses. Studies have proposed categorisations of responses varying from coupling to lose coupling or decoupling from exogenous pressures. Oliver (1991) identified five strategic responses that organisations

commonly deploy: acquiescence, compromise, avoidance, defiance and manipulation. Oliver (1991) also posited that conformity responses depend on why pressures are being exerted, who is exerting them, what the pressures are, how, or by what means, they are exerted, and where they occur.

By reviewing the findings of multiple studies on organisational responses, Bromley and Powell (2012) advocated that there are two main forms of 'decoupling' from what has been imposed by the environment or two main forms of organisational non-compliance with the pressures exerted on them: symbolic adoption and symbolic implementation (Figure 2.1). Policy–practice decoupling or symbolic adoption arises when practices do not result in significant implementation, creating a 'gap' between policy and practice (Bromley et al., 2012). For instance, reform efforts are a constant feature of organisational life but do not necessarily produce tangible changes in daily activities (Bromley et al., 2012). In this type of decoupling, policies are adopted purely as 'ceremonial window dressing' or implemented and evaluated inadequately, not altering daily work routines (Bromley and Powell, 2012). Policies, in this case, are rarely a strong predictor of daily activities (Bromley and Powell, 2012). Through policy–practice decoupling, organisations can adopt multiple policies in response to external pressures without disrupting daily operations by implementing inconsistent strategies (Bromley and Powell, 2012). Thus, one of the 'benefits' of decoupling for organisations is protection of the technical core from external pressures (Bromley and Powell, 2012). Some studies have shown that stock markets, for example, react favourably to adopting some governance features, regardless of implementation (Westphal and Zajac, 1998), leading organisations to 'symbolically' adopt new practices.

Figure 2.1 – Types of decoupling



Source: Bromley and Powell (2012)

Recently, some scholars started to assert that, in an increasingly managerial world that emphasises evaluation and benchmarking, the policy–practice form of decoupling might become less common (Bromley and Powell, 2012). Another type of decoupling, named 'means-end' decoupling, is on the rise (Bromley and Powell, 2012). In this case policies are implemented but scant evidence shows that these activities are linked to organisational effectiveness or outcomes; in other words, it consists of symbolic implementation (Bromley and Powell, 2012). Organisations that comply with the imposed policies may not, or may hardly, achieve the objectives that policy-makers envisage (Wijen, 2014). While coupling policies and practices, organisations may not achieve the intended results because the adopted policies are inappropriate (Wijen, 2014). Comparatively, this form of decoupling is less explored in the literature. Some studies have recently started to emerge looking at aspects such as 'how' and 'why' this type of decoupling persists over time (Dick, 2015). Wijen (2014) posited that means-ends decoupling predominates, especially in highly opaque fields, where it is difficult to identify prevailing characteristics of practices, establishing causal relationships between policies and outcomes and measuring policy implementation results.

Independent of the type, empirical studies tended to conceptualise decoupling as a dichotomy: some organisations implement exogenous pressures, while others do not (Bromley et al., 2012). More recently, Battard et al. (2017) asserted that organisations do not respond to institutional pressures as a whole; rather, physical (material elements and formal rules), mental (meaning) and social (identity) spaces of organisations integrate institutional expectations separately and to varying degrees. Li (2017) also recently posited that decoupling occurs not

only between ‘doing’ and ‘saying’, as asserted by existing studies, but also between ‘doing’ and ‘meaning’, and between ‘meaning’ and ‘saying’.

The consequences of such variance in the adoption and implementation of policies and practices have also been highlighted by past research. Barratt and Choi (2007), for example, noted that under coercive pressures, and to the eyes of external constituents, all organisations subjected to pressure will start to look similar after a while but underneath implementation may not correspond to the apparent isomorphic behaviour. From an organisational perspective, MacLean and Behnam (2010) demonstrated that decoupling creates a ‘legitimacy façade’, enabling the institutionalisation of misconduct and precipitating a loss of external legitimacy.

When subjected to similar institutional pressure, some organisations decouple, while others do not, suggesting that organisations in the same organisational field do not respond similarly to the same pressures. A question that another group of studies has investigated is which variables affect whether an organisation engages in decoupling. Some studies have highlighted the influence of the pressure itself and its characteristics on how organisations respond. In contrast, others have highlighted aspects related to the context in which the pressure is exerted. Bensal et al. (2014) advocated that the characteristics of different kinds of practice shape the extensiveness of adoption patterns. They have identified that practices that do not impose high technical requirements are more likely to be implemented following the institutional prescriptions (Bansal et al., 2014). Barrat and Choi (2007) posited that a lack of clarity about the exogenous pressure is related to decoupling. There is also a line of argument around conflicting institutional logic. If the pressure imposes a conflicting logic with the existing one, variance in response related to decoupling is more likely to occur. Pache and Santos (2012), for example, identified that in circumstances of competing institutional logic, organisations selectively couple intact elements prescribed by each logic, allowing them to project legitimacy onto external stakeholders. Raaijmakers et al. (2014) found that situations of institutional complexity lead decision-makers to delay compliance.

From an organisational perspective, Beck and Walgenbach (2005) identified that top management, organisational size and administrative intensity impact the implementation of imposed structures. Berrone et al. (2010) highlighted that who controls the organisation, and how much the controlling party values achieving social worthiness, apart from any economic gains, influence the adoption of some pressures, such as sustainability-related practices. Westphal and Zajac’s studies show that decoupling is more common when top managers are influential over their boards when a firm has network ties to other firms engaging in similar decoupling, and when a firm has prior experience with decoupling (Westphal and Zajac, 1994,

2001; Zajac and Westphal, 2004). Other aspects identified by past research as influencing the extent of coupling or decoupling include: the constellations of power and interests in potential adopters (Fiss and Zajac, 2004); organisational identity (Kodeih and Greenwood, 2013); the presence of particular internal structures (Bird et al., 2019); the capacity to implement the policies; the motivation and stage of adoption (Bromley and Powell, 2012); the interplay between internal managerial and external stakeholder dynamics (Crilly et al., 2012); issue salience and cost-benefit (Durand et al., 2017); decision-makers' framing of environmental pressure as a threat or opportunity (George et al., 2006); decision-makers' interpretation of institutional complexity and their personal beliefs about the practice itself (Raaijmakers et al., 2014); the level of conscious reflection during implementation (Gondo and Amis, 2013); and complex goals and internal fragmentation (Heese et al., 2016); among others.

In terms of implementing similar structures to those explored in this research, namely, standards through coercive isomorphism, previous research has found that adaptation to institutional pressure is not necessarily straightforward, and daily practices remain somewhat decoupled from the prescriptions of standards (Boiral, 2007). Desai (2016) posited that, when faced with regulatory mandates, organisations may increase compliance by establishing close collaboration with regulatory agents to overcome uncertainty. But, as posited by Brunsson et al. (2012), although research so far has identified a variety of potential reasons for decoupling, there is still limited empirical evidence regarding the implementation of standards.

In summary, although a considerable body of research or organisational responses to exogenous pressures has been conducted, there are still gaps to be addressed, as mentioned in the case of the specific pressure investigated in this research. Decoupling has mostly been investigated at organisational level. As pointed out by Crilly et al. (2012), most organisational-level variables identified by previous research are relevant when single actors direct firms' responses. Regarding the inter-organisational level, responses are coordinated by multiple actors involved in the context, but this has not yet been explored. Also, the influence of variables is often posited in isolation, or the influence of a pair of variables is usually considered. The variety of underlying causes identified by previous studies, nevertheless, suggests that multiple causes might be related to non-extensive compliance. This might be the case with projects, as they are embedded in multiple contexts. These gaps create opportunities for research at inter-organisational level that may contribute to this body of literature.

2.4 Projects and their interaction with the environment

Projects are considered a significant characteristic of modern organisations (Soderlund, 2004), and have become relevant in structuring work in many contexts (Svejvig and Andersen, 2015). Projects have been discussed as integrating mechanisms enabling cross-functional integration, as time-limited teams working towards specified deadlines, as temporary organisations with distinguishing characteristics, as the natural way of working in some organisations, and as the units of analysis for exploring the production of high-cost and complex products (Engwall, 2003). The field of project management research is actually dispersed, multi-disciplinary and continues to expand to new domains (Pollack and Adler, 2015). It is characterised by contributions from practitioners and researchers focused on not only the discipline but also specific areas or industries where projects are managed (Pollack and Adler, 2015).

A range of literature reviews have been conducted in the past (around forty review papers were found), analysing the structure, evolution and state-of-the-art in the field of project management, as well as reviewing the state-of-the-art regarding specific themes (e.g. Soderlund, 2011; Pollack and Adler, 2015; Svejvig and Andersen, 2015; Padalkar and Gopinath, 2016). Soderlund (2011) proposed that project management research can be divided into seven schools of thought. The first is the optimisation school, which includes prescriptive research drawing on optimisation techniques and systems analysis. The second is the factor school, which involves empirical research relying on descriptive statistics and systems analysis. The third is the contingency school, which looks at the characteristics of projects, differences and contextual dimensions. The fourth is the behaviour school, which includes interpretative and descriptive research on organisational behaviour in projects. The governance school covers prescriptive research on governance and contract issues in projects. The relationship school covers research on relations between actors in projects. Finally, the decision school involves descriptive and interpretative research on politics and decision-making in projects (Soderlund, 2011).

Other analyses of the field have identified that the existing body of research can be clustered in three main eras (Padalkar and Gopinath, 2016): i) the deterministic era, ii) the explanatory era, and iii) the non-deterministic era. The deterministic era concentrated on deterministic themes with a dominant focus on project performance based on the iron triangle of cost, schedule and quality (Padalkar and Gopinath, 2016). This era, characterised as rationalist and technocratic, has dominated project management research (Svejvig and Andersen, 2015). From the mid-1980s, the field moved to a more explanatory phase, and

research started to focus on seeking explanations for project phenomena, including, for example, the antecedents of project performance and human resources management (Padalkar and Gopinath, 2016). Finally, in the mid-2000s, scholars started to raise the need to move from deterministic and explanatory research to reconceptualising project phenomena, adopting new paradigms and methodologies. A stream of research on 'rethinking project management' started to develop (Padalkar and Gopinath, 2016). Scholars highlighted that existing research had been dominated by a perspective based on the lonely project (Engwall, 2003). Calls emerged, for example, for the conceptualisation and exploration of projects as complex social systems and the consideration of aspects such as non-linearity, values, multiple perspectives and social processes in project environments (Cicmil et al., 2006).

Svejvig and Andersen (2015) identified that research on rethinking project management had been built around six main categories. There have been studies covering the contextualisation of projects and the need to expand beyond isolated projects' narrow goals and consider the project environment. Another emerging stream has moved from a traditional focus on specific tools and procedures to the inclusion of social and political aspects of projects and how they shape projects, for example, power structures, emotionality and identities. The third category of studies covers alternative approaches and perspectives to rethink how project stakeholders work. The fourth category of research consists of contributions covering complexity and uncertainty and methods to manage those aspects. The other category covers research looking at the actuality of projects and a better understanding of what actually occurs in projects and adopting a project-as-practice approach to research (Blomquist et al., 2010). Finally, the last group of emerging research has approached a broader conceptualisation of projects, project management and project success (Svejvig and Andersen, 2015).

Despite the growing research interest and broadening of research focus, scholars have highlighted that the understanding of projects within certain aspects remains limited. Almost two decades ago, Engwall (2003) posited that existing project-based research was dominated by a perspective based on the lonely project (Engwall, 2003), and despite the advancement of research within the context of rethinking the project management discipline, Soderlund and Sydow (2019) recently asserted that advancement towards understanding the embeddedness of projects in an organisational, inter-organisational and wider institutional context remains limited. Projects are still mostly treated and viewed as separate islands with little interaction with the environment, and scholarly work fails to consider the role of the institutional environment in understanding the actuality and dynamics of projects (Soderlund and Sydow, 2019). Major project management outlets continually urge contributions focused on debating

and theorising on how projects relate to broader institutional contexts (Geraldi et al., 2020). Scholars have asserted that, among other things, a direction of research towards a greater understanding of projects and institutions is to explore the institutional pressures placed on projects and the responses that projects develop (Soderlund and Sydow, 2019). As mentioned in Chapter 1, this understanding seems limited, especially in the context of construction management, as empirical observation has demonstrated that projects have responded to institutional pressures in ways not necessarily envisaged by the designers of such pressures, and the existing literature (as discussed next) has assumed a linear implementation of pressures.

A search for project studies was carried out to identify research looking at the interaction between projects and the environment. The identified body of research looking at projects and their institutional context is, indeed, limited in comparison to the vast body of project management research. Most of the existing research has emerged in recent years, and studies have been conducted along two main lines. First, there are studies theorising about institutions as the context of projects. Some research has looked at how different types of institutional pressure (such as mimetic and normative pressure) lead to changes in projects processes, such as integrating sustainability-related practices (e.g. Ullah et al., 2020). Others have adopted the project's perspective and looked at complexities in the institutional context (Mahalingam and Levitt, 2007) and, more recently, how projects cope with those complexities (especially in the context of megaprojects) through institutional work (e.g. Dille et al., 2018; Qiu et al., 2019; Tonga et al., 2019; van den Ende and van Marrewijk, 2019). These studies have identified coping mechanisms to institutional demands, such as selective coupling (Matinheikki et al., 2019). Dille et al. (2018) identified that actors within a megaproject context adopt three strategies to cope with temporal institutional requirements: temporal avoidance, temporal splitting and temporal matching. Others have looked at the enactment of multiple, co-existing institutional logic (Fred, 2020). There are also studies considering the influence of the institutional context on managing project portfolios (Martinsuo and Geraldi, 2020). Other studies have started looking at how projects shape institutions, but mostly at organisational level (Lieftink et al., 2019; Matinheikki et al., 2019). Lieftink et al. (2019), for example, explored how actors use relational, institutional work in inter-organisational projects to mobilise key stakeholders from two loosely coupled sub-fields to institutionalise a new project-delivery method. More recently, other studies have emerged looking at how institutional projects (projects launched with the explicit mission of changing the field) play a role in changing institutional fields (Winch and Maytorena-Sanchez, 2020).

Although some research has started to emerge, institutional theory has various perspectives and remains underused in the project-based domain. One decade ago, Morris and Geraldi (2011) highlighted that one fruitful area of research at institutional level is to explore the interplay between agency and institutions, which remains largely untheorised. Other scholars have highlighted that institutional lenses can be useful to explore, for example, change (Bresnen, 2016). Thus, this research builds on the existing gaps and opportunities that an institutional lens may offer to research in project-based contexts and explores agency in projects when interacting with institutional pressures that envisage promoting change within the field.

2.5 Construction projects and their environment

In the context of construction management literature, similar to research in project management, exploration of construction projects' interaction with the environment is still scarce. Despite the proliferation of work within construction management drawing upon management theories, there is still an under-use of dominant perspectives in management research such as institutional theory (which is at the core of exploration of projects and their environment) to frame construction management issues (Bresnen, 2017).

Construction management studies so far have adopted an institutional lens to investigate, for example, the adoption and diffusion of innovations (such as BIM) through coercive, mimetic and normative pressures (e.g. Cao et al., 2014; Saka and Chan, 2020). These studies have looked at the impact of different pressures on how innovation diffusion evolves. Aghimien et al. (2020), for example, identified that, in South Africa, pressures from the client and competitors have a significant influence on the digitalisation of construction. Phua (2006) found that the extent to which construction firms are motivated to use partnering is a function of how deeply entrenched the institutional environment is concerning the rules, regulations, norms and expectations associated with the practice. Other studies have looked at the role of normative and mimetic isomorphic pressures as external enablers for integrating, for example, sustainability in construction project processes (Ullah et al., 2020).

As another stream of research, some studies started to look at how construction projects, including mega-infrastructure projects, and organisations, deal with such environmental pressures. Greenwood (2001) investigated an apparent shift in the attitude of main contractors to subcontract procurement in the UK as an institutional pressure, and the adoption of a code of practice to select subcontractors. Greenwood's (2001) findings identified that, despite

contractors' declared interest in closer buyer–supplier relationships, they remained traditional and cost-driven. More recently, He et al. (2020) studied the formation mechanism of contractors' greenwashing behaviours. In terms of responses to conflicting institutional pressures and logic, Gottlieb et al. (2020) explored hybrid organisations' formation (strategic partnerships) in response to institutional complexity. Matinheikki et al. (2019) also investigated how public buyers of a tunnel construction project formed a multi-party project alliance's hybrid organisation to respond to institutional complexity. Ju and Rowlinson (2014) found that, when facing institutional complexity regarding workplace safety approaches, construction sites adopt mixed strategies. Li et al. (2019) identified that the adoption of corporate social responsibility in construction corporations depends on ethical leadership, managerial moral motivation and managerial autonomy. In summary, these studies imply actors' active behaviour when responding to environmental pressures and when facing institutional complexity.

When it comes to institutions as the context, some studies have acknowledged the influence of national institutions, or regulatory, normative and cultural institutions on infrastructure projects' arrangements (Chi and Javernick-Will, 2011). Hoffman and Henn (2008) identified that rules, norms and beliefs could perpetuate barriers to green construction at institutional level. Jacobsson et al. (2017) acknowledged that the socio-cognitive environment and governance systems within the institutional environment shape the adoption and use of technologies. Hall et al. (2020) also asserted that the construction industry is stuck in a mirroring trap, which hinders systemic innovations that do not align with the prevailing structure. Others have identified what institutional knowledge is relevant for project stakeholders working in international projects (Javernick-Will, 2009; Javernick-Will and Scott, 2010). From these two groups of study, it can be inferred that: i) projects respond to pressures from the environment (recognised as active behaviour), and ii) the institutional context shapes projects' processes. Studies exploring both perspectives together, namely, how the existing institutional context might influence the responses that projects deploy to external pressures, were not found.

Other studies applying institutional lenses have looked at how projects might modify the institutional field; these include Gluch and Bosch-Sijtsema (2016), who applied the lens of institutional work to clarify environmental experts' agency concerning construction project practice. Lieftink et al. (2019) looked at how actors use relational, institutional work to mobilise key stakeholders to institutionalise a new project-delivery method. Salignac et al. (2018) investigated the drivers and processes of change concerning gender equality in the

construction industry. Rasmussen et al. (2017) looked at the agency's role in institutional change and the framing of policy problems.

Despite some studies having emerged in recent years, as previously discussed, construction management scholars continue to raise that the construction management discipline can still be enriched by borrowing from social science and organisational science, especially institutional theory (Volker, 2019). Volker (2019) asserted, for example, that the multiplicity in the organisational responses lens from institutional theory and interactions between different institutional levels is relevant in understanding change, or the lack thereof, in the construction industry. As previously mentioned, this research builds on the gaps identified in both project management and construction management literature and addresses the interactions between construction projects and institutional pressure in a context of change, taking into account the context in which projects are embedded. In other words, this research explores 'how' institutional pressure, envisaging the promotion of change, actually leads to the predicted change, taking into account that existing embedded structures shape how projects respond to the pressure.

2.6 Built environment policy

The gaps between the formulation and outcomes of built environment policy are not new phenomena (Muller, 2016). The nature of built environment policy-making has been considered a process full of contradiction, conflict and ambiguity (Simmons, 2015; Warwick, 2015). A range of studies has been conducted in the past, looking at diverse types of built environment policy, especially regarding sustainable development and climate-change mitigation policy (e.g. Larsson, 2003). Past research commonly agrees that many previous policy efforts have failed. These studies have highlighted a disconnection between policy design and implementation. Scholars have asserted that policies are usually developed in such a way that they are disconnected from the realities of those implementing them (Chan and Dainty, 2007), often have a narrow objective and focus, resulting in resistance and unintended consequences (Eker et al., 2018), and are not evaluated when put into practice (Christensen et al., 2014). There is often neglect of follow-through, enforcement and feedback (Cohen and Bordass, 2015). Foxell and Cooper (2015) suggested that the design–implementation disconnect commonly occurs because those involved in policy-making are situated in national organisations, while those expected to implement the frameworks are based locally.

Nevertheless, mechanisms for bridging these divides are poorly developed in the context of built environment policy (Foxell and Cooper, 2015).

With regard to research looking at policy design, there have been studies comparing policy approaches and developing frameworks for the design of optimal programmes (Gillich et al., 2018), research looking at how existing regulations, such as energy-related, could be redesigned (Gram-Hanssen et al., 2018), which types of programme are more appropriate in specific contexts (Li et al., 2020), and which, and how, policy discourses change over time (Moncaster and Simmons, 2015), among others. By analysing policy approaches, previous research has found that, sometimes, in the formulation of those programmes, there is a disconnect between intent and approach (Gupta et al., 2015), and interpretative flexibility in the implementation of policies is related to variability in outcomes (Moncaster and Simmons, 2015).

Among the recommendations to improve policy formulation, existing studies have suggested an explicit and diverse system in order to advocate for policy objectives (Bollo and Cole, 2019), an expectation of results that can actually be achieved, establishing monitoring and feedback systems that provide early evidence that things are going wrong (Cartwright, 2016), consistent and well-coordinated strategies and a clear assignment of responsibilities to ensure continuity of implementation (Cohen and Bordass, 2015). Others have proposed more integrated approaches to address the complex interactions with the process (Eker et al., 2018) and co-design of policy in open and transparent forums, including stakeholders' community and members with an experiential understanding of how things are (Foxell and Cooper 2015; Schweber et al. 2015; Warwick 2015). Foxell and Cooper (2015) advised that this approach could benefit from being combined with a risk-based assessment of the chances of policy success in the face of inadequate conception, underpowered implementation and politics. Others have suggested criteria to be considered in policy design such as robustness and revisability (Galea et al., 2015) and increased focus on 'how' the objectives can be achieved instead of 'what' those objectives are (Gupta et al., 2015). Imposed practices as part of policy approaches are mediated by the performance of practices comprising daily routines, and studies have asserted that programmes relying solely on technical interventions, without considering the mediating effect of daily routines and behaviour, will have limited impact (Pan and Ning, 2015; Goulden et al., 2017), it being necessary to reframe them around, and position them to address, everyday practices (Judson and Maller, 2014).

Other studies have looked at the implementation side and considered aspects such as assessment criteria (Calderon and Keirstead, 2012), acceptability, feasibility and viability of

proposed policies (Garrigós et al., 2017). There is recognition that interventions that are not implemented correctly may result in unintended consequences (Eker et al., 2018). Studies looking at actual practice, usually through surveys with implementers, have found, for example, that not all organisations that adopt policies implement them. In the case of sustainability-related policy, previous research has found that the diverse aspects of sustainability are not given equal importance in practice (Carter and Fortune, 2007). Some have suggested that recurring auditing is a potential approach to ensuring that policy is fully implemented (Gabe, 2016). Nevertheless, many of these implementation studies depart from an underlying assumption that implementation is disconnected from policy itself, not taking into account the impact of the interaction between the policy and the context of implementation and those doing the implementing on how implementation unfolds and the outcomes. Few studies looking at this interaction were found, and the results show that policy implementation influences the disparity between policy intent and outcome (Maund et al., 2018). The studies' findings have identified, for example, that how implementers perceive the policy has implications for its implementation at organisational level (Lingard et al., 2000). Others have found context-specific conditions that impact successful implementation: i) policy operationalisation, ii) organisational position, iii) professional belief, and iv) specialist knowledge and understanding (Maund et al., 2018). The context of implementation and its interaction with the policy influence how implementation unfolds (Pan and Ning, 2015). As Rasmussen et al. (2017) asserted, the formulation and implementation of reform initiatives are not a rationalist process.

Research on real-world implementation is still limited when compared to studies analysing policy and programmes themselves. However, a better understanding of inadequate conception and implementation issues requires feedback loops on policy outcomes and learning about what has, and has not, worked, and why (Foxell and Cooper 2015). As posited by Simmons (2015), there is a need to look at how policy is used. In the case of BIM policy, despite there being a shared assumption that policy contributes to widespread adoption (e.g. Lee and Borrmann, 2020), the literature lacks critical analyses of both design and implementation of such policies. Exploring how implementation unfolds will thus contribute to both the built environment and BIM literature, as elaborated next.

2.7 Building information modelling

The term BIM is used in many different ways. However, a holistic conceptualisation describes BIM as *'a set of interacting policies, processes and technologies that generate a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle*' (Succar et al., 2012, p. 120). BIM is described as a typical systemic innovation, meaning that the innovation system goes beyond a single organisation's boundaries. In the past decade BIM has increasingly been regarded as one of the most promising innovations to address performance problems that have long plagued the construction industry (Cao et al., 2017).

As identified by previous studies (e.g. Gurevich and Sacks, 2020), research on BIM adoption and implementation can be broadly categorised as focused on some levels: i) individual adoption from the perspective of people involved; ii) adoption and implementation at organisational level (e.g. by design firms, clients and construction firms); iii) adoption and implementation at project level; and iv) macro-level or national-level adoption and implementation. Although this body of literature is vast, some issues can be identified. As pointed out by Ahmed and Kassem (2018), first, the concepts of adoption and implementation are often used interchangeably. This blurs the distinction between interrelated concepts and impacts the understanding of the individual barriers/enablers for adoption and successful implementation. There have been studies revealing the same factors as affecting both adoption and implementation. However, according to Rogers (2003), adoption is related to a decision to make full use of innovation. Implementation relates to the phase that occurs once an innovation has been put into use, indicating that factors affecting adoption and implementation may not be the same. Additionally, there is considerably more research from an organisational perspective than a project perspective (Cao et al., 2014), in terms of both adoption and implementation. Nevertheless, implementation occurs at project level. Clearly, despite the amount of research conducted so far, the understanding of implementation remains limited. A summary of the existing research is outlined next.

2.7.1 BIM adoption

In innovation studies, adoption is related to making full use of an innovation as the best course of action (Rogers, 2003). BIM is a systemic innovation (Hall et al., 2018). As such, adoption studies, following studies on innovation diffusion, would be expected to be related to the pre-stages anticipating BIM adoption by organisations, individuals (project members) or from a

project perspective. However, as pointed out by Ahmed and Kassem (2018), a universal agreement of what adoption and implementation mean in the context of BIM is lacking in the literature. The same authors, nevertheless, following previous studies, suggest that a 'more holistic' definition of adoption is necessary. Their proposed conceptualisation of adoption follows Succar and Kassem (2015), who conceptualised BIM adoption as the successful implementation whereby an organisation crosses the 'point of adoption' into one of the BIM capability stages, namely, modelling, collaboration and integration (Succar and Kassem, 2015; Ahmed and Kassem, 2018). This mixed conceptualisation of what adoption really means in the context of BIM is reflected in other studies that commonly adopt both terms interchangeably.

By considering the concept of adoption from the perspective of innovation studies (Rogers, 2003), research to date is varied. There have been studies looking at acceptance and adoption at individual level, with an empirical focus in different countries and professionals, such as architects and quantity surveyors (e.g. Aibinu and Venkatesh, 2014; Addy et al., 2018), using models such as the technology acceptance model, and the unified theory of acceptance and use technology model (e.g. Howard et al., 2017; Acquah et al., 2018; Sanchís-Pedregosa et al., 2020). Studies applying these methods postulate that the level of success is determined by user acceptance, measured by factors including perceived usefulness, perceived ease of use, attitudes towards using and behavioural intentions to use.

Factors found to affect the intention to use include effort expectancy, facilitation conditions and hedonic motivation (Addy et al., 2018), technical defects of BIM and BIM capability of the project team (Ding et al., 2015). Park et al. (2019) also identified that compatibility and organisational support affect individuals' perceived ease of use and usefulness. Sanchís-Pedregosa et al. (2020) found that perceived usefulness is the most important determinant of behavioural intention, while perceived ease of use is found to have no significant effect on behavioural intention. Other studies found that performance expectancy does not directly affect behavioural intention, meaning that BIM is usually perceived as an unrewarded addition to existing work processes (Howard et al., 2017; Addy et al., 2018). From an organisational perspective, some have found that relative advantage is a driver for adoption (e.g. Chen et al., 2019). Others have posited that the benefits and challenges influence organisational decisions to adopt, but only in infrastructure projects (Hong et al., 2019). Some studies have found that the perception (and subsequently realisation) of benefits increases with experience (Ahankoob et al., 2018). Cao et al. (2017) asserted that project participants have stronger economic motivations to improve project performance as their BIM capability

matures. Nevertheless, studies at adoption from an individual perspective are less common than studies from an organisational standpoint.

Various studies have looked at factors influencing adoption from an organisational perspective, considering the internal organisational environment. Others have applied a technology–organisation–environment framework and identified technology, organisation and environment as the three sets of contextual factor by which organisations adopt BIM (e.g. Ahuja et al., 2016; Chen et al., 2019). These studies also have specific empirical contexts of application, sometimes focusing on specific organisations such as architectural firms, and apply surveys and quantitative methods to identify the influence of BIM adoption factors. Some studies also focus on factors driving organisational adoption in specific contexts, such as specific countries (e.g. Babatunde et al., 2020). Others compare factors driving adoption among organisations from different countries (e.g. Hong et al., 2020).

In terms of unpacking the concept of adoption, Ahmed and Kassem (2018) proposed a taxonomy for adoption. They looked at factors influencing BIM adoption from an organisational perspective by considering different adoption stages. They suggested the impact of different individual factors on the awareness, intention and decision to adopt BIM. This was the only study found taking a more detailed view of what adoption entails. Among the factors influencing adoption as a whole, studies have identified, for example, top management support (Son et al., 2015; Ahuja et al., 2016; Ahmed and Kassem, 2018; Chen et al., 2019), expertise, trialability of the technology (Ahuja et al., 2016), willingness/intention, communication behaviour, observability, relative advantage, compatibility, social motivations, organisation size, organisational culture, organisational readiness (Ahmed and Kassem, 2018), financial restrictions, knowledge, client enforcement (Gamil and Rahman, 2019), type of project (Hong et al., 2019), subjective norm and compatibility (Son et al., 2015), as related to variance in organisational adoption.

Other studies have also looked at the influence of different forces on adoption by organisations and projects. These studies have applied institutional theory lenses. Cao et al. (2014) investigated how different institutional pressures relate to the extent of BIM adoption in projects. They found that coercive and mimetic pressures significantly influence adoption, but coercive pressures have a stronger influence on clients/owner support, which mediates the extent of project-level adoption. Ahmed and Kassem (2018) also asserted that coercive pressures significantly influence adoption by organisations. Nevertheless, adoption at project level is less investigated than at organisational level (Cao et al., 2014). Among a few studies from a project perspective, Papadonikolaki (2018) investigated the links between adoption and

implementation and identified projects where firms motivated by internal BIM adoption drivers (e.g. increasing quality) implemented BIM collaboratively flexibly. In contrast, projects that adopted BIM to comply with external demand were rigid and competitive during implementation. In terms of the influence of specific organisations on BIM adoption in projects, studies have highlighted the importance of the client organisation (e.g. Cao et al., 2014; Cavka et al., 2015), especially the public sector (Cheng and Lu, 2015).

At macro-level, there have been studies comparing adoption across, for example, European countries (e.g. Charef et al., 2019) and organisations worldwide (Won et al., 2013). Kassem and Succar (2017) explored the BIM adoption dynamics across countries and developed conceptual models for assessing macro-BIM adoption across markets and informing the development of BIM adoption policies. Other studies have also looked at the diffusion of specific BIM uses (e.g. 3D visualisation, clash detection, energy modelling, 4D) across markets such as the US (Gholizadeh et al., 2018) and the UK (Gledson and Greenwood, 2017), using diffusion models. Within the UK specifically, studies looking at widespread adoption have found that, although respondents agree that coercive pressure has influenced adoption, and most of those taking part in surveys reported having adopted BIM, the same studies show that adoption of the process standards part of the coercive pressure has not increased to the same level (Eadie et al., 2015). There is no evidence, however, for why adoption of the standards is limited.

In summary, a general conclusion from these studies is that there are varying levels of adoption within the same context, among professionals (individuals and organisations) and across contexts (Gu and London, 2010). Different environmental pressures influence the extent of adoption. Another group of studies have looked at implementation, as discussed next.

2.7.2 BIM implementation

As previously mentioned, from the perspective of innovation diffusion studies, implementation occurs once an innovation has been put into use. Studies on BIM implementation have two main focuses: implementation at organisational and at project level.

At organisational level, similar to studies looking at adoption, there have been studies looking at implementation in specific contexts, such as SMEs (Arayici et al., 2011; Abuelmaatti and Ahmed, 2014; Awwad et al., 2020), or implementation from the perspective of specific actors such as design and engineering firms (e.g. Arunkumar et al., 2018; Muñoz-La Rivera et al., 2019), facilities managers (Kula and Ergen, 2021), and also implementation in specific

countries. These studies have captured aspects such as organisations' perceptions of implementation (e.g. Jin et al., 2017) or how to implement BIM given the organisational context's characteristics. The role of actors such as clients in driving adoption and guiding implementation has also been emphasised (Lindblad, 2019; Lindblad and Guerrero, 2020).

Factors affecting implementation reported by these studies include strategic initiatives, cultural readiness, learning capacity, knowledge capability and IT leveragability, network relationships, process and performance management, organisational support and structure to execute BIM, the existence of industry standards, BIM vision and leadership from management, changes in organisational structure and culture, training, changes in work routines, and experience and governance of BIM-related policies and standards, among others (e.g. Chan et al., 2019, Liao and Teo, 2019; Abbasnejad et al., 2020; Ma et al., 2020). Many factors are also cited by BIM adoption literature, and both terms are used interchangeably among existing studies. Also, these factors have mostly been identified through literature reviews or surveys with industry practitioners.

Few in-depth studies looking at actual implementation were found. Among these, Sackey et al. (2014) looked at BIM implementation through the lens of socio-technical systems. They identified that when BIM is implemented, a complex and interrelated set of incidents, events and gaps unfold, threatening organisations' deep structures. Their findings draw attention to interrelations among the work system's elements, where a change event in any one of the elements leads to a change in the other elements. Poirier et al. (2015) conceptualised adoption and implementation by considering multiple embedded contexts of innovation. These studies acknowledge that the implementation process is a complex change process involving and shaped by multiple aspects. Gurevich and Sacks (2020) conducted in-depth analysis of implementation at client organisations in the UK and Israel. They identified multiple actions necessary for successful implementation and the realisation of benefit for the organisations . In terms of other studies on BIM implementation in the UK, studies have looked at critical success factors for BIM implementation in organisations such as SMEs (Awwad et al., 2020) and client organisations (Dakhil et al., 2019).

From a project perspective, there have been studies looking at the distribution of effort spent on various tasks over the project life cycle and how it can be used as a metric for assessing and improving implementation performance (Aibinu and Papadonikolaki, 2020). Others, also through surveys, have identified critical factors for implementing strategies for enhancing implementation (e.g. Ma et al., 2020). The critical factors cited by these studies include standard platforms for integration and communication, education and training, standardisation,

clear definition and understanding of users' requirements, clearly defined plans and objectives for BIM implementation, financial support, development of capabilities and skills, improvement in availability and interoperability of engineering information and data, and the aligned objective of BIM implementation with the project goal (Amuda-Yusuf, 2018; Ma et al., 2020). Nevertheless, as identified by previous studies (e.g. Cao et al., 2014; Murguia et al., 2021), research on BIM adoption and implementation from a project perspective is still limited, especially analysis focused on the real context.

Some other scholars have previously looked at the real context and highlighted aspects of the social or institutional context of the construction industry that frame innovation implementation in the sector. However, that is not very much explored when looking at BIM implementation. Harty (2008) argues that innovation in construction projects can only be understood by following the dynamic interactions and accounting for a range of influences, actors and artefacts. Construction project work is shaped by an unbounded context, and the effects of implementing an innovation cannot always be tightly controlled and constrained and extend beyond the influence of a single organisation or individual (Harty, 2008). In other words, the implementation of innovations in construction projects is placed beyond the control of a single sphere of influence (Harty, 2005). To innovate in such contexts, the cooperation and alignment of multiple actors and spheres of influence across different organisations are required (Harty, 2005). Pre-existing expectations, assumptions and practices from outside are difficult to exclude from or contain within a specific innovative initiative in a project context. Dowsett and Harty (2018) also pointed out that innovation implementation is influenced by where the decision to introduce the innovation has originated from and the power and influence that the decision-maker has.

When involving technological artefacts, Harty (2008) has also emphasised that the politicised character of technology development and how developers indelibly affect the artefacts they produce are important in considering how contained or unbounded specific innovative activity might be (Harty, 2008). The technology itself imposes a redefinition of roles and relationships among actors involved in the project (Linderoth, 2010). The programs of actions inscribed in the technology delegate new roles and competencies to the actors in the network, and the actors in the network also start to redefine each other's roles and relationships when interacting mediated by technology (Linderoth, 2010). In other words, technology and other artefacts are regarded as actors shaping roles and relationships in the network. Thus, the implementation of technological innovation and the outcomes of technology deployment can be seen then as a combination of actors' interpretations of technology and programmes of

actions inscribed in technological artefacts (Linderoth, 2010). However, the concept of inscription does not necessarily advocate technological determinism – the actors in the setting where the artefacts are introduced are already following their own programmes of actions, and the technological inscriptions are blended with those existing programmes (Linderoth, 2010).

In summary, innovation scholars have highlighted that understanding innovation implementation in construction requires consideration of the social and organisational contexts in which it is located (Harty, 2005). There should be an account for the multiple interactions and influences as innovations are developed and implemented (Harty, 2005). However, most existing research on innovation implementation in construction projects, including BIM implementation, relies on a single driving force, whether a single organisation, external driver or a coordinated coalition, to introduce innovation and manage them (Hardy, 2005). Studies looking at the implementation of BIM policy mandates in projects and that account for the social context have not been found, despite claims that coercive pressures lead to widespread adoption and implementation of BIM. How implementation unfolds under the conditions of such pressures and considering the particularities of the context and the multiple actors, influences and artefacts have not been addressed. Thus, exploring the implementation of a mandate, while accounting for the social context of implementation, will enhance the understanding of the project-level implementation of BIM.

2.8 Shortcomings and opportunities for contributions

The literature review confirmed that extant research is limited in providing explanations for how projects interact with environmental pressures. By investigating how construction projects responded to BIM level 2, this research will contribute to both filling gaps in the existing literature and addressing some of the taken-for-granted assumptions in the different literature streams.

Although organisational theory literature has extensively tackled how organisations respond to external pressures, exploring inter-organisational responses might provide new insights to this body of research, as projects are characterised by multiple parties and shaped by multiple contexts, and these characteristics might influence responses in different ways than those observed at organisational level. As posited by Crilly et al. (2012), dominant theories of decoupling largely overlook the potentially complex interplay between the external environment and internal organisational environment, and this interplay is evident in the project context. This literature is also limited in terms of empirical evidence related to the

implementation of standards as environmental pressures. Exploring implementation of BIM level 2 standards will add to this empirical body of evidence and might also offer new insights regarding the influence of the pressure itself on how implementation unfolds. Also, findings from existing studies have posited that decoupling is more likely to occur when the pressure involves technical aspects, contradicting the views in the BIM literature that coercive pressures such as BIM mandates involving new technical structures lead to widespread adoption and implementation. Second, the findings will directly contribute to gaps in the project management research regarding projects' interactions with the broad environment. Construction management scholars have highlighted the potential of institutional lenses for theory-building. In combination with structuration theory, its application will provide new insights into the dynamics of change in the construction sector framed by institutional forces. The institutional theory provides the theoretical framing to account for the influence of the different institutions that shape the work in construction projects. The institutional theory holds that organisations and individuals who are part of organisations are suspended in a web of values, rules, beliefs, norms and taken for granted assumptions that define the way the world should be (Barley and Tolbert, 1997). The institutional theory, therefore, provides a blueprint to understand the actions of project members when innovation is implemented by highlighting the types of institutions that set bounds on rationality. However, although institutional theory acknowledges the interdependence of actions and institutions, it does not consider how they are recursively related (Barley and Tolbert, 1997). Gidden's (1984) work on structuration theory helps articulate how institutions are formed, reproduced, and modified through an interplay of action and structure (Barley and Tolbert, 1997). Thus, this complementary lens will support the exploration of how BIM implementation unfolds or how the implementation is affected by existing institutions.

Finally, from a BIM perspective, this research will shed light on modes of implementation at project level, challenging the perceptions of BIM enactment as a linear process.

Chapter 3 – Research Design

3.1 Chapter introduction

Exploring how projects respond to institutional pressures required rich data, taking both the context and perspective of implementers into account. By considering the current state-of-the-art, this chapter provides details on the rationale behind the research design employed, including the philosophical position, the reasoning approach, the methodological choice in alignment with the philosophical tradition chosen, the research strategies, the data-collection procedures and the data-analysis process. Procedures for ensuring the quality of the research design are also discussed. All decisions concerning the research design are justified based on the existing literature and on assumptions made on the way of inquiring into the world (Edmondson and McManus, 2007; Easterby-Smith et al., 2018).

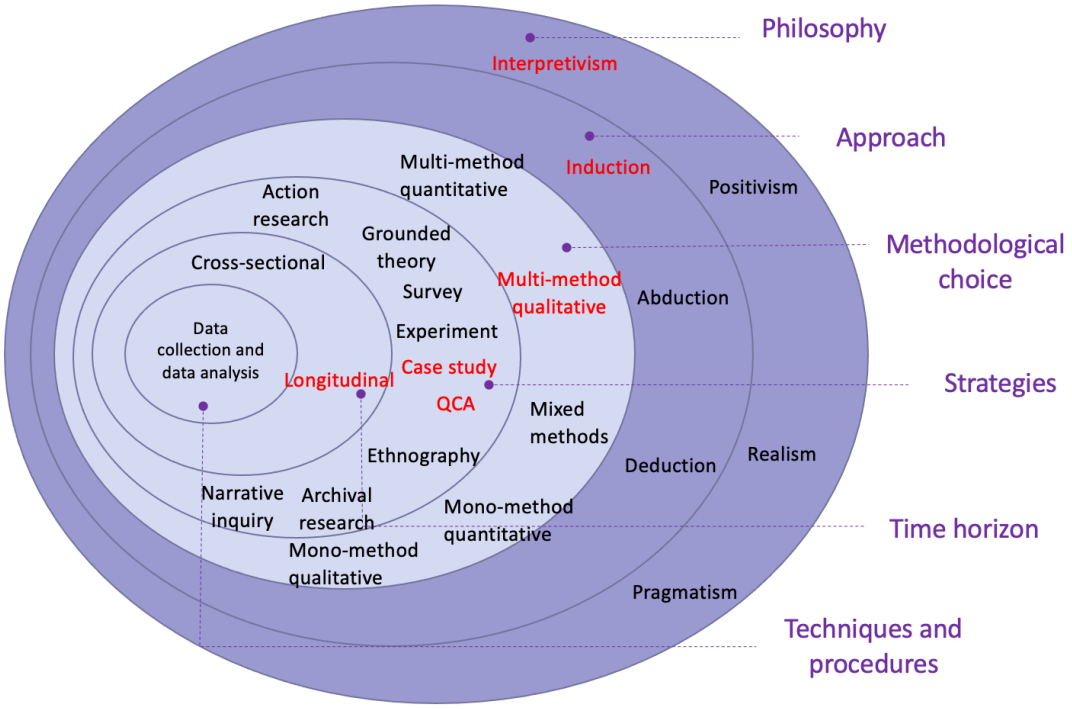
Philosophical orientation plays a vital role in research projects and should be established early in the research process (Remenyi et al., 2002). Decisions about ontology and epistemology inform other decisions, such as data-collection and analysis methods (Easterby-Smith et al., 2018). Thus, this chapter begins with an overview of the research process in Section 3.2, which is the frame of reference for the methodological design of the thesis. The philosophical position on the nature of reality and the assumptions surrounding various ways of inquiring into the nature of the world are outlined in Section 3.3. The research design is then described in detail in Section 3.4, starting with the methodological choice following the interpretivist research design traditions, followed by a description of a set of elements to achieve coherence in the research design.

Section 3.5 describes the quality of the research design and outlines how the project's elements were articulated to demonstrate methodological fit. Finally, the chapter concludes with a summary of the main characteristics of the research design in Section 3.6.

3.2 The 'research onion'

The 'research onion' shown in Figure 3.1 summarises the steps taken, and choices made, proceeding from the goal of elaborating upon the dependent variable (projects and how they respond to external pressures) to the data-collection and analysis methods employed to generate the findings.

Figure 3.1 – Research onion (choices in red)



Source: Adapted from Saunders et al. (2012)

The choice of research methodology, strategy, time horizon and data-collection and analysis techniques (light purple part in Figure 3.1) are underlined by a range of core assumptions regarding the research philosophy (dark purple in Figure 3.1): the ontology (the underlying assumptions about the nature of reality), the epistemology (the assumptions about the best ways of inquiring into the nature of the world) (Easterby-Smith et al., 2018), and the reasoning to claim the findings from the data. The choices are described next.

3.3 Research philosophy

The research philosophy concerns the development and nature of knowledge (Saunders et al., 2012). In other words, it involves assumptions about the way the researcher views the world and underpins the research questions, the methods used and how the findings are interpreted (Saunders et al., 2012). Ontology is concerned with the nature of reality (Saunders et al., 2012). As a researcher, I adopted a subjectivist view, believing that social phenomena are created through the perceptions and consequent actions of actors. This means it is necessary to study the details of a situation to understand what is actually happening, as reality is socially

constructed. Thus, the first assumption is that successful implementation of an institutional pressure is socially constructed through the actions of those implementing it.

Epistemology is concerned with the nature of knowledge and different ways of inquiring about the world (Easterby-Smith et al., 2018). There are two main contrasting views regarding the way research should be conducted: positivism and social constructionism, also known as interpretivism (Saunders et al., 2012; Easterby-Smith et al., 2018). Positivism assumes that the social world exists and that its properties can be measured through objective methods rather than subjective inference (Remenyi et al., 2002; Easterby-Smith et al., 2018). A researcher adopting a positivist approach works with observable social reality, and the end product is the derivation of law-like generalisations similar to those produced by physical and natural scientists (Remenyi et al., 2002). Conversely, social constructionism states that reality is not objective but rather constructed by people who place different meanings upon their experiences (Easterby-Smith et al., 2018). The critical assumption of social constructionism is that there may be different realities, and so the researcher needs to gather the perspectives of a diverse group of participants (Easterby-Smith et al., 2018). Table 3.1 shows a comparison between these two main perspectives.

Table 3.1 – Main differences between positivism and social constructionism / interpretivism (extracted from Remenyi et al., 2002; Johnson and Duberley, 2013; Easterby-Smith et al., 2018)

Theoretical orientation	**Positivism**	**Social constructionism/ interpretivism**
Ontology	There exists a singular objective reality	Reality is subjective, and multiple realities may be seen by participants in a study
Research methodology	Quantitative	Qualitative
Research designs	Large surveys, multi-cases	Small number of cases
The observer	Must be independent	Is part of what is being observed
Human interests	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Logic/approach	Deductive	Inductive
Concepts	Need to be defined so they can be measured	Should incorporate stakeholder perspectives

Theoretical orientation	Positivism	Social constructionism/ interpretivism
Starting points	Hypotheses	Questions

As pointed out by management scholars, the social world of management is too complex for theorising through definite 'laws' like the physical sciences (Saunders et al., 2012). Practical implementation of an institutional pressure is complex and unique to the organisational context, depending mostly on individuals' actions and views. The 'social reality' of the practical implementation of a policy mandate, therefore, is ultimately determined by the people involved rather than by objective or external factors. Thus, an interpretivist position was adopted to inquire into this phenomenon, which underlines the research approach adopted in this thesis.

3.3.1 Research approach

The research questions addressed in this thesis are conducive to inductive theory-building (Edmondson and McManus, 2007), meaning that the theory comes from the data and it is expressed through a framework. Thus, the main form of reasoning in this research involves collecting data on the practical implementation of the imposed structure to identify themes and explain patterns of how the BIM level 2 mandate has been implemented in projects, which can offer insights into how projects interact with institutional pressures.

This form of reasoning was chosen considering the current state of the literature (Edmondson and McManus, 2007; Saunders et al., 2012), as shown in Chapter 2, especially regarding the relationship between internal processes and the external environment of projects. The reasoning strategy employed to move from the grounds to the claims (the theoretical interpretation and theoretical generalisation) are explained further in this chapter. As shown in Figure 3.1, the research philosophy and approach underpinned the next layers of the research onion, which constitutes the design.

3.4 Research design

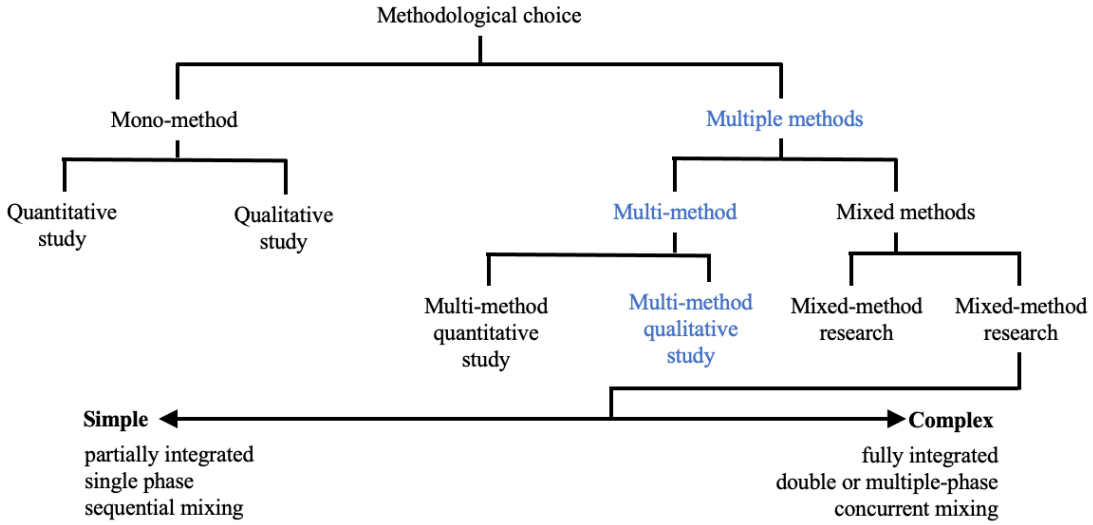
Interpretivist research designs start from the assumption that verifiable observations are subject to different interpretations and the researcher should establish how various claims for truth and reality become constructed in everyday life (Saunders et al., 2012). These philosophical assumptions informed the methodological choices described next.

3.4.1 Methodological choices

An interpretive philosophy such as this one, where the researcher needs to make sense of the subjective and socially constructed meanings expressed about the phenomenon being studied, is associated with qualitative research (Saunders et al., 2012). Therefore, a naturalistic research design was considered, meaning that the researcher had to operate within the context of implementation of the institutional pressure under analysis to have access to meanings and an in-depth understanding of its implementation.

In order to create a more fruitful approach to data collection on BIM level 2 implementation in practice, a multi-method qualitative approach was employed, as shown in Figure 3.2. A multi-method approach can be defined as the employment of two or more different methods or styles of research within the same study, regardless of whether they are qualitative or quantitative (Brewer and Hunter, 2006; Hunter and Brewer, 2015). The main goal of this research is a good example of phenomena commonly investigated through a multi-method approach, namely, the disconnection between what people say they do (i.e. the adoption of a policy and said implementation) and what they really do on the ground (the real implementation) (Hunter and Brewer, 2015). Past research looking at enactment of policies adopted by organisations has employed a similar multi-method approach (e.g. Bromley et al., 2012).The decision to adopt a multi-method approach also addresses many of the normative ideals for scientific research and reduces scepticism about the research results, leading to an increase in credibility (Hunter and Brewer, 2015).

Figure 3.2 – Methodological choice of a multi-method approach



Source: Saunders et al. (2012)

There are many methods and combinations of methods available for use. The choices in multi-method research design involve i) which methods can be combined and ii) how the adopted methods are deployed and implemented together during the research process (Hunter and Brewer, 2015). This research was designed in three main phases, as shown in Figure 3.3. The use of multiple methods occurred during data collection and analysis, as well as in the interpretation of the findings (Saunders et al., 2012). The multi-method approach was constructed sequentially, meaning one method was used after another to elaborate and expand upon the initial findings. As it will be explained in more detail in the following sections, the methods employed involved multiple case studies and the subsequent application of the qualitative comparative analysis (QCA) technique, enabling a fine-grained conceptualisation and empirical investigation of causal complexity through the logic of set theory (Misangyi et al., 2017). A case-based approach was chosen for the first stage. Case studies emphasise the rich, real-world context in which the phenomena occur (Eisenhardt and Graebner, 2007), being the best methodology to explore and understand the practical implementation of a policy mandate by considering contextual aspects. Moreover, as a theory-building approach is deeply embedded in rich empirical data, building theory from case studies will likely produce an accurate and testable theory (Eisenhardt and Graebner, 2007). Multiple projects from different settings and with different motivations for BIM adoption and implementation were chosen. Multiple case studies were preferred over a single case study design to explore if implementation occurred similarly across multiple projects, independent of the motivation for adoption, i.e., to observe literal replication or if the cases predicted similar results. The case studies consisted of multiple holistic cases, meaning that the projects from each context were the units of analysis (Yin, 2014). The case design was employed to explore how the projects responded to the mandate and the causes leading to such responses. When exploring possible ways projects might respond to a mandate, it was observed that those responses had a multifaced nature – multiple causes and configurations of causes were related to the responses employed. Thus, to shed light on the observed causal complexity, the QCA technique was employed. QCA is a set analytic method capable of handling causal complexity by capturing multiple conjunctural causation (Misangyi et al., 2017). The data collected in the first stage of the research design served as input for the QCA – the responses identified and causes leading to those responses were used to build the truth tables, which are the central element in the application of QCA. Thus, the research design developed in this thesis can be classified as a sequential exploratory research design. The details of the strategies applied in each phase are explained next.

3.4.2 Research strategies, techniques and procedures

As shown in Figure 3.3, this research was motivated by the empirical observation (discussed in Chapter 1) that the BIM policy approach in the UK as a coercive pressure has not been fully implemented and has not had the projected transformative effect. These observations from industry-focused studies led to the formulation of the research questions, and subsequently the first stage of this research, which consisted of analysis of the different literature streams underpinning this research to understand what has been written so far in terms of explanation of the phenomenon.

In the second phase the aim of RQ1 was to explore how the BIM level 2 policy was enacted in practice. Through multiple case studies featuring both within-case and cross-case analyses, this phase identified, inductively, possible responses employed by projects and underlying causes. A categorisation of those responses is proposed. This stage also identified causes for the identified responses. After this stage of analysis, the findings presented characteristics that required further analysis, and a subsequent method was applied. Then, in the third research stage, the theoretical arguments generated in stage two and their causal mechanisms were analysed via qualitative comparative analysis (QCA) (Rihoux and Ragin, 2012). The methods employed in each phase, and a description of the data-collection and analysis procedures and techniques employed in each stage, follow.

3.4.2.1 Stage 1: Literature review

Overview

The theoretical foundations underpinning the research questions and findings of this thesis involved four main streams of literature, as elaborated in Chapter 2. The procedures for reviewing these streams of literature were described in Chapter 2, but in methodological terms the review had three main purposes. First, the background literature, especially concerning organisational science research and what has been written regarding how organisations respond to external pressures, provided the framework to investigate the research question in the context of projects. This literature also provided the basis for identification of constructs, as suggested by Eisenhardt (1989). Second, the literature review confirmed that extant research has not reported on the interaction between projects, especially construction projects, and the

environment. Finally, the review provided the basis on which the contributions of this research were built. Figure 3.4 shows the review process and its outcomes.

Figure 3.3 – Research stages, strategies and techniques

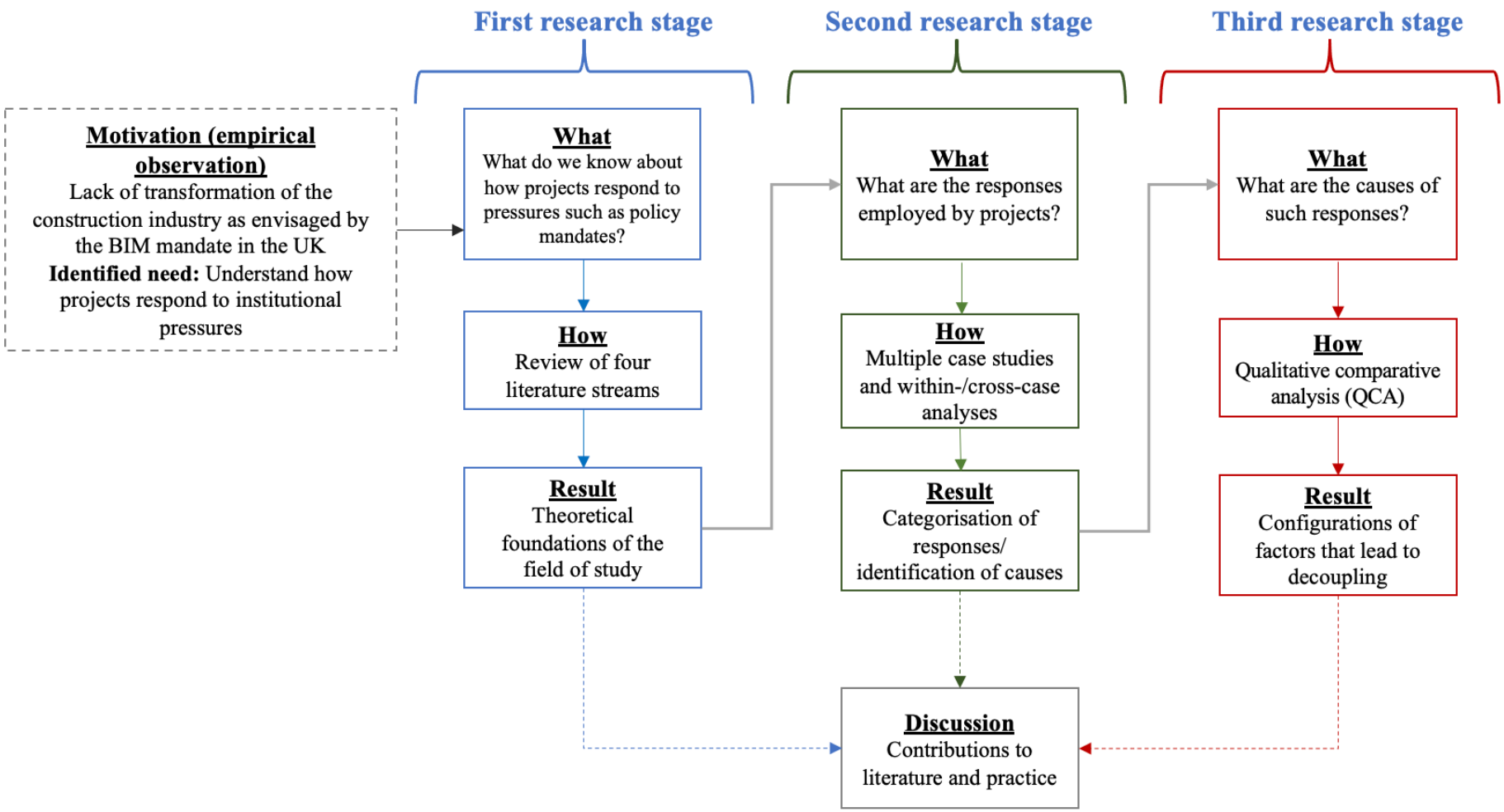
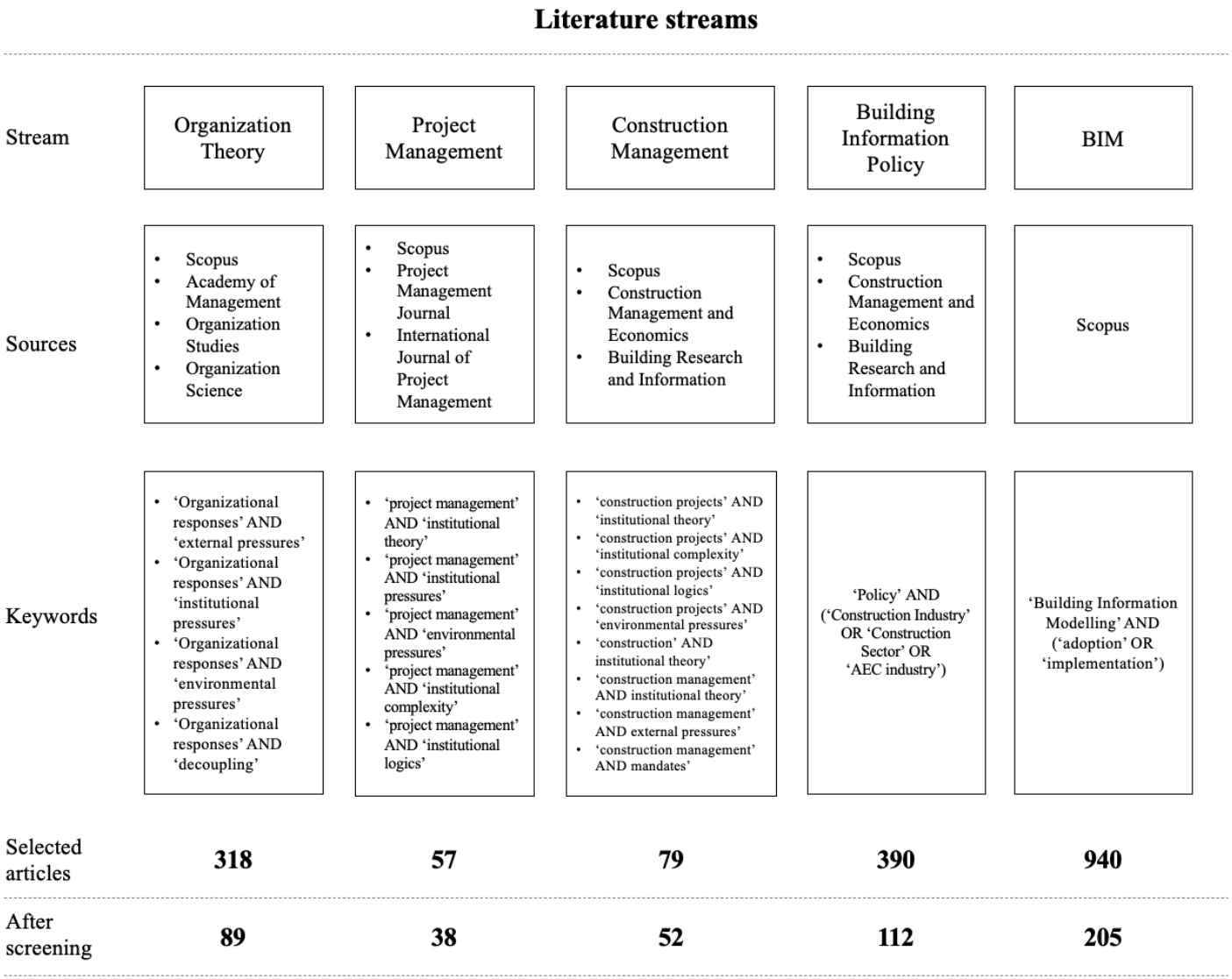


Figure 3.4 - The review process



3.4.2.2 Stage 2: Inductive multiple case studies

Overview

This research stage can be classified as exploratory, as the goal was to explore the phenomenon in terms of practical implementation. A multiple-case-study approach was adopted as previously mentioned, as case studies are valuable for exploring a phenomenon within its context (Saunders et al., 2012), and they enrich the understanding of the processes being enacted (Eisenhardt and Graebner, 2007). The case-based approach also helps to generate answers to 'why' and 'how' types of question, as explored here (Saunders et al., 2012). The case-based approach is also appropriate for building theory related to complex processes such as situations where there are likely to be configurations of variables (Gehman et al., 2018), as could be expected in a project context because of the multiple contexts involved.

According to Yin (2014), a case-study design involves the definition of a range of elements, including the unit of analysis, the case-study boundaries and analytical techniques, among others. The units of analysis here are the construction projects in which the imposed structure was implemented, namely, the inter-organisational level, which included implementation of the mandate across all stages of a project, as defined by the Royal Institute of British Architects (RIBA) plan of work (RIBA, 2013) in the context under analysis. The RIBA plan of work organises the processes of briefing, designing, constructing and operating building projects into eight stages and is widely used in the UK, where this research was conducted. The UK was selected as the best setting to explore the practical implementation of a BIM policy approach because it is considered to be a well-developed example of BIM adoption in the world in terms of policy approach (Kassem and Succar, 2017), providing an appropriate context to explore responses by implementers to well-disseminated institutional pressure. This research also employed a longitudinal design, aiming to look across all stages of the projects.

A multiple-case design was chosen because of its capacity to demonstrate 'replication'; in other words, the cases are treated as a series of independent experiments that confirm or disconfirm emerging conceptual insights (Brown and Eisenhardt, 1997). As it enables the collection of comparative data, this design is useful for developing theoretical insights when research focuses on areas that extant theory does not satisfactorily address (Eisenhardt, 1989; Ozcan and Eisenhardt, 2009), as in the case of projects' interaction with their environment.

Case selection

The aim of this research was to induct generalisable theory, and so theoretical sampling was used to select construction projects applying the policy mandate (Eisenhardt, 1989). Theoretical sampling is purposefully non-random, and each case is chosen for its ability to illuminate the focal phenomenon and fill theoretical categories that enhance generalisability (Eisenhardt, 1989). In keeping with the theoretical sampling approach, and by considering that previous research had found that when BIM implementation is driven by internal factors such as technical reasons or quality assurance, it is more collaborative and flexible than when it occurs only to comply with external demand (Papadonikolaki, 2018), construction projects with varying adoption motivations were selected in order to determine if different motivations led to different responses, or if similar responses would emerge independent of the motivation for adoption of the mandate. As recommended by Eisenhardt (2021), the cases were selected in such a way that they could improve theory-building; in other words, cases with different motivations for the adoption/implementation of the policy mandate were chosen, so ways of responding to external pressures could be identified despite the reasons leading to its adoption.

Eight construction projects from three different client organisations were selected for longitudinal analysis. One of the selected organisations implemented BIM level 2 mostly for technical reasons, one for compliance reasons (as a public-sector client, implementation of the BIM mandate has been compulsory for its projects), and the third because of either technical or compliance reasons. Institutional construction projects (school and university buildings) were selected, because BIM implementation is disseminated among these types of project. As the data would need to be collected for projects where BIM has been compulsory, and those projects are public-sector projects and are usually related to public buildings, client organisations and projects that were similar in terms of context and complexity were chosen to allow for comparison. It was also important to select client organisations with a similar context that could be compared. All three client organisations develop, and are owners of, the built assets. Besides the availability of projects, projects implementing BIM within these organisations were selected considering their delivery approach, so similar projects in terms of delivery method could be selected. The projects were also selected considering their delivery team – with the exception of one contractor, which was inexperienced, all projects had large and experienced lead contractors, well known in the national context. This selection allowed variation to be controlled. The logic for selecting the projects followed the principle of

selecting them as new data was required in the interactive processes of data collection and analysis. The procedures adopted for data collection follow.

Data sources and data collection

Case studies with the goal of theory-building usually combine a range of data-collection methods (Eisenhardt, 1989). The most appropriate data sources to understand how the mandate was implemented were considered. Although some traditional approaches in inductive theory-building (Gioia et al., 2013) give preference to specific data sources, such as interviews, in the case of the research question under analysis, more varied sources were preferred, as it could be predicted that informants would not be helpful in completely reporting the enactment of new processes in detail. Some scholars have highlighted that most of the research on BIM implementation so far has been based on surveys/interviews with project stakeholders, and these are mostly based on opinions rather than a real evaluation of activities and how implementation actually takes place (Dainty et al., 2017). Thus, multiple sources were necessary to reconstruct enactment and understand how real implementation occurred.

Interviews with different project members were also conducted, especially with those directly involved and undertaking BIM roles in the projects, in order to collect their individual views and also different views. A questionnaire was developed covering questions on each aspect of the BIM level 2 mandate. There were questions on the application of PAS 1192-2 and PAS 1192-3, which constitute the two main processual standards part of the mandate. The questions were designed to cover what the standards have asked to be implemented, in addition to the benefits and challenges/barriers and use of technologies and new processes. The BIM documentation that needs to be developed for the project, according to the mandate and the standards, was also collected and analysed. Observations of project team meetings and design meetings (i.e. clash detection) were conducted for some of the projects to understand how the project team worked. Other secondary sources of data, namely, internal reports from the client organisations on their BIM strategy, were also considered. These multiple sources of data allowed for data triangulation, which refers to the use of different data sources (Flick, 2014). For example, interviews focused on participants' knowledge and experience and allowed issues of the past to be introduced, while observations focused on practices and interactions at a specific moment. Documents led to a complementary understanding of what happened in the past and in terms of implementation. In other words, the different sources of data were used

and combined to 'reconstruct' how implementation of the mandate occurred in practice. Table 3.2 shows the sources of data employed to reconstruct enactment.

The data-collection process and analysis occurred concurrently and the data-collection process for the subsequent cases proceeded after analysing the data collected from the first projects (client organisation's A projects), following the theoretical sampling logic. This process occurred until any new findings had been identified across the different projects and contexts. In other words, after collecting and analysing the data for the projects involving similar enactments of the mandate, similar types of response were observed across the cases, and similar types of cause leading to those responses were also found.

The research started with data collection and analysis of implementation at five construction projects within the first client organisation under analysis, organisation A. Despite it not being a public-sector client organisation where central government has mandated implementation of BIM level 2, organisation A implemented the mandate not only because of its potential benefits but also because of its reputation in the national context and, therefore, the desire to align itself with national best practices. Thus, implementation was observed within a context in which both technical and legitimacy reasons drove implementation in order to gain a comprehensive understanding of how enactment takes place and the responses that projects employ to pressure that are not necessarily related to one motivation for adoption or another.

The five construction projects analysed included organisation's A first BIM level 2 projects, as well as other BIM level 2 projects in progress at the time of data collection. Three were at the handover stage during data collection (projects 1 to 3), one was at the construction stage (project 4) and one was at the design stage (project 5), so data on implementation could be more extensively collected considering the stage of the project at the time, resulting in a more in-depth understanding of implementation across all stages.

Data collection for organisation A took place between June 2018 and December 2019. I undertook the role of observer-as-participant (Bryman and Bell, 2011) and was embedded in the organisation, so a wider perspective on implementation was gained. The first approach to data collection involved understanding the strategy adopted by organisation A to respond to the mandate. Documents such as the BIM strategy, reports (secondary data sources) on organisation's A approach to BIM adoption and other internal documents, such as documents directed to project managers, were analysed. For projects 1 to 3, which were at the handover stage at the time of data collection, two main approaches were considered: i) analysis of documents (client's Employer Information Requirements (EIR) and Asset Information Requirements (AIR) for all three projects), BIM execution plans (BEPs) when available and

progress reports/compliance reports when available; and ii) semi-structured interviews with the individual undertaking the role of BIM/information manager for the project and project managers. For project 3, a meeting on lessons learnt was also attended. As the projects were at the handover stage, overall observations could not be carried out, so implementation was analysed from the perspective of the interviews and documents analysed. For projects 4 and 5, which were in progress at the time of data collection, more interviews and observations were carried out. For project 4, a workshop (group interview) was carried out with the whole team, which also covered questions on their perception of the benefits and challenges. Observations on the handover process were also carried out. For project 5, more documents could be analysed, and design review/BIM workshops could also be observed.

In planning and operationalising research, sufficient participants need to be identified and chosen to provide the necessary breadth, depth and saliency of data (Saunders and Townsend, 2016). Despite there being no agreement in the qualitative research literature on the number of participants and interviews necessary when using interview data (Saunders and Townsend, 2016), researchers such as Creswel (2007) advise between three and five interviews per case for case-study strategies, which was covered for the projects of each setting. The different ways of collecting data addressed different levels of the same issue, namely, implementation of an environmental pressure, at the same time that they produced different data with different characteristics.

Inductive analysis was performed parallel to data collection on organisation A's projects, resulting in the identification of patterns on how enactment occurred in projects 1 to 5 (explained in the following section). The data collection then progressed to organisation B's project, which implemented BIM because, as a public-sector client, it was mandatory for its projects. The goal with organisation B's project was to collect data on a case where implementation was mandatory and that was the main motivation for adoption, aiming to identify if the same responses identified for projects 1 to 5 were replicated, if only part of them would replicate, or if new responses could emerge. The same data sources were followed.

Table 3.2 – Data gathered

Client organisation/projects	Data source	Description	Project	Number of pages (transcribed data/documents)
Organisation A (projects 1 to 5)	Document analysis	Digitally enabled estate strategy report	All projects	17
	Document analysis	BIM handbook for project managers	All projects	17
	Document analysis	EIR + Construction Operations Building Information Exchange (COBie) deliverables tables	All projects	80
	Document analysis	AIR	All projects	58
	Document analysis	Pre-contract BEP	All projects	13
	Document analysis	Suppliers BIM capability and capacity assessment approach	All projects	2
	Interviews	Client's project manager	Project 1	21
	Interviews	BIM manager (main contractor)	Project 1	146
	Secondary data analysis (industry-based article)	Project overview	Project 1	21
	Secondary data analysis (industry-based article)	Project overview article (services engineer)	Project 1	5
	Secondary data analysis (industry-based article)	Project overview article (main contractor)	Project 1	2
	Secondary data analysis (industry-based article)	Project overview article (main contractor)	Project 1	2
	Secondary data analysis (industry-based article)	Project overview article (main contractor + client)	Project 1	21

Client organisation/projects	Data source	Description	Project	Number of pages (transcribed data/documents)
	Secondary data analysis (industry-based article)	Project overview article (main contractor + client)	Project 1	3
	Interviews	BIM manager (main contractor)	Project 2	71
	Interviews	Client's project manager	Project 2	20
	Document analysis	BEP	Projects 1 and 2	21
	Document analysis	BIM compliance report (end of RIBA stage 4) - Technical design stage 1	Project 2	20
	Document analysis	BIM compliance report (end of RIBA stage 4) - Technical design stage 2	Project 2	15
	Interviews	Digital engineer/BIM manager (main contractor)	Project 3	22
	Observations (notes)	Meeting notes/lessons learnt	Project 3	1
	Interviews	BIM manager (lead designer)	Project 4	31
	Observations (notes)	Digital handover meeting	Project 4	80
	Observations (notes)	Meeting notes	Project 4	24
	Interviews	Project team workshop (joint interview with the whole project team)	Project 4	181
	Interviews	Project manager/BIM manager (main contractor)	Project 4	17
	Interviews	Client's facility manager	Project 5	18
	Interviews	BIM manager (main contractor)	Project 5	26
	Interviews	Client's information manager	Project 5	31

Client organisation/projects	Data source	Description	Project	Number of pages (transcribed data/documents)
	Document analysis	COBie strategy	Project 5	49
	Document analysis	BEP	Project 5	35
	Document analysis	Operational Information Requirements (OIR)	Project 5	4
	Document analysis	Digital handover process template	Project 5	17
	Document analysis	BIM progress reports (construction stage)	Project 5	22
	Document analysis	Master Information Delivery Plan	Project 5	56
	Observations (notes)	Meeting notes	Project 5	2
	Document analysis	RIBA stage 4 COBie strategy review	Project 5	6
	Document analysis	RIBA Stage 3 Completion Information Management Report	Project 5	40
	Document analysis	Standards, methods and procedures	Project 5	45
	Observations (notes)	BIM workshop meeting minutes	Project 5	3
	Observations (notes)	Meeting notes (level of information - LOI)	Project 5	1
	Observations (notes)	Meeting notes	Project 5	6
	Observations (notes)	Meeting notes	Project 5	2
Organisation B (project 6)	Document analysis	Asset list	Project 6	27
	Document analysis	EIR	Project 6	35
	Document analysis	AIR	Project 6	17

Client organisation/projects	Data source	Description	Project	Number of pages (transcribed data/documents)
	Document analysis	Meeting minutes	Project 6	2
	Document analysis	Pre-contract BEP	Project 6	28
	Interviews	Project team workshop 1 (group interview 1)	Project 6	118
	Interviews	Interview with the person responsible for the digital transformation strategy	Project 6	20
	Interviews	Project team workshop 2 (group interview 2)	Project 6	172
	Interviews	Project manager	Project 6	41
	Interviews	BIM manager (main contractor)	Project 6	48
	Observations (notes)	Lessons learnt (data review) meeting	Project 6	65
	Observations (notes)	Digital handover (asset tagging) shadowing process	Project 6	3
Organisation C (projects 7 and 8)	Interviews	Client's information manager	Projects 7 and 8	24
	Interviews	Lead designer	Project 7	17
	Observations (notes)	Client's information manager presentation	Projects 7 and 8	14
	Interviews	BIM manager (main contractor)	Project 8	26
	Interviews	Client's facilities manager	Projects 7 and 8	12
	Interviews	Project manager (main contractor)	Project 7	23
	Interviews	Project manager (client side)	Project 7	19
	Document analysis	OIR	Projects 7 and 8	3

Client organisation/projects	Data source	Description	Project	Number of pages (transcribed data/documents)
	Document analysis	AIR	Projects 7 and 8	7
	Document analysis	EIR	Projects 7 and 8	21
	Document analysis	BIM options review meeting minutes	Project 7	2
	Document analysis	BIM review meeting minutes	Project 7	4
	Document analysis	BIM meeting minutes	Project 7	2
	Document analysis	BIM asset strategy register meeting	Project 7	3
	Document analysis	BEP	Project 8	9
	Document analysis	Data collection template	Projects 7 and 8	1
	Document analysis	RIBA stage 3 report	Project 7	314
			Total pages	**2351**

Data collection for organisation B took place between November 2018 and October 2019. BIM level 2 had been implemented in a range of projects since 2016 (around 100), and one in particular was initially selected for analysis by organisation B. This project is representative of organisation's B projects and it was at the construction stage at the time of data collection. As it was not one of organisation's B first BIM projects, that is, BIM implementation had occurred before for many other projects and also a wider perspective on implementation across all stages could be gained, just one project was selected for analysis. The patterns in implementation identified in project 6 were also aligned with the patterns seen in data analysis for organisation's A projects, so the analysis of just one project was enough to confirm the previously identified findings.

As shown in Table 3.3, data collection for organisation B's project involved individual interviews, first with the person responsible for the digital transformation strategy, so a wider understanding of BIM adoption could be gained, then with the individual undertaking the role of information manager and group interviews with the whole project team. The project documentation was analysed, and observations of meetings were conducted. The data was analysed and compared with previously collected data.

The data collection then proceeded for organisation C's projects. A contractor had suggested BIM implementation in one of the projects (project 7 considered for analysis), and it had been seen to be beneficial to the client organisation since then. Thus, organisation C adopted BIM level 2 for mostly technical reasons, and this organisation and its projects were selected following the theoretical sampling logic aiming to collect data on projects that implemented the policy mandate because they found it beneficial, in order to verify if the same types of response emerged. Data collection for organisation C's projects consisted of interviews with project stakeholders and analysis of project documentation, as shown in Table 3.3. The data-collection process took place between March 2019 and August 2019.

Data was collected for two projects (projects 7 and 8) – organisation C's first BIM level 2 project, and their second, which was the ongoing BIM level 2 project at the time of data collection (the construction stage). The second project was selected for analysis because project 7 was already complete at the time of data collection and because it was not a fully BIM level 2 project. Similar to the logic adopted for organisation B, as this project was at the construction stage, a wide perspective on implementation across stages could be gained. The same implementation patterns were observed, and only one more project was then selected. It was found that, despite the motivation for adoption, similar responses might occur.

As previously mentioned, the inductive approach for data collection and analysis suggested by grounded theory (Charmaz, 2009), which can also be applied to the inductive case-study designs, as in this research, posits that data gathering should stop when gathering fresh data no longer sparks new theoretical insights. Patterns in the responses adopted by the projects to the policy framework and reasons for implementation in certain ways were repeating across cases from three different contexts, meaning no more cases were necessary to confirm the findings.

Also, according to Yin (2014), when defining the number of replications in a case-study design, a researcher may consider the theory emerging from the case studies as a criterion for selecting the cases. When the emerging theory is straightforward, as in the case of this research and the observed way that projects responded (i.e. decoupling), the design might not need a large number of replications (Yin, 2014). By collecting data in project-based contexts where implementation was driven by technical, legitimacy, or both, reasons, it could be observed in the interactive process of data collection and analysis that the general responses emerging were straightforward and independent of the motivation for the pressure's adoption.

Data analysis

An analytical strategy was defined, as recommended by Yin (2014), before starting the data analysis. The analytical strategy chosen consisted of working the data from the ground up, which means closely examining the enactment of the BIM level 2 mandate without prior theoretical propositions. The research question looked at how projects interact with pressures from the environment, so the data collection and analysis consisted of looking at how implementation of the mandate unfolded regarding what constituted the mandate, as shown in Table 3.3.

Table 3.3 – Information maturity level 2 according to government mandate

Information models developed following enabling tools
Provision of a single environment to store shared asset data
Development of BEP by the supplier
Evaluation of the proposed approach, capability and capacity of each supplier
Provision of a clear definition of the EIR and key decision points
Originators producing information in models
Application of BS 1192:2007

Application of BS 7000-4:1996
Application of BS 8541-1:2012
Application of BS 8541-2:2011
Application of BS 8541-3:2012
Application of BS 8541-4:2012
Application of PAS 1192-2:2013
Application of PAS 1192-3:2014
Application of PAS 1192-5:2015
Application of PAS 91:2012
Application of BS 1192-4
CPIx protocol
CPI Uniclass
CIC BIM protocol
CIC scope of services
Government soft landings
Institutional plans of work

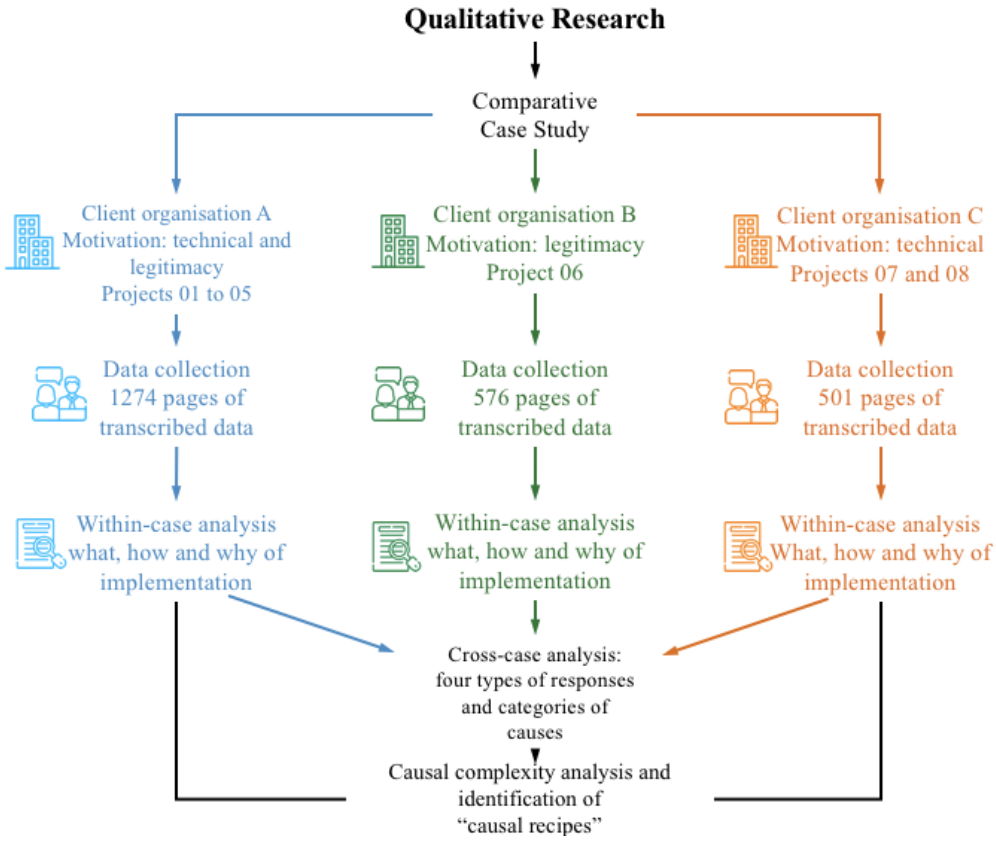
Within-case analysis and cross-case synthesis techniques were employed to understand and compare enactment. The analysis focused on implementation of two of the standards that are part of the BIM level 2 framework and which were commonly implemented across all projects – PAS 1192-2:2013 and PAS 1192-3:2014 – as shown in Table 3.3. Besides being standards adopted across the cases, and being the most relevant standards as they describe the processes for producing and managing the information models, similar enactment was observed for the processes of these two main standards within and across cases, and no new themes emerged, so the two standards were sufficient to demonstrate ways that projects may interact with institutional pressure and implement the recommended structure. In total, implementation of 144 clauses of these 2 standards and their recommended processes was analysed within and across projects.

In terms of analysis, the adopted procedures followed aspects of both Gioia et al. (2013) and Eisenhardt's (1989) methodologies for inductive theory-building, focusing on the strengths of both approaches. While Eisenhardt (1989) suggests data-collection and analysis procedures for multiple case studies, Gioia et al. (2013) propose the development of a data structure and data-themes tables, which is useful to show how high-order concepts emerge in the theory-building process.

The analysis carried out in this stage was input for the next stage of the research, which is implementation of the crisp-set qualitative comparative analysis (csQCA) technique. QCA was implemented because causal complexity was observed when coding the data for stage 1.

The choices and steps involved in its implementation are discussed further. Figure 3.5 presents the logic adopted in the data analysis moving from within-cases analysis to cross-case analysis and then to the application of csQCA.

Figure 3.5 – Data collection and analysis



The set of moves used in the data-analysis process when engaging with the data that drove theory development is outlined next for both the within-case and cross-case analyses.

Within-case and cross-case analyses

The data-analysis process started with a within-case analysis designed to understand practical implementation in each individual setting/project. The collected data was triangulated by linking the different sets of data in the processes of the analysis as a whole. The sources of evidence were first matched to the information management processes and activities that were supposed to be implemented as part of the two main aforementioned standards.

All projects implemented what was imposed by the environment, but the goal was to explore the details of implementation. The first step in the analysis was to understand 'what' was implemented by each setting/project. This consisted of looking at the data and identifying

which of the mandate requirements as a whole had been adopted/implemented, that is, the standards, documents and procedures, and also which clauses, processes and activities of those standards had been implemented. Then, the analysis focused on understanding 'how' implementation occurred. Tables on 'how' the clauses and processes/activities had been implemented were built. Descriptions of 'how' each clause/process had been enacted were created, based on the different data sources; in other words, enactment of the clauses was reconstructed. Data tables examples are provided in Chapter 4.

The 'why' of implementation was then examined. The reasons for why enactment happened in the ways it did were identified when analysing the data, and also through the different data sources. Descriptions of the reasons for implementation in certain ways were created for each clause/process of the two main standards analysed, and tables were built describing the reasons. This structure of looking at the 'what', 'how' and 'why' was followed when building the detailed case-study write-ups for each site (Chapter 4).

After the data was organised in this way, it was categorised from lower to higher levels of abstraction, following the procedures described in the literature (Gioia et al., 2013) and considering the data for multi-case studies (i.e. starting with setting A and moving to settings B and C). Descriptive codes were created and labels assigned to the data (to the descriptive tables built, as previously explained) to summarise in a phrase the topic of the data (Miles et al., 2014) related to each process being implemented. This was performed for each of the 144 clauses/processes. Gioia et al. (2013) emphasise the creation of codes based on informants' words, as in their proposed methodology interviews are the main source of data. In this research the codes were created based on different pieces of data and combined data, and they refer to enactment of the processes/activities that should be implemented according to the mandate. This process is referred to as open coding (Strauss and Corbin, 1990; Flick, 2014), the aim of which is to describe and classify the phenomenon under study.

The same was performed for the data related to the reasons; the variables found as reasons were categorised according to their similarity in terms of referring to the same construct. Chapter 4 describes these variables, and the first-order categories are presented in Chapter 5.

This analytical procedure led to the observation that enactment followed some patterns that were independent of the process and activity being enacted, and that there were some reasons for this. Four first-order categories or types of response to the BIM level 2 policy for organisation's A projects were created: i) non-implementation, ii) violation, iii) assimilation and iv) accommodation. Each type of response was named using content-characteristic words (Elo and Kyngas, 2007) and considering the previous literature, as previously mentioned. For

these reasons, the descriptions of the causes of enactment in certain ways for the first five analysed projects (organisation's A projects) were identified as related to the following variables: strategic orientation, scripts from bodies of knowledge, repetition of role expectation, repetition of models of reality, early stages of adoption, existing authority systems, existing governance systems, repetition of existing procedures and reward and cost structures. These labels for the variables were given considering content-characteristic words, and also considering concepts in the literature. These reasons came from both the organisational and industry contexts. These variables were then categorised as normative rules, cognitive rules, regulative rules, strategic orientation and capacity, which are the first-order categories. These first-order categories were also labelled according to the existing literature.

The data collection and analysis proceeded with the analysis of the other projects where implementation was motivated by different reasons. It was observed that the identified categories of response were repeating across the cases; no new variances in response emerged. The same procedure was performed regarding the underlying first-order categories of reasons for the following projects and then compared with the previous ones. There were variables forming the first-order categories that were repeating, and others that emerged in the following cases (two emerged for project 6), but the emerging ones were still related to the defined first-other categories. As new categories did not emerge for projects 7 and 8, it was concluded that saturation in the possible categories for responses had also been reached.

After this saturation across the cases had been observed, the first-order categories were clustered into second-order themes, in the theoretical realm. It was identified that some types of response were related to policy–practice decoupling, and two variances could be observed. These higher-order themes were created based on the organisational theory literature. The same was performed for the first-order categories of reasons; they were clustered as related to two main second-order themes: ability and willingness, following organisational theory literature and conceptualisation of constructs described in this literature (Oliver, 1991). The data structure that emerged from these 'moves' is presented in Chapter 5. Then, the second-order themes were collapsed into aggregate dimensions of 'project' responses to institutional pressures and predictors of decoupling, which form the conceptual framework answering the posited research questions. Figure 3.6 summarises the analytical process.

When comparing the differences in response adopted by each project to the implementation of each clause/process, and the reasons leading to these responses, it was observed that the causal relationships between the found causes and the identified phenomenon (i.e. the relationships in the theoretical realm or second-order themes) presented characteristics

of complex causality: the outcomes (responses) actually resulted from the interdependence of multiple causes or conditions, the same causes or conditions were leading to different types of response, and it seemed that equifinality could also occur, meaning that more than one pathway could lead to the observed outcomes. Thus, it was identified that further analysis was necessary to explore causality and the complex aspects in the relationships. This apparent existing complex causality was further investigated through the application of QCA, as explained next.

3.4.2.3 Stage 3: qualitative comparative analysis (QCA)

Overview

As identified in the within- and cross-case analysis, that project responses to institutional pressures presented characteristics of complex causality, a QCA technique was applied to assess the combination of factors related to each type of outcome. QCA is a comparative case-oriented research technique based on Boolean algebra. It is grounded in set theory and ideally suited to studying explicit connection (Ragin, 2008). QCA is particularly useful because of its capacity for analysing complex causation, a situation in which the same outcome may follow from different combinations of causal conditions (Ragin, 2008), as was apparently identified in the findings.

While general linear regression models can, to some extent, capture conjunctural causation through interaction effects, interpreting interactions of more than two variables is challenging (Misangyi et al., 2017). QCA views conjunctural causation as that observed through 'causal recipes', in which attributes combine to produce an outcome and an outcome may follow from different causal recipes. Also, QCA allows asymmetry to be captured and identifies if the presence and absence of any attribute produce the same outcome depending on its combination with other attributes (Misangyi et al., 2017).

From the within-case and cross-case analysis, the following research questions are investigated through the application of QCA: *Which combinations of underlying conditions are found among cases that demonstrate decoupling from the 'what' and decoupling from the 'how'?* Guided by this research question, the application of QCA followed some steps, as shown in Figure 3.7 and described next.

Figure 3.6 – Stepwise approach for within-case and cross-case analysis

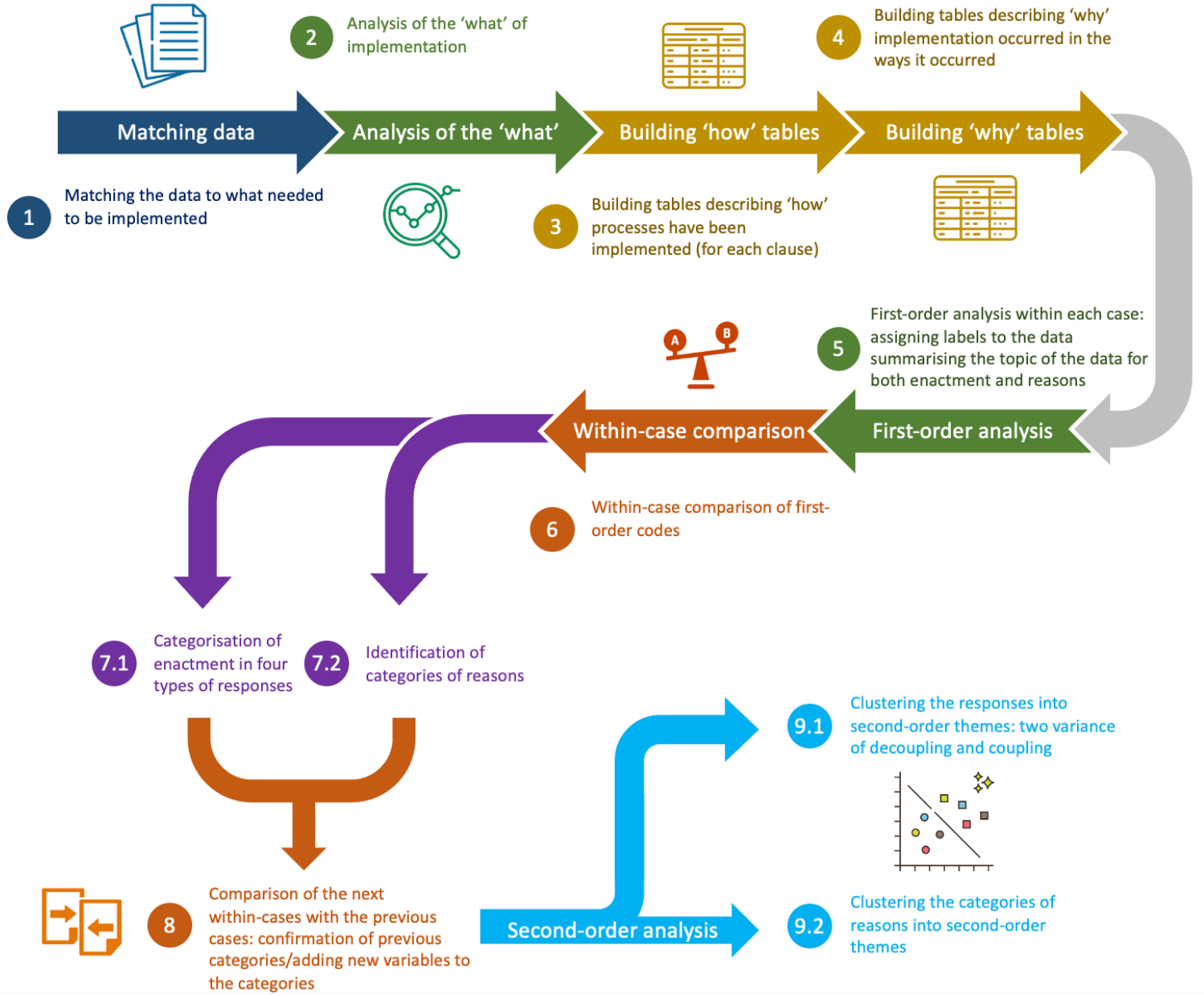
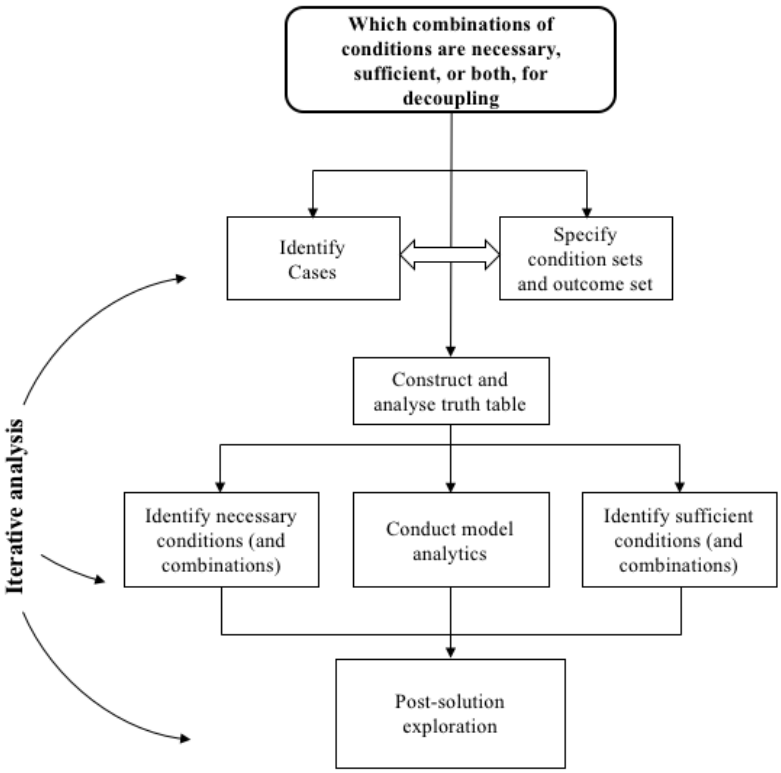


Figure 3.7 – Stepwise approach for QCA application



Steps in conducting the QCA

The analytical process starts with specification of the configurational model, which involves identification of the cases, conditions and outcome sets. Chapter 5 provides details of how the cases were identified and selected; the purpose of applying the QCA was to understand how each project implemented each clause/respective processes of the standards considered in the analysis, so the unit of analysis for the QCA is each clause/process implemented by each project. A 'most similar' system design was adopted for the QCA, meaning that the design is based on the belief that differences will be found among similar systems (Berg-Schlosser and De Meur, 2012). The number of cases selected followed what is recommended in the literature, that there is no upper limit to the number of cases to be included in the analysis, if the cases are relevant to the research question (Kahwati and Kane, 2019). Chapter 5 documents how a raw data table of possible cases was created and the cases that could be part of the analysis were selected.

The outcomes of the configurational model represent the responses identified in the previous stage (i.e. decoupling), and the conditions are the causes for the identified responses (i.e. the categories of causes). The number of identified conditions matches recommendations to keep the number of conditions low (Berg-Schlosser and De Meur, 2012). The limited number

of causes helps to explain the phenomenon better, as it comes closer to the core elements of causal mechanisms (Berg-Schlosser and De Meur, 2012).

Among the QCA techniques, a crisp-set technique (csQCA) (Rihoux and De Meur, 2012) was chosen. The essence of this technique is understanding how configurations of explanatory conditions are linked to a specific outcome; instead of analysing the relationships between two variables, csQCA compares cases by comparing configurations of explanatory conditions with the presence or absence of an outcome (Marx, 2010). With crisp-set calibration, cases can only take on full set membership (SMV = 1) or full set non-membership (SMV = 0). This technique is best for when conditions and outcomes are explicitly dichotomous.

The next stage consisted of constructing and analysing the truth tables, but before that another step was necessary. The first step in this process consisted of creating a matrix of set membership values for the selected cases to be included in the analysis. The matrix consisted of setting the membership values for the selected cases as [0] when decoupling does not occur, and [1] when decoupling from the 'what' or the 'how'. Two matrices of membership values were created, one for decoupling from the 'what' and one for decoupling from the 'how'. For the conditions, the membership values of [1] or [0] were also assigned to each case; the [1] value was attributed when the condition was present, and the [0] value was attributed if there was absence of the condition.

Next, the matrices of set membership values could be transformed into truth tables. Truth tables display all the possible combinations of condition (i.e. configurations), show the cases that belong to each of the possible configurations and identify the set relationships between each configuration and the outcomes (Kahwati and Kane, 2019). Chapter 5 describes the steps in constructing the truth tables and the results obtained, so the reader can understand in detail what it entails, the analysis carried out in each stage, the steps followed and the results obtained. This is not described here to avoid duplication. The analysis was conducted using the QCA R package (Dusa, 2019), as the use of software is recommended in the literature to avoid errors of calculating solutions manually (Kahwati and Kane, 2019).

Transforming the data matrices into truth tables involved three main steps: i) creating a truth-table shell; ii) assigning cases from the data matrices to truth-table rows; and iii) assigning an outcome value to each row (Kahwati and Kane, 2019). Again, details of each step and the results are described in Chapter 5. Afterwards, the truth tables should be assessed before conducting the analysis, and the data needs to be assessed for necessary conditions, followed by analysis of sufficient conditions. In the analysis of sufficient conditions, analyses of the truth tables are carried out to identify sufficient conditions and combinations of condition,

which also entails examining different solution types: i) parsimonious, ii) conservative, and iii) intermediate (Kahwati and Kane, 2019). The solutions are then explored within the context under analysis in order to report its meaning. As shown in Figure 3.7, this process is iterative.

The process followed, and the results of each of the previously described stages and steps are reported in Chapter 5 with the use of set (Boolean) operators and symbolic notation used in QCA, as shown in Table 3.4.

Table 3.4 – Boolean operators and symbolic notation used in QCA

Logical operator	Synonyms	Symbol	Description	Equation
NOT	**Complement;** Boolean negation	~	Negation of the original value	~X = 1 - X
AND	**Conjunction;** Boolean multiplication	•	Set intersection – calculated as the minimum value of two (or more) sets	X • Y = min (X, Y)
OR	**Disjunction**; Boolean addition	+	Set union – calculated as the maximum value of two (or more) sets	X + Y = max (X, Y)

The procedures adopted to ensure the quality of this research design are described next.

3.5 Quality of the research design

Underpinning the discussion of the research design is the issue of the quality of the findings. According to Yin (2014), there are two main criteria and four sub-criteria for judging the quality of case-based research design: validity and reliability.

3.5.1 Validity

According to Easterby-Smith et al. (2018), the criteria to assess the validity of a qualitative research design involve the consideration of multiple perspectives and access to the experiences of those involved in the setting. This research design matches the suggested criteria by considering the viewpoints of multiple project members in the interviews and by collecting data through observations, that is, by having direct access to the real experiences of those involved.

Regarding construct validity (which refers to the quality of the conceptualisation or operationalisation of concepts), a chain of evidence is provided in Chapters 4 and 5 describing

how the research proceeded from the within-case analysis to the conceptualisations shown in a data structure presented in Chapter 5. The constructs were conceptualised in light of the relevant literature. Multiple data sources and triangulation also facilitated the adoption of different angles. This process has already been explained in this chapter.

Saunders et al. (2012) and Yin (2014) also differentiate between internal and external validity. Internal validity is established when the research demonstrates a causal relationship between two variables, and it is applied to case studies where the goal is to explain how and why event x led to event y (Yin, 2014). This research is exploratory in the sense that it aimed to explore and understand practical implementation of the BIM level 2 policy approach, but it involved a stage that aimed to analyse the relationship between the causes and outcomes. By adopting a most-similar research design in the csQCA, the internal validity of the observed relationships is enhanced (Berg-Schlosser and De Meur, 2012). By matching the cases as much as possible, the variables can be better controlled and the different outcomes attributed to the factors that differentiate the cases, improving the inference of the causal relationships.

External validity is concerned with how findings can be generalised to other settings. Although there is criticism around generalising from case studies compared to large-sample quantitative methods, scholars recognise that a case-based approach has merits over quantitative methods in terms of theoretical generalisation (Tsang, 2014). Gomm et al. (2011) posit that there are two ways of drawing general conclusions from a smaller set of cases to a broader set, which they refer to as theoretical inference and empirical generalisation. Empirical generalisation is concerned with whether specific characteristics are typical of the population from which the case or sample was drawn, or typical of another population (Tsang, 2014). Gomm et al. (2011) suggest that one way to improve the quality of the empirical generalisation is to consider relevant respects in which the target population might be heterogeneous, essentially whether the studied cases are typical or atypical in relevant respects. By investigating the implementation of BIM level 2 in both public- and private-sector clients, and by selecting school and university building projects, which are typical projects where the policy is implemented, the sample is representative of the population for which generalisation is intended. The systematic selection of the organisations and projects, considering the motivation for adoption, is another aspect that improves generalisability. In theoretical generalisation the research develops explanations of the relationships between the observed variables (Tsang, 2014). Theoretical generalisation concerns theory-building, as seen in this research. The multiple-case research design and case-selection approach provide the basis for theoretical generalisation, as the findings are observed within and among multiple projects.

Also, the case-study reports produced after data collection explaining aspects related to enactment were sent to the project teams for feedback and validation of how implementation was reconstructed – that is, a procedure to increase validity, as suggested by Yin (2014) and Ozcan et al. (2017). Follow-up checks were also conducted with individuals in the roles of information manager or strategy implementation for client organisations A and C, and the contractor's information manager for organisation B, to confirm that the findings and conclusions were accurate and inductively derived from the data (Ozcan et al. 2017).

3.5.2 Reliability

Reliability concerns whether the data-collection techniques and analytical procedures would produce consistent findings if the same procedures were replicated by another researcher (Saunders et al., 2012). Transparency and replication are critical for claims of reliability. Transparency is demonstrated by documentation and references to the data collected for each organisation and respective projects and the documentation of the research procedures in this chapter. Replication is also addressed by describing the research strategy, as well as its stages and steps in detail, and by having the data set and sources used in the analysis. Riege (2003) identified a range of techniques that may also be used to increase reliability. Assuring congruence between the research issues and features of the research design is one of the suggested techniques, which has been explained in this chapter. Riege (2003) also suggests recording observations and actions and recording data mechanically. As previously mentioned, and as demonstrated in Chapter 4 when presenting the narratives, all data in the form of interviews was recorded and transcribed.

3.5.3 Quality of the QCA analysis

Some important aspects should be considered when carrying out QCA analyses in order to render it technically correct and meaningful (Schneider and Wagemman, 2010). The design adopted followed the good practices for configurational comparative methods, as described in the literature (e.g. Schneider and Wagemman, 2010).

First, the criteria concerning the purpose of QCA were followed. QCA was not applied as the only data-analysis technique, with the case-study method being used in a complementary way. Familiarity with the cases was gained before QCA application. The configurational method was also not applied in a purely mechanical way; despite software being used, each step and the results are described and related to the cases in Chapter 5. Regarding the results

presented in Chapter 5, the solution of the analysis of necessary and sufficient conditions was reported in formal and correct notation; appropriate terminology was followed.

Regarding the selection of cases, conditions and other criteria, Chapter 5 reports the justification for the selection of cases and conceptualisation of the conditions and outcomes following empirical prior knowledge gained in the previous stage of the research design. Contradictory truth-table rows are resolved before the minimisation of the truth tables, and the process is explained in detail. The treatment of contradictory rows in the logical minimisation process is transparent, and the solution formulas for the parsimonious and complex solutions are also reported. In the interpretation of the analytical results, care was taken not to overinterpret single conditions of the equifinal solution. Each path was analysed according to its empirical and theoretical relevance. The coefficients of consistency and coverage are considered when discussing the analysis.

Finally, the quality of research was ensured by promoting methodological fit and demonstrating consistency among elements of the research project from its early stages, as discussed next.

3.5.4 Methodological fit

According to Edmondson and Mcmanus (2007), in well-integrated field research the elements of a research project are congruent and mutually reinforcing. As previously mentioned, the motivation for this research was a lack of understanding of how projects respond to institutional pressure, which has attracted little theorising to date, characterising literature on the topic as 'nascent' (Edmondson and Mcmanus, 2007). As little is known, rich and detailed data was needed to shed light on the phenomenon. The use of multiple sources of evidence created a clearer picture of how BIM level 2 implementation unfolds in practice. A good practice to explore phenomena like the one addressed here is to become embedded in the context, as was done in the early stages of this research (Edmondson and Mcmanus, 2007). An inductive approach was adopted to connect the data to existing and suggestive theory – a categorisation of responses employed to external pressures and underlying conditions for such responses. Thus, methodological fit was ensured by connecting prior work (nascent theory) with the most suitable methodological approach (qualitative/inductive research design) and the respective techniques for data collection and analysis, enhancing the quality of the research design. Table 3.5 summarises the elements of the research design that ensure methodological fit.

Table 3.5 – Methodological fit, adapted from Edmondson and Mcmanus (2007)

Elements of the research design	State of prior theory and research: nascent	This research
Research questions	Open-ended inquiry about a phenomenon of interest	How- and why-type questions aimed at understanding the phenomenon in context
Type of data collected	Qualitative, initially open-ended data that needs to be interpreted for meaning	Qualitative data and inductive research design
Illustrative methods for collecting data	Interviews; observations; obtaining documents or other material from field sites relevant to the phenomena of interest	Use of multiple sources of evidence, including observations of practical enactment, interviews, document analysis and secondary data analysis
Constructs and measures	Typically, new constructs, few formal measures	New constructs on decoupling in projects, emerging from the data
Goal of data analyses	Pattern identification	Identification of patterns among the cases and categorisation
Data-analysis methods	Content analysis/coding for evidence of constructs	Content analysis of the data, leading to categories of responses employed and the causes of such responses
Theoretical contribution	A suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study	Identification of two variances of a decoupling phenomenon and its underlying causes, characterising decoupling in projects as complex

3.6 Summary and final remarks of the chapter

This chapter laid out the methodological foundations of this research. Table 3.6 summarises the most important characteristics of the research design. The following two chapters present the results of the second and third stages of this research. Simultaneously, the subsequent chapters explain the analytical process from which the main findings emerged.

Table 3.6 – Summary of the research design

Research stages	First stage	Second stage	Third stage
Research philosophy	**Interpretivism**		
Research questions	What do we know about built environment policy implementation, project interaction with the environment, BIM implementation and organisational responses to external pressures?	How do projects respond to institutional pressures? How are projects responding to the BIM level 2 mandate?	Why do projects respond in the identified ways? What are the causes of such responses?
Research approach	**Abductive**	**Inductive**	**Abductive**
Research strategy	Critical literature reviews	Case-study design	QCA
Data collection	Search on Scopus and relevant outlets	Interviews, document analysis, secondary data analysis, observations	'Most similar' system design, selection of variables based on the previous research stage, development of a truth table with data from the second stage and minimisation process
Data analysis	Content analysis of publications	Content analysis of the data through coding and within-case and cross-case comparisons	Application of Boolean minimisation procedure using the QCA R package
Outcomes	Description of what is known/gaps in terms of built environment policy implementation, BIM implementation and how/why organisations and projects respond to institutional pressures	Categorisation of responses employed by projects to the BIM mandate; identification of causes	Categories of a combination of reasons that have led to two variances of decoupling or causal 'recipes'

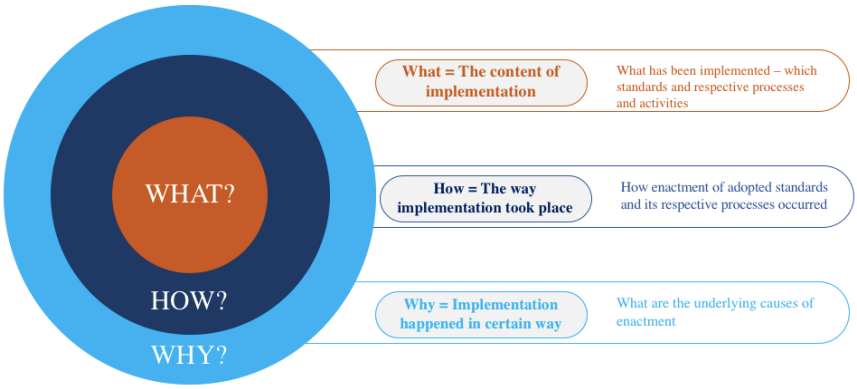
Chapter 4 – Within-case analysis: BIM level 2 implementation in practice

4.1 Chapter introduction

This chapter describes the enactment of BIM level 2 in the analysed projects. As noted by Eisenhardt (1989), building stories of the cases enables familiarity with the cases, leading to identification of patterns. Thus, within-case analysis was the first step in identifying patterns of how projects may respond to institutional pressures.

The chapter outlines implementation of the principles for level 2 information modelling and the processes and procedures recommended in the documents and standards that were part of the information modelling maturity level 2 (see Chapter 3), with a focus on the two main standards of the framework that were commonly applied across the projects and which are processual standards (PAS 1192-2:2013 and PAS 1192-3:2014). Particular attention is paid to the content of implementation (the 'what' of implementation) and the actions undertaken to implement the processes and procedures (the 'how' of implementation). These aspects are considered the research aims to understand the interaction between projects and the environment and 'what' and 'how' it has been implemented. The underlying causes of how implementation took place were also identified for each setting, with the aim of understanding why interaction occurred as it did. Figure 4.1 shows how the case-study stories are presented in the following sections, laying the foundation for a conceptual framework explaining how projects might respond to institutional pressures, which are presented in Chapter 5. Data tables are presented for each setting, illustrating the systematic grounding of the cases.

Figure 4.1 – Structure of the case stories presented in this chapter



4.2 Client organisation A: BIM implementation in projects 1 to 5

4.2.1 Overview

Organisation A is a private-sector organisation with a vast estate – its buildings are used for teaching, research and administrative activities and comprise 600,000 m^2 across 350 operational facilities. The complex nature of organisation A's estate presents many challenges; for example, some buildings are quite old and protected by English heritage. To enhance decision-making and ensure better outcomes, organisation A decided to digitise its estate. In creating a fully digital estate, adoption of BIM level 2 was considered an essential component to align with the government's national strategy.

Organisation A began its transformational journey in 2011 following the announcement of the government's new strategy for the construction industry. At that time, organisation A had already adopted some of the British Standards (i.e. BS 1192) for the production of 2D information (BIM level 1, according to a previously adopted BIM classification). In May 2013 implementation of the BIM level 2 mandate was recommended by organisation A's building committee; in other words, implementation was driven by the client in consideration of the value it could provide. However, as a national reference of excellence, organisation A also aimed to align with the government's strategy. A commitment was made to work towards BIM level 2 within the capital delivery programme and to align with the government's strategy to deliver all projects at BIM level 2 by 2016. In July 2016 a consultancy firm was commissioned to build on previous work and establish the BIM documentation. A set of BIM documents was developed (e.g. EIR, AIR), as well as a BIM maturity assessment framework to be embedded as part of the tendering process. Other supporting documentation included a BIM handbook for project managers, in addition to internal standards, including space data guidelines, CAD standards and a CDE guide. Organisation A's first five BIM level 2 projects were selected for analysis, as explained in Chapter 3. These projects were at different stages of their life cycles at the time of data collection, as shown in Table 4.1.

Table 4.1 – Organisation A's projects

Project	Description	RIBA stages at the moment of data collection
Project 1	18,000 m^2 six-storey building containing state-of-the-art laboratories	RIBA 6 (handover)
Project 2	2,600 m^2 facility for the study of neurodegenerative disorders	RIBA 6 (handover)
Project 3	Biological support facility for the schools of clinical medicine and biological sciences	RIBA 6 (handover)
Project 4	Three-storey building comprising laboratory and workshop spaces for the department of engineering	RIBA 5 (construction)
Project 5	37,160 m^2 building comprising a range of laboratories, offices, clean rooms and workshops, as well as multiple lecture theatres	RIBA 4 (design)

4.2.2 The 'what' or the content of BIM level 2 implementation

As mentioned in Chapter 3, the BIM level 2 mandate comprises a range of principles, including the use of tools to develop the information models and a range of documents and standards recommending new processes/activities. Organisation A's projects adopted/implemented the majority of the documents and standards as part of the mandate, as shown in Table 4.2.

Table 4.2 – Principles, standards and documents implemented in organisation A's projects

Information modelling maturity level 2	Implementation	Data underlying the findings	Representative quotes/events/documents
Information models developed following enabling tools	X	Observations of design review meetings where the models were presented, the use of tools reported in interviews and EIR, access to the models in the CDE	*So, the drawing of it, we're using BIMcollab as our tool to address clashes and issues in the state of the model. Viewpoint itself has its own model viewer built in, and you can extract COBie data from there. We're also using Navisworks for clash detection. Then we've also used plugins for Tekla Structures to link with the Revit model. Asta Powerproject, which are scheduling software.* (project 4)

Information modelling maturity level 2	Implementation	Data underlying the findings	Representative quotes/events/documents
Provision of a single environment to store shared asset data	X	Access to the CDE where information has been exchanged, reporting of use of a CDE in the interviews	*We interviewed three CDE providers: Asite, Viewpoint and BIMExtra. Evaluated the relative merits of those, plus the cost, and went with Viewpoint. That was from the outset, that kind of got us working in a structured manner right the way through, and that is what we're still using today.* (project 4)
Development of BEP by the supplier	X	Access to BEP produced by the suppliers	Access to BEPs
Evaluation of the proposed approach, capability and capacity of each supplier	X	Access to client's capability assessment approach; reporting of assessment of suppliers' capabilities in the interviews	*We asked them to demonstrate what they'd done with BIM on other projects, talk about how they're going to implement BIM, and on all those things.* (project 5)
Provision of a clear definition of the EIR and key decision points	X	Access to EIRs	EIRs for all projects
Originators producing information in models	X	Reporting on interviews on the use of tools and production of information in models	*For example, in terms of construction planning, just looking at what you've got here, construction planning, as I've said, we have done a broad sequencing of the project in 4D using Synchro.* (project 5)
Application of BS 1192:2007	X	Reported in EIR	Clause 3 of EIR
Application of BS 7000-4:1996	X	Reported in EIR	Clause 3 of EIR
Application of BS 8541-1:2012	X	Reported in EIR	Clause 3 of EIR
Application of BS 8541-2:2011	X	Reported in EIR	Clause 3 of EIR

Information modelling maturity level 2	Implementation	Data underlying the findings	Representative quotes/events/documents
Application of BS 8541-3:2012	X	Reported in EIR	Clause 3 of EIR
Application of BS 8541-4:2012	X	Reported in EIR	Clause 3 of EIR
Application of PAS 1192-3:2013	X	Reported in EIR	Clause 3 of EIR
Application of PAS 1192-3:2014	X	Reported in EIR	Clause 3 of EIR
Application of BS 1192-4	X	Reported in EIR	Clause 3 of EIR
CPIx protocol			
CPI Uniclass	X	Reported in EIR and observed in COBie	Clause 3 of EIR
CIC BIM protocol	X	Reported in EIR	Clause 3 of EIR
CIC scope of services	X	Reported in EIR	Appendix B of EIR
Government soft landings			
Institutional plans of work	X	Reported in EIR	Clause 3 of EIR

A range of tools have been used in all of organisation A's projects, specifically to fulfil its requirements in terms of the BIM uses stated in the EIR, such as enabling tools for sustainability evaluation, structural analysis, and so on. All projects had a CDE in place; however, the EIRs stated that the provision, management and training of the CDE falls under the client's responsibility, but it was observed that, in practice, the lead contractors set up the CDE and were responsible for its management, giving the client access to it. As one project manager noted (project 4):

> *The EIR says that the client should manage the CDE. We were kicking off the project, and there wasn't a client CDE in place at the time; A site wasn't there, [it] wasn't ready I don't think. So, we went and got our own to kick off the design process.*

For all projects, lead appointed parties submitted a BEP, and their capability and capacity were assessed. Organisation A, however, developed its own capability and capacity assessment approach using neither the CPIx protocol and its proposed templates for BIM capability, IT and resource assessment, nor the PAS 91:2012. Government soft landings is another document that, despite its mention in the EIR, was not implemented in practice.

Despite the majority of standards and documents being adopted, analysis of the project documentation and practical enactment revealed that not all of these standards and documents were fully implemented. It was observed that there were clauses/processes prescribed that were not implemented. Examples include, for some projects (projects 1 to 3), the EIR not having been incorporated into the tender documentation to enable suppliers to produce their BEP, as prescribed by clause 5.1.4 of PAS 1192-2:2013 and noted by a BIM manager (project 2):

> *What we received to tender on and for us to review was a pre-contract BEP. There were references to COBie and the workflows, but we didn't actually receive an EIR document.*

Project 3 also reported not having all the documentation in place from the start of the project, as noted by a digital engineer/BIM manager:

> *There could be a lot of room for improvement. So, I think that, certainly, getting the documentation to us of what you require or what the estates required would've been much better if it had been done straight away at the beginning.*

Furthermore, it could be observed that, because implementation was not focused on the whole-asset life cycle, there were processes and activities related to the handover of information models and their use/maintenance that were not implemented. These processes included, for instance, documentation of a formal handover process in the EIR (clause 10.2.1) of PAS 1192-2:2013. The requirements for asset information management processes, including the definition of roles and responsibilities, specification of processes, procedures and activities for information management, consideration of the risks related to information management, and aspects of information exchange with stakeholders (i.e. other users of information), as specified in the PAS 1192-3:2014, were not put in place either. Actually, organisation A did not define its organisational information requirements formally, which should serve as input to generate the AIR and represents a critical element in the information management process. Also, organisation A did not establish an information management process covering the operational life cycle of the asset operating within its organisational systems and functions.

The asset information has not been managed as an organisational resource, and, for this reason, there have been no information governance processes in place. Also, there have been no mechanisms for the creation, receipt, validation, verification, storage, sharing, archiving and

reporting of the information held in the asset information model (AIM). The PAS 1192-3:2014 recommends defining the mechanisms and processes for maintaining the AIM, but these were not defined for organisation A's projects. It could be observed, therefore, that although the standards were adopted, they were rarely implemented in full. Table 4.3 shows examples of clauses and respective processes/activities that were found not being implemented for projects 1 to 5 (for PAS 1192-2:2013 and 1192-3:2014), illustrating how enactment was reconstructed based on different sources of data.

Table 4.3 – Examples of clauses/processes non-implemented in organisation A's projects (for the two main processual standards analysed)

Clause	**Enactment**	**Representative quotes/events/documents underlying enactment**
5.1.4	The EIR was not incorporated into the tender documentation.	*What we received to tender on and for us to review was a pre-contract BIM execution plan. There were references to COBie and to the workflows, but we didn't actually receive an EIR document. (project 2)*
10.2	A formal handover process was not defined in the EIR.	EIR and interviews: *They didn't specify it. I think it could definitely be improved. I think the handover process, from both sides, maybe, only got decided when it actually needed to be done. So, there are still some elements where people aren't quite sure what they should or shouldn't be receiving.* (project 3)
4.1	The client organisation has not established, documented, implemented and maintained an information management process.	There is no reference in any documentation; the client organisation has not established a formal OIR.
4.2	There is no information management process in place.	Same as above
4.3 item a	No governance processes were established.	There is no reference in any documentation.
4.3 item b	There is no OIR guiding the process, although a document started to be drafted.	OIR draft
4.3 item f	No mechanisms for maintaining the AIM and monitoring the quality of data and information within the AIM were defined.	There is no reference in any documentation.

Clause	Enactment	Representative quotes/events/documents underlying enactment
4.4	The client organisation has not determined and catalogued a formal OIR.	OIR draft, EIR, AIR
4.5.3	As there is no formal OIR, it was not conveyed to external contractors or in-house work teams through a task- or project-specific AIR.	OIR draft, AIR. Interview: *We received a very generic, not project-specific EIR, which puts us in the unknown. We questioned why it was as it was, because it didn't seem to be representative of what we were doing.* (project 2)

The data collection also focused on analysing 'how' implementation took place, as outlined in the following section.

4.2.3 The 'how' of BIM level 2 implementation

An analysis of practical enactment revealed two main characteristics of the 'how' of implementation. First, it was observed that, despite implementation, some of the processes/activities were not extensively implemented. In other words, the 'how' of implementation did not occur to the extent prescribed by the standards. The clauses usually cover many aspects, and it was observed that implementation did not follow all that was prescribed by many of these clauses.

Examples included one of the first clauses of PAS 1192-2:2013, which recommends defining the information exchange and collaborative working requirements that shall be undertaken in parallel with other procurement and project definition activities. For projects 1 to 4, the definition of information exchange was not undertaken in parallel with other project definition activities, and the projects did not have those definitions established from the beginning, as highlighted by a project member (project 3):

> *When the project started, there was a lack of clear information. I think only after a year or a year-and-a-half did we receive a project-specific EIR. I get the impression that that was because it was being developed as they were going along.*

Clause 5.1.2 of PAS 1192-2:2013 was also not completely followed regarding the recommendation for the requirements in the EIR to only provide sufficient information to answer the plain language questions (PLQ) required at a particular stage, with the EIR asking for information about everything, as noted by a project member (project 3):

> *They tended to ask for nearly all of the information, and then people might come in later and say: 'Actually, I don't want to know about everything'.*

The requirements set out by client organisation A, therefore, were not specific and realistic, as prescribed by clause 5.1.3 of PAS 1192-2:2013. As pointed out by a BIM manager (project 4):

Realistically, we can't do all the stuff that's being asked of us here.

Moreover, it was noticeable that the EIRs were not issued as part of the employer's requirements or tender documentation, as required by clause 5.2.1 of PAS 1192-2:2013, and there were modifications of the EIR issued across the projects' stages.

The PAS 1192-3:2014 also establishes that the AIR should define the structure, process and content of the information to be exchanged, and the AIR did not contain specifications for the information-exchange processes and content. The standard specifies that the information should be of a quality appropriate for the asset management decisions and activities it supports, as well as the asset's operation, maintenance and management; however, the asset information requirements were not defined in terms of the asset management decisions and activities it supports. The AIR was limited in the identification of assets that should be considered, as highlighted by a BIM coordinator (project 2):

> *What we received was: this is the project requirements, and then there's a small list at the end of the document, which is the asset list. That isn't an obvious way of checking what's there. Then, yes, the assets weren't listed, wasn't reflecting the actual expectations by the estates team. There weren't any set of specific requirements. What was highlighted was very limited, so that's why we did go back saying: Are you sure you just want the boiler or the air-handling units? We can give you a bit more than that if that's what you wanted. It was very M&E focused, but with quite a narrow approach for what items were required for COBie.*

Analysis of the project documentation also revealed that the submitted BEPs did not contain all the requirements stated in a specific clause, such as a summary of the supply chain's capabilities. It was also observed that, for some projects (for example, project 4), the contractors/subcontractors were appointed independent of their capabilities; in other words, although there was a capability assessment approach in place, it was not strictly applied in practice.

During the production stage of the information delivery cycle, the project information model should be developed in accordance with the master information delivery plan (MIDP), according to clause 9.1.2 of PAS 1192-2:2013. However, as noted by a digital engineer of project 3, the project information model was not developed in full compliance with the MIDP and model production and delivery table (MPDT):

I think that, sometimes, they didn't fully, say, asset-tag something, so it wasn't immediately obvious what it was. You could say it's an level of detail (LOD) issue. It wasn't so bad. It was present, though, and sometimes caused some issues when someone thought an object that looked quite generic was something that it wasn't.

Also, information exchange, which is supposed to take place through the CDE, still took place by email on some occasions, as highlighted by a BIM coordinator (project 2):

It's been difficult to get them out of the habit of just sharing drawings by email before uploading onto a system.

Table 4.4 provides examples of clauses/processes that were not fully implemented.

Table 4.4 – Examples of clauses/processes not fully implemented in organisation A's projects

Clauses	**Enactment**	**Representative quotes/events/documents underlying enactment**
5.1.3	The information requirements were not specific, realistic and achievable.	*Realistically, we can't do all the stuff that's being asked of us here.* (project 4)
5.2.1	The EIRs were not issued as part of the employer's requirements or tender documentation.	*When the project started, there was a lack of clear information. I think only after a year or a year-and-a-half did we receive a project-specific EIR. I get the impression that that was because it was being developed as they were going along.* (project 3)
6.1.2	The BEPs did not have enough specification for the employer to identify if the supply chain had the capabilities to deliver what was asked in the EIR.	Contractor's BEP
6.1.5	There is no information about the supplier's information cascade process.	Contractor's BEP, EIR
6.2	The contents of the BEP could not cover everything in the EIR because an EIR was not provided.	Contractor's BEP, interview: *What we received to tender on and for us to review was a pre-contract BIM execution plan. There were references to COBie and the workflows, but we didn't actually receive an EIR document.* (project 2)
6.3.2	The PIP includes the supply chain capability summary form, but it does not include everything in 6.4 to 6.7.	Contractor's BEP, BEP template

Clauses	Enactment	Representative quotes/events/documents underlying enactment
6.4.2	The supplier assessment form did not cover explicit questions about the quality of the data exchanged and BIM analysis.	Supplier BIM maturity assessment form
6.7	Supply chain capability summary form not analysed by all organisations within the delivery team as part of the sub-contract procurement process.	Supplier BIM maturity assessment form
7.2.1	BEPs lacking specific required content such as revised PIP confirming the capability of the supply chain.	Contractor's BEP, supplier BIM maturity assessment form
7.5.1.1	Some roles were not explicitly defined.	*Facilities managers were coming to us for what they want, rather than through their own team, which sometimes blurs the lines about who should be doing what, and when.* (project 3)
8.2	Not all selected software was tested.	EIR, and interview: *As you got your building modelled as it is, you can't just press a button and put it into your thermal modelling software because the software won't understand any clashes.* (project 5)
9.1.2	The project information model (PIM) was not strictly developed in accordance with the MIDP/MPDT.	*I think that, sometimes, they didn't fully, say, asset-tag something, so it wasn't immediately obvious what it was. You could say it's an LOD issue. It wasn't so bad. It was present, though, and sometimes caused some issues when someone thought an object that looked quite generic was something that it wasn't.* (project 3)
9.1.5	The process of delivery management was not strictly followed, with information exchanges still occurring via email.	*It's been difficult to get the team out of the habit of just sharing drawings by email before uploading onto a system. (project 2)*
4.3 item d	Mechanisms for analysing and reporting on the information and data held in the AIM were not defined.	AIR
7.1.2	The information identified by the organisation was not defined by considering the asset management decisions and appropriate to the operation and management of the asset.	AIR and interview: *Then, the asset list wasn't reflecting the actual expectations by the estates team.* (project 2)

Moreover, although some clauses and respective processes were fully implemented, on some occasions they were implemented in a way that, despite complying with what the standard says or 'the letter', they did not comply with the intended goals or the 'meaning'. Examples included the consideration of information requirements in project contracts to avoid duplication of responsibilities (clause 5.1.5 of PAS 1192-2:2013). Despite complying with the formal specification of the standard, that is, information requirements are included as part of the contracts, those requirements were not precisely specified and changed over the projects' life-cycle stages, in turn, creating issues in terms of the responsibilities in some projects (e.g. project 2). Other examples included, despite having an EIR in accordance with the standards, having a generic EIR not tailored to the project, as highlighted by a BIM coordinator (project 2):

> *We received a very generic, not project-specific EIR, which puts us in the unknown. We questioned why it was as it was, because it didn't seem to be representative of what we were doing.*

Also, the EIR sets out that contractors are required to collaborate with the delivery team on the definition of those requirements, but without actively involving facilities managers who are also information-users. PAS 1192-2:2013 (clause 5.1.5) indeed sets out that the employer is advised to assign the role of project-delivery manager to one or more individuals as early as possible to develop these requirements; however, the information requirements were defined by consultants without considering the input of users of this information, as noted by a digital engineer (project 3):

> *Some of the EIR, I feel that it still needs organisation's A expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from organisation's A eyes and say, actually, no, we don't want this. We do want that.*

Moreover, the PAS 1192-2:2013 standard also states that the EIR should include commercial management aspects related to the exchange of information and alignment of information exchanges, work stages, purpose and required formats. By analysing the EIR, it was observed that organisation A set the requirements for information exchange and commercial management and asked bidders to review a pre-defined level of definition requirements established in a MPDT. The EIR, however, asks bidders to review the level of definition and model geometry specification within the MPDT proposed in the EIR and confirm whether they are sufficient to support carrying out the required BIM uses in their appointment. The EIR does not consider and require bidders to take a systemic view of the project when reviewing the level of definition and model geometry specification. Although the

EIR follows the PAS 1192-2:2013 standard and the recommendations for EIR content, the way it specifies what bidders should do reinforces the discipline-based nature of work instead of a collaborative and holistic mindset. Table 4.5 shows other clauses that have been followed according to the 'letter' of the standard but not its intended meaning.

Table 4.5 – Examples of clauses/processes for which the 'letter' has been followed but not the meaning in organisation A's projects

Clauses	**Enactment**	**Representative quotes/events/documents underlying enactment**
5.1.2	Although the information requirements set out in the EIR only provide enough information to answer the PLQs, the PLQs actually ask for information about everything.	*They tended to ask for nearly all of the information, and then people might come in later and say: 'Actually, I don't want to know about everything'.* (project 3)
5.1.5	Information requirements are included in contracts, but they change afterwards. The client organisation assigns the role of delivery manager to individuals to develop the requirements, which are defined, but they are not representative of what the organisation needs.	*Some of the EIR, I feel that it still needs organisation's A expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from organisation's A eyes and say, 'Actually, no, we don't want this. We want that'.* (project 3)
5.3b item 1	The client set the requirements for information exchange and commercial management and asked bidders to review a pre-defined level of definition requirements established in a MPDT. The EIR, however, asks bidders to review the level of definition and model geometry specification within the MPDT proposed in the EIR and confirm whether they are sufficient to support carrying out the required BIM uses in their appointment. The EIR does not consider and require bidders to take a systemic view of the project when reviewing the level of definition and model geometry specification.	EIR, MIDP/MPDT
7.5.1	Roles were embedded in contracts, but when it comes to the client organisation members, the roles were not very specific.	Observations, interview: *Facilities managers were coming to us for what they want, rather than through their own team, which sometimes blurs the lines about who should be doing what, and when.* (project 3)

Clauses	Enactment	Representative quotes/events/documents underlying enactment
7.5.1.6	The information exchange activities, as listed in this clause, were followed, but they were performed following existing templates. For example, the information management role enabled reliable information exchange through a CDE, but exchange also occurred via email before uploading to the CDE.	Observations, interview: *It's difficult to get them out of the habit of just sharing drawings before uploading onto a system.* (project 2)
9.2.2.12	The accepted gate of the CDE was used for information to be verified and validated for use in operation of the facilities. However, as information-users were not completely involved in the process, changes occurred.	Observations, interview: *Different members of the project team were influencing things as they went through. So, towards the end, the facilities team got more involved, and their requirements were different. What they've asked for has changed, because more people have become involved.* (project 4)
7.1.1	Information exchanges were carried out in accordance with the AIR, but the AIR does not consider the operations of the organisation in detail and the organisation as whole. The information exchanges are not arranged to provide information for key decision-making points.	AIR and interview: *I feel that it still needs the client's expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from the client's eyes and say, 'Actually, no, we don't want this. We want that'. Because there have certainly been times where we've said, 'Well, this is what you've asked for', and they've said, 'I didn't realise that'.* (project 3)

It could be observed that, on average, around half of the clauses and processes that were supposed to be implemented as part of the analysed standards were not completely implemented.

4.2.4 The 'why' of BIM level 2 implementation

The within-case analysis also focused on identification of the causes of enactment as it was performed. For organisation's A projects, nine underlying conditions were identified. The causes were labelled according to their meaning, as explained in Chapter 3, and are explained next. Table 4.6 shows the identified causes and their repetition across projects. Examples of how the causes were related to influencing enactment are described next.

Table 4.6 – Causes for implementation of the clauses and respective processes for PAS 1192-2:2013 and PAS 1192-3:2014 (projects 1 to 5)

	Project 1	**Project 2**	**Project 3**	**Project 4**	**Project 5**
Governance systems	27	27	27	27	27
Reward/cost structures	9	9	9	9	5
Role expectation	18	18	18	17	15
Authority systems	6	6	6	6	6
Procedures	15	15	15	15	5
Skills/experience/resources	3	3	1	2	0
Early stages	7	7	7	6	4
Bodies of knowledge	4	4	4	4	3
Models of reality	5	5	3	4	1
Strategic orientation	19	19	19	19	19

4.2.4.1 Client's organisation strategic orientation

As previously mentioned, BIM level 2 implementation at organisation A was grounded in both technical and legitimacy motivations. Organisation A, however, focused on the implementation of BIM level 2 mostly at the capital delivery stage, as identified in their digital strategy report:

> *Estate management identified that BIM, as defined in the government's construction strategy of 2011, was necessary to support capital delivery. EM invested a significant amount of time and money in establishing the foundations for using BIM across the capital delivery programme.* (Digital Estate Progress Report, p. 3)

This primary focus on capital delivery, which was the client's strategic orientation, was identified as a reason for the lack of full implementation of processes/activities across the operational phase. Non-practical implementation of the soft-landings document, which aims to enable a smooth transition from construction to operation, can also be related to a lack of focus on the operational phase of the asset life cycle. Since initially the primary purpose of the information models was not to support the buildings' operations but to help with project delivery, the processes and activities related to asset operation, such as the definition of a formal handover process, were not the primary focus of BIM implementation. Table 4.7 shows some examples of clauses/processes where enactment was influenced by the client's strategic orientation.

Table 4.7 – Examples of clauses/processes where enactment was influenced by the client's strategic orientation

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
9.9.7	Not fully implemented	The objects' information at the use stage has not been updated yet, as the information models have not been entirely used in the operational phase yet, because of the initial focus on capital delivery.	Internal report and observations that the primary and strategic focus has been on capital delivery.
10.2	Non-implementation	No formal handover was documented in the EIR, as the focus of the EIR was mostly capital delivery.	EIR focused on the delivery stages and not on the production of an asset model that would be used in the operational phase, from the analysis of the BIM implementation strategy report, AIR and EIRs.
4.1	Non-implementation	The client organisation has not established, documented, implemented and maintained an information management process.	Focus on the delivery stage, from analysis of the BIM implementation strategy report, AIR and EIRs.
4.3. item c	Not fully implemented	As a formal OIR was not defined, the AIR could not be defined in order that the OIR could be satisfied.	A draft of an OIR has been developed, but it has not been used to guide the definition of information requirements, as asset data was not the primary focus of BIM implementation.
5.1	Implementation of the 'letter' of the clause only	The client organisation has implemented processes to provide the CDE in order to maintain integrity and control of the data, but this has not been applied in the operational phase – the CDE is only used as a data archive.	Asset data management was not the primary focus of BIM implementation, from analysis of the BIM implementation strategy report, AIR and EIRs. Observations of the CDE confirm that it has been used mostly as an archive.
5.2	Clause not fully implemented	The produced AIM has not been used as a means to access links to the information about the event works, for example, from linked enterprise systems.	Asset data management was not the primary focus of BIM implementation, from analysis of the BIM implementation strategy report, AIR and EIRs. Observations of the CDE confirm that it has been used mostly as an archive.

7.1.1	Implementation of the 'letter' of the clause only	Information exchanges have been carried out in accordance with the AIR, but the AIR does not consider the operations of the organisation in detail or the organisation as a whole. The information exchanges are not arranged to provide information for key decision-making points, as asset data management was not the primary focus of BIM implementation.	AIR and interviews: *I feel that it still needs the client's expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from the client's eyes and say, 'Actually, no, we don't want this. We want that'. Because there have certainly been times where we've said, 'Well, this is what you've asked for', and they've said, 'I didn't realise that'.* (project 3)

4.2.4.2 Scripts for action from bodies of knowledge (discipline-based focus)

The data also revealed that discipline-based ways of working continued to shape work, when a more integrated approach was required. It was identified, for example, that production of models was performed with only the specific work-package/life-cycle stage in mind, and not considering the other disciplines and related BIM uses in later stages. Table 4.8 shows examples of clauses where enactment was found to be influenced by existing discipline-based frames. Previous studies have already identified that failing to form a collaborative and integrated design environment renders BIM a mere 3D drafting tool, and a change in traditional mind sets and collaboration is necessary (Al Hattab and Hamzeh, 2018); the data has shown that this focus led the implementation of new processes to be mostly performed according to the 'letter' but not the 'spirit' of the standards.

Table 4.8 – Examples of clauses/processes where their enactment was influenced by a discipline-based focus

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
5.3b item 1	Implementation of the 'letter' of the clause only	The client set the requirements for information exchange and commercial management and asked bidders to review a pre-defined level of definition requirements established in a MPDT. The EIR, however, asks bidders to review the level of definition and model geometry specification within the MPDT proposed in the EIR and to confirm whether they are sufficient to support carrying out the required BIM uses in their appointment. The EIR does not consider and require bidders to take a systemic view of the project when reviewing the level of definition and model geometry specification, and to follow their individual appointment.	EIR and MPDT showing a focus on the work-package/life-cycle stage
7.4.5	Implementation of the 'letter' of the clause only	task information delivery plans (TIDPs) are used to take into account the required sequence of model preparation, without considering the other stages.	TIDP showing a focus on the work-package/life-cycle stage
7.5.1.6	Implementation of the 'letter' of the clause only	The information exchange activities, as listed in this clause, were followed but performed following existing templates. For example, the task team manager looked at the production of design output related to a discipline-specific package-based task. The design output did not consider the big picture of model use in the next stages.	EIR and MPDT showing a focus on the work-package/life-cycle stage

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
9.1.2	Implementation of the 'letter' of the clause only	The PIM was developed according to the MIDP, but issues emerged because of the discipline-focused perspective.	Interviews showing modelling issues when applying BIM use, as required by the client. *As you got your building modelled as it is, you can't just press a button and put it into your thermal modelling software because the software won't understand any clashes.* (project 5)

4.2.4.3 Models of reality (cultural systems)

The data also showed that there are common frames and patterns that are part of the culture and logics that structure the field, which are part of the models of reality and which influenced the actions of the project team. Examples include the patterns of communication/interaction followed by subcontractors of generally sharing drawings and exchanging information in emails, as highlighted by a BIM coordinator (project 2):

> *When we've got a big push where we don't want anyone sharing drawings in emails, it's difficult to get them out of the habit of just sharing drawings before uploading onto a system.*

This habitual form of exchanging information was found to frame the enactment of some processes, as shown in Table 4.9.

Table 4.9 – Examples of clauses/processes where their enactment was influenced by models of reality/habitual dispositions

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
7.5.1.6	Implementation of the 'letter' of the clause only	The information exchange activities, as listed in this clause, were followed but performed following existing templates. For example, the information management role enabled reliable information exchange	Observations, interviews: *It's difficult to get them out of the habit of just sharing drawings before uploading onto a system.* (project 2)

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
		through a CDE, but exchange also occurred via email before uploading to the CDE.	
9.1.5	Clause not fully implemented	The process of delivery management was not strictly followed, with information exchanges still occurring via email.	Same as above
9.1.6	Clause not fully implemented	The process of sharing and issuing information was not consistent, with exchanges still occurring via email.	Same as above

Apart from shared conceptions of how to enact, shared conceptions regarding the roles of project team members were also identified.

4.2.4.4 Existing roles

The data has also shown that there some expectations regarding project members' roles (at both industry and organisational levels) that persisted and framed enactment. For example, conventionally, facilities managers and asset-operators are not actively involved in the early stages of projects, during which requirements and specifications are made. These existing conceptions of appropriate goals and activities for particular individuals of the project team or specified social positions have not changed in practice, with facilities managers/asset-operators usually not getting involved in the specification of asset information requirements that are part of the information models, although it has been reported (EIR) that these should be 'consulted'. In other words, not all clients of the information models have been actively involved in the specification of the requirements, as noted by a BIM manager:

> *I think, definitely, they need to get the team to agree on the requirements. When I say the team, I mean the whole team, not just, maybe, the people on the project team. I think you have to think about the building as a whole life cycle, and someone at the project level might have a completely different opinion on what they want to someone on the facilities side, and maybe even someone in the technical aspects. I would say get the whole estates team involved in the decision.*

Past research has identified that such changes in the division of labour and roles are necessary, and the data confirmed that a lack of reconfiguring existing roles led to either non-

complete compliance with the standards or compliance with the 'letter' but not the 'spirit'. The non-involvement of all information-users, for example, led the client organisation to ask for information about everything at the beginning of the project and to let it be refined at later stages when facilities managers became involved, complying with the 'letter' of clause 5.1.2 of PAS 1192-2:2013, for example, but not its 'spirit', which prescribes that information requirements set out in EIRs shall only provide enough information to answer the PLQs required at a particular stage – and not information about everything.

Moreover, the requirements were defined by consultants, as specified in the standard, but they might not necessarily have specific knowledge of how the operation of assets occurs within the particular context. This leads to specification of requirements and compliance with the standards, but not the purpose of creating information models that will support decision-making across assets' life, as noted by a BIM manager:

> *The detail is fairly good. The content is pretty good. Some of it, I feel that it still needs the client's expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from the client's eyes and say, 'Actually, no, we don't want this. We want that'. Because there have certainly been times where we've said, 'Well, this is what you've asked for', and they've said, 'I didn't realise that'.*

It was found that conceptions for existing roles shaped the enactment of a range of clauses/processes. Table 4.10 shows some examples.

Table 4.10 – Clauses/processes where their enactment was influenced by existing roles

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
5.1.2	Implementation of the 'letter' of the clause only	Although the information requirements set out in the EIR only provide enough information to answer the PLQs, the PLQs actually ask for information about everything, as facilities managers and information-users did not get involved and information requirements were defined by consultants.	*I feel that it still needs the client's expertise adding to it. I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from the client's eyes and say, 'Actually, no, we don't want this. We want that'. Because there have certainly been times where we've said, 'Well, this is what you've asked for', and they've said, 'I didn't realise that'.* (project 3)

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
7.5.1	Implementation of the 'letter' of the clause only	Roles were embedded in contracts, but when it comes to client organisation members, the roles were not very specific. The roles of facilities managers were highly defined in the EIR, for example, but they continued to act as before.	EIR, interviews*: I think, definitely, they need to get the team to agree on the requirements. When I say the team, I mean the whole team, not just, maybe, the people on the project team. I think you have to think about the building as a whole life cycle, and someone at the project level might have a completely different opinion on what they want to someone on the facilities side, and maybe even someone in the technical aspects.* (project 3)
7.5.1.1	Clause not fully implemented	Some roles were not explicitly defined, and project members continued to act as before.	*Facilities managers were coming to us for what they want, rather than through their own team, which sometimes blurs the lines about who should be doing what, and when.* (project 3)

4.2.4.5 Early stages of adoption and lack of experience

The data also revealed that the lack of focus on the operational stage of the asset life cycle was combined with the fact that BIM implementation was new to organisation A, and there was a lack of experience and even knowledge contributing to non-holistic implementation, as in the case of the provision of a specific EIR, as required by clause 5.1.3 and noted by a digital engineer (project 3):

> *When the project started, there was a lack of clear information. I think we received a very generic, not project-specific EIR, which put us in the unknown. I think only after a year or a year-and-a-half did we receive a project-specific one. I get the impression that that was because it was being developed as they were going along.*

The project team also attributed requiring more information than necessary to being a consequence of the early stages of adoption, as organisation A was not completely sure about the relevant requirements:

> *We can't do all the stuff that's being asked of us here, but I appreciate that it's an evolving thing, and even the client is still deciding what they'd like.*

The overspecification, however, was also a consequence of not involving all information-users in the definition process, as previously mentioned. Being early in the adoption process nevertheless also impacted the production of information, as noted by the project team:

> *Because it's a pilot project and early stages, that might be why that happened. It means that some of the data that we could've included is, maybe, missed out. Things like object naming isn't, maybe, up to the British standard that it could be, which is unfortunate. So, we sort of had a mix where some of it did get captured, and some of it didn't.*

Lack of experience in conducting an activity, aligned with previous habits, as previously mentioned, also led to non-holistic implementation of new processes (e.g. clauses 9.2.2.1, 9.2.2.9).

4.2.4.6 Existing authority systems

The authority systems and hierarchies in place at client organisation A were not reconfigured and continued to frame the actions of project team members, such as facilities managers. For example, although clause 7.5.1.2 of PAS 1192-2:2013 was followed in the sense that the roles and responsibilities of individual team members were highly defined, they were not strictly defined/followed. The internal authority system was not reconfigured, leading, once again, to compliance with the 'letter' but not the 'spirit', as noted by a digital engineer (project 3):

> *I think the communication between the client's management team doesn't seem to be quite as good as it should be. They seem to be coming to us for what they want, rather than through their own team, which sometimes blurs the lines about who should be doing what, and when.*

Organisation A has an authority system in place and an internal structure for capital delivery/facilities management involving internal disputes. The structure and distribution of authority have not changed, influencing enactment of some processes, as exemplified in Table 4.11.

Table 4.11 – Examples of clauses/processes where their enactment was influenced by authority systems in place

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
7.5.1.1	Clause not fully implemented	Some roles were not explicitly defined (not in the matrix), which occurred in the case of facilities management.	Observations revealed that structural aspects related to authority inside the client's organisation led to issues. Interviews showing authority issues in place: *Facilities managers were coming to us for what they want, rather than through their own team, which sometimes blurs the lines about who should be doing what, and when.* (project 3)
7.5.1.2	Implementation of the 'letter' of the clause only	Some roles and responsibilities were not explicitly defined, which occurred in the case of facilities management.	Same as above
4.3 item e	Clause not fully implemented	It was not defined interfaces for exchange of data and information between the AIM and all other information systems, and this was not implemented through two-way connectivity. There have been internal disputes with regards to the computer-aided facilities management (CAFM) system to be used, influencing those definitions.	AIR observations of meetings between the facilities management team and business services team
4.3 item f	Non-implementation	No mechanisms for maintaining the AIM and monitoring the quality of data and information within the AIM were defined. There are also hierarchies in the asset operations and issues about authority between the operations management team and local operators of the assets that have been seen as an issue.	Observations of meetings between the facilities management team and business services team

4.2.4.7 Existing procedures

Organisation A's internal procedures or prescriptions about appropriate ways to conduct activities, such as change management, were not updated, leading, for example, to rework and remodelling when changes were incorporated, as highlighted by a project manager (for project 4):

> *Because of the changes here we've had to go in and remodel, and I think that's the bit that's taken the time and the cost.*

In other words, existing procedures kept framing how new processes and activities were conducted. Procedures defined by the client organisation also shaped how other processes were carried out; for example, the BIM capability assessment form developed by the client organisation asked suppliers to describe if the supply chain had the capability to deliver the project and to provide evidence of that. As this information was provided as required by the client organisation, it was not provided in detail again later, post-contract award. Existing and adopted procedures were found to influence the enactment of a range of clauses. Table 4.12 provides some examples.

Table 4.12 – Examples of clauses/processes where their enactment was influenced by existing procedures

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
6.1.2	Clause not fully implemented	The BEPs did not have enough specification for the employer to identify if the supply chain had the capabilities to deliver what was requested in the EIR; information about the capabilities of the supply chain is provided in the supplier BIM maturity assessment form, following the organisation's procedures.	BEP, supplier BIM maturity assessment form
6.1.4	Clause not fully implemented	BEP submitted by the main contractor not confirming the supply chain's capabilities; information about the capabilities of the supply chain is provided in the supplier BIM maturity	BEP, supplier BIM maturity assessment form

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
		assessment form, following the organisation's procedures.	
9.1.2	Implementation of the 'letter' of the clause only	The PIM was developed in accordance with the MIDP but because of existing change management procedures within the client's organisation that have not been reconfigured, many changes emerged, resulting in extra costs.	*Because of the changes here, we've had to go in and remodel, and I think that's the bit that's taken the time and the cost.* (project 4)

4.2.4.8 Reward and cost structures

The data has shown that the reward and cost structures associated with the delivery approach adopted – in which a single 'lump-sum' price is agreed before works begin and if the actual cost of the works exceeds the agreed price, the contractor must bear the additional expense – played a role in how enactment of the mandate occurred. As the risk is assumed by the contractor, some processes were not completely implemented as expected by the standards, as the contractor would bear any expected costs anyway. This included, for example, at the mobilisation stage, not testing all software, IT systems and infrastructure according to clause 8.2 of PAS 1192-2:2013.

4.2.4.9 Existing governance systems

The data also showed that existing governance systems remained in place and influenced enactment. For example, regarding clause 7.5.1.1, not all information management roles were identified and confirmed at the beginning of the project, as by following the governance system adopted in the projects the main contractor would only be formally appointed and become involved in the later stages of design. Another example of an existing governance system influencing enactment of new processes is clause 9.1.6 of PAS 1192-2:2013, which states that the process of creation, sharing and issuing of production information should be managed and delivered in a lean and timely manner. Because of the governance systems in place within client organisation A in alignment with existing procedures, regarding the involvement of final-users and specification of requirements, the creation of information models was not managed and delivered in a lean and timely manner, as observed for project 4, for example.

In summary, it could be observed that the identified causes led to enactment in different ways; that is, the same cause might have led to non-implementation of a clause or non-complete implementation of a clause, for example. The causes repeated for multiple clauses, meaning they are not related to specific clauses or processes being implemented. As described in Chapter 3, analysis of implementation in another organisation's project was conducted simultaneously, as described next.

4.3 Client organisation B: BIM level 2 implementation at project 6

4.3.1 Overview

Organisation B, a public-sector client organisation for which implementation of BIM level 2 was a requirement, began its digital transformation journey in 2011 as part of the government's mandate. Projects with a procurement over five million have been required to implement the BIM mandate. At the time of data collection, BIM level 2 had been implemented in more than 100 projects. Organisation B's estate comprises 23,000 educational facilities across the UK. There is a range of parties involved in the management of these assets, including local authorities. The assessment management policy revolves around local management of the buildings.

One of the first steps in organisation B's digital transformation journey was to establish the key BIM level 2 documentation in alignment with the policy framework. The organisation worked on the EIR and AIR with external consultants and contractors to identify the requisite information requirements. An external consultancy firm was appointed to support setting up the BIM documentation and to consult with the contractors currently working with organisation B on the definition of the information requirements, as noted by the person responsible for BIM adoption across organisation B:

> *We had recruited consultancy X to help us set up the key BIM documents. This consultancy did quite a lot of consultation work with the contractors on our framework.*

Organisation B also set up a strategy for BIM implementation at organisational level. A programme was developed to introduce BIM internally, which included awareness sessions to introduce the information management processes and the new BIM documentation. More than 350 people, including project directors, project managers and technical advisors (TAs), were trained in 2016. Additionally, a three-hour workshop was provided to technical advisors (who

are external consultants in the projects) explaining the BIM level 2 principles and how to produce and manage digital information in projects. A BIM guide was also developed to support TAs with practical implementation.

As previously mentioned, however, organisation B does not operate and manage the estate centrally. The information models produced during the capital delivery phase are handed over to the final-users and operators of the buildings and might end up not being used during operation of the building. Even if the information models are used, they are not used in the same way across the whole estate. The fact that organisation B does not operate its estate led to difficulties in its buying into BIM, as highlighted by the person leading the interface with the government policy for organisation B's estate:

> *I think it's fair to say we've struggled with buy-in to BIM within the organisation generally. Why are we doing BIM? I think a big part of it is the mandate, to be honest. The same questions always come back, we don't operate this estate.*

As mentioned in Chapter 3, only one of organisation B's projects was analysed. The project consisted of a three-storey facility with enhanced sports and arts facilities. The contractor for the project, who was also the contractor for organisation C's projects, is an experienced organisation. The operation and management of the facility, similar to other facilities, is under the responsibility of a local organisation, named academy trusts. At the time of data collection, the project was under construction (RIBA stage 5), and retrospective data for the other stages was collected, leading to a comprehensive view of implementation across all stages. Further detail is discussed next.

4.3.2 The 'what' or the content of BIM level 2 implementation

Similar to projects 1 to 5, implementation of the BIM level 2 mandate for project 6 varied in terms of content. Table 4.13 shows the standards, documents and principles implemented.

Table 4.13 – Principles, standards and documents implemented in organisation B's project

Information modelling maturity level 2	Implem-entation	Data underlying the findings	Representative quotes/events/documents
Information models developed following enabling tools	X	Reported use of tools	*On this scheme everybody is working from the 3D model.* (group interview 1)
Provision of a single environment to store shared asset data	X	Reported use of a CDE	*We've all got access to BAM CDE.* (group interview 1)

Information modelling maturity level 2	Implem-entation	Data underlying the findings	Representative quotes/events/documents
Development of BEP by the supplier	X	Access to BEP produced by the main contractor	BEP
Evaluation of the proposed approach, capability and capacity of each supplier	X	Requirements set in the EIR	EIR
Provision of a clear definition of the EIR and key decision points	X	Access to the EIR	EIR
Originators producing information in models	X	Reported use of tools and production of information in models	*I think because we're using the 3D model in that environment with the designers, we can explain to them the sorts of information that we're trying to get, so it makes it more obvious in that way. Then they're able to become aware of the types of information that we need.* (BIM manager, main contractor)
Application of BS 1192:2007	X	Reported in EIR	Clause 3.1 of EIR
Application of BS 7000-4:1996			
Application of BS 8541-1:2012			
Application of BS 8541-2:2011			
Application of BS 8541-3:2012			
Application of BS 8541-4:2012			
Application of PAS 1192-3:2013	X	Reported in EIR	Clause 3.1 of EIR
Application of PAS 1192-3:2014	X	Reported in EIR	Clause 3.1 of EIR
Application of BS 1192-4	X	Reported in EIR	Clause 3.1 of EIR
CPIx protocol			
CPI Uniclass	X	Reported in EIR and observed in COBie	EIR
CIC BIM protocol			
CIC scope of services			

Information modelling maturity level 2	Implem-entation	Data underlying the findings	Representative quotes/events/documents
Government soft landings			
Institutional plans of work	X	Reported in EIR	

According to the EIR, the standards and guidance documents applied in the project included only the BS 1192:2007, PAS 1192-2, PAS 1192-3, PAS 1192-5 and BS 1192-4. Standards that were not implemented included government soft landings, the CIC BIM protocol and the CIC scope of services. The BS 8541 range of standards for library objects for architecture, engineering and construction were not mentioned in the project documentation as compulsory, although they were implemented. Additionally, the BS 7000-4 standard for managing design in construction was not specified as a required standard, although its clauses and content were partially applied. The same occurred with the CIC BIM protocol. For example, the EIR specifies that the contractor should carry out the role of information manager, but contractors were not required to have a BIM protocol appended to their contracts. Moreover, it was captured in the interviews that PAS 91:2012 and pre-qualification questionnaires were used. Regarding PAS 1192-5, although the generic EIR template states that PAS 1192-5 is a required standard, the BEP for the project particulars states that the security requirements of PAS 1192-5 were not required for this project.

The other principles of BIM maturity level 2, such as the development of information models following enabling tools with originators producing information in models, were adopted, although the extent of adoption varied. For example, regarding the principle of evaluating the proposed approach, capability and capacity of each supplier and their supply chain, this was performed only for the main consultants, as noted by the lead contractor's BIM coordinator:

> *The main consultants we have. Not the rest of the supply chain so much. We've got a standard form, a two-part form. Going to the wider supply chain, I don't think we assessed anybody else on this project.*

The Uniclass classification structure was also adopted. Data exchange took place at the lead contractor's CDE, and the client had access to it, as it did not have a CDE in place.

Moreover, it could also be observed that, even though a standard/document was adopted/implemented, not all of its processes/activities were implemented, similarly to the previously analysed projects. Table 4.14 shows the clauses that were not implemented.

Table 4.14 – Examples of clauses/processes non-implemented in organisation B's project

Clause	Enactment	Representative quotes/events/documents underlying enactment
5.3a item 6	The EIR does not require bidders to submit proposals for BIM/CDE-supported H&S/CDM management.	EIR template
5.3b item 4	The EIR does not include an initial responsibility matrix.	EIR template
6.1.3	A BEP was not submitted by the supplier post-contract award.	Pre-contract BEP, interview: *We never produced a post-contract BEP.* (BIM manager, main contractor)
6.1.4	A BEP was not submitted by the supplier post-contract award.	Same as above
7.2.1	A BEP was not submitted by the supplier post-contract award.	Same as above
10.2	A formal handover process was not documented in the EIR.	EIR template
4.1	The organisation has not established, documented, implemented and maintained an information management process.	*That's because we don't operate the estate. If they want to… I don't think it's a winnable thing, to force schools to update their model that we hold. It'll just be a legacy model, 'That's how it was.' It won't be taking full advantage.* (BIM implementation leader)
4.2	There is no management process in place.	Same as above
4.3 item a	There is no information governance in place.	Same as above
4.3 item b	An OIR has not been defined.	AIR, EIR
4.3 item e	The interfaces for the exchange of data and information were not defined.	*Before information is uploaded into PS Assets it needs some standardisation and cleaning up; that did not happen.* (CAFM provider)
4.3 item f	There are no mechanisms for maintaining the AIM.	AIR
4.4	An OIR was not defined.	AIR, EIR
4.5.3	An OIR was not defined.	AIR, EIR
4.5.4	No exchange of data and information with the AIM was established.	AIR

Clause	Enactment	Representative quotes/events/documents underlying enactment
4.6.4	There are no processes for maintaining the AIM.	*That's because we don't operate the estate. If they want to… I don't think it's a winnable thing, to force schools to update their model that we hold. It'll just be a legacy model, 'That's how it was.' It won't be taking full advantage.* (BIM implementation leader)
5.1	The organisation does not have a CDE in place; for capital delivery, it was provided by the contractor.	*'Should we hold the models?' At the moment, we don't hold O&M manuals or as-built drawings. People say, 'Why should we?' We've got a whole filing system in the department, using SharePoint. So, there's an ongoing debate as to whether we should hold BIM models? I'm going to say, 'Well, I'm going to collect because…' One of our senior directors, actually, has said, 'We should have a Facebook kind of account.' I'm not sure quite what he means. I'm taking it as a positive, that he thinks we should store BIM models.* (BIM implementation leader)
6	Roles and responsibilities for information management were not set.	*That's the bigger challenge. I don't think it's a winnable thing, to force schools to update their model that we hold. It'll just be a legacy model, 'That's how it was.' It won't be taking full advantage.* (BIM implementation leader)

Examples included an EIR that does not set out the requirements for bidders' proposals for BIM/CDE-supported H&S/CDM management (clause 5.3a item 6 of PAS 1192-2) and an EIR that does not contain an initial responsibility matrix setting out any discipline responsibilities for model information production in line with the defined project stages (clause 5.3b item 4 of PAS 1192-2). This was also the case for the PAS 1192-3:2014, with most of its clauses not being implemented. Client organisation B does not have, for example, an information management procedure in place, has not defined its OIR and has not defined its processes for maintaining the AIM.

Thus, in terms of the content of implementation, similar enactments were observed across the projects of settings A and B. All projects, despite implementing many of the standards and their clauses/processes, had standards and documents that were not implemented and/or processes recommended by an adopted standard that were not implemented. Similarities could also be observed with regards to the way implementation took place, as described next.

4.3.3 The 'how' of BIM level 2 implementation

Data on practical implementation showed that many processes/activities as part of the BIM level 2 standards/documents were not implemented to the extent that they should be according to the standards. Around 30% of the clauses and processes suggested by the standards were not implemented in full. Table 4.15 shows some examples.

Table 4.15 – Examples of clauses/processes not fully implemented in organisation B's projects

Clauses	Enactment	Representative quotes/events/documents underlying enactment
5.1.3	The information requirements were not specific.	*I suspect that one of the lessons learned from all of this would be how the client and the end-user in this type of construction project can work together earlier to look at what potential future asset management requirements the Trust might need.* (technical advisor)
5.1.5	The EIR highlights that the contractor should perform the role of information manager; it does not provide details about the roles and responsibilities.	EIR
5.3a item 11	The EIR only defines that a master grid file should be established setting out the point of origin, but it does not provide specific requirements.	EIR
6.1.2	The BEP does not provide enough information to determine if the requirements within the EIR are achievable – the capabilities of the whole team are not clear.	*BEP: Each BIM supplier is to complete a BIM competence assessment.*
6.1.5	The details of the supplier's information cascade process are unclear.	BEP
6.2	The contents of the BEP did not cover everything as specified in clause 6, such as the PIP.	BEP
6.3.1	The PIP within the BEP does not provide details to	BEP

Clauses	Enactment	Representative quotes/events/documents underlying enactment
	assess the capabilities of all suppliers.	
6.3.2	The PIP does not contain details on all forms.	BEP
6.4.1	An assessment form has been completed according to the main contractor but the BEP does not provide a way to assess their capability.	BEP
6.4.2	An assessment form has been completed according to the main contractor but the BEP does not provide a way to assess their capability.	BEP
7.5.1	There was no clarity of roles/responsibilities for all project members, such as the TA.	*It should be the technical advisors. The technical advisors have that in their scope of work. How specific that is… I think it's just one line saying, 'You'll do everything necessary to do BIM'.* (BIM implementation leader)
8.2	No all software has been procured and tested at the appropriate time for information production.	*What we are proposing at this moment in time won't capture that. The PS asset software won't necessarily take all of that. But we still have nowhere to store that.* (asset-operator)
9.1.6	The process of creation, sharing and issuing of information has not been consistent.	*Actually, one of the things that is notable on this project is there is still an awful lot of email communication. There is an awful lot of correspondence, and there is an awful lot of discussion. Even though we've all got access to the contractor's CDE, it's actually not the place where that discussion is actually typically taking place. It's still taking place in workshop environments and across those emails.* (technical advisor)

Examples regarding the EIR include, although it highlights that the contractor should perform the role of information manager, that it does not provide details regarding the roles and responsibilities (clause 5.1.5). In terms of information production, the project information model has been progressively developed and delivered to the employer (according to clause 9.1.1) but has not coincided with the employer's decision-making processes. For example, in terms of the information necessary to procure the mechanical and electrical maintenance services, no formal information exchanges occurred to support the client's procurement of

those services. Also, more information than necessary has been delivered (i.e. non-graphical data).

Moreover, the process of sharing and issuing production information has not been consistent, according to that prescribed by clause 9.1.6, and information has not been delivered in a lean manner. There has been significant communication by email instead of via CDE, as highlighted by a technical advisor:

> *Actually, one of the things that is notable on this project is there is still an awful lot of email communication. There is an awful lot of correspondence, and there is an awful lot of discussion. Even though we've all got access to the contractor's CDE, it's actually not the place where that discussion is actually typically taking place. It's still taking place in workshop environments and across those emails.*

Although information exchange has been established in the EIR, the formal exchange of information has not occurred (according to clause 9.1.1), as highlighted by a technical advisor when discussing the process:

> *My nervousness is if you start to say you have to have a formal BIM information exchange. You will get some contractors who are not as savvy as contractor X who will almost start to separate out BIM, and that BIM is an item that they do. It is a deliverable, rather than BIM is the process we are adopting to actually deliver the project.*

This non-extensive implementation of processes/activities also could be seen for standards other than PAS 1192-2:2013. For example, for PAS 1192-3:2014, in terms of information exchange, the data produced has not been of a quality appropriate for asset management decisions, the activities they support or the systems and processes operated by the asset-operators, as required by PAS 1192-3:2014 (clause 7.1.2) and highlighted by the CAFM system provider:

> *Data is supplied regarding the equipment deployed across the academy. Different suppliers, different methods of working, different levels of accuracy and different formats have caused a number of issues.*

Another observed aspect related to implementation was the enactment of activities as prescribed by the standards but not achievement of the intended goals. Similar to organisation's A projects, the process/activity is carried out as recommended but not in a way that its meaning can be realised. The 'how' of the activity, or the way in which it is enacted, does not lead to achievement of the outcomes. Table 4.16 provides some examples of clauses where that has happened.

Table 4.16 – Examples of clauses/processes for which the 'letter' has been followed but not the meaning in organisation B's projects

Clauses	Enactment	Representative quotes/events/documents underlying enactment
5.1.2	A generic EIR, not particular to the project, is proposed, and particulars are only defined after the appointment is made. The EIR was developed by a consultancy and does not cover the real needs of end-users/asset-operators.	*It's very much organisation B is the client, the Trust is the end-user and stakeholder, and only organisation B makes the decisions on the specification. However, sometimes the end-user might have a view on that.* (asset-operator)
5.1.4	The EIR has been incorporated into the tender documentation, but it is the generic EIR, and their capabilities are assessed against this generic document.	EIR
5.3a item 1	The EIR contains the levels of detail for submission at defined project stages but it assumes that the assets are not going to be used during the operational phase. The LOD does not support decision-making.	EIR and interview: *The template calls for a very high level of definition at handover, and presumably that is to account for the fact that as clients, you are not going to be taking advantage of that.* (technical advisor)
5.3c item 1	The EIR contains requirements of competence assessment, but it is not applied in practice for small contractors.	*We were harder on the bigger contractors, we had to balance it with… We get criticised if we don't allow smaller contractors onto our frameworks. We didn't want BIM to be a pass/fail kind of thing.* (BIM implementation leader)
9.1.5	The process of delivery management has been followed, but not in a way it can guarantee that it is accurate and appropriate.	*At each stage, the technical advisor is going to do this, that and the other. Whether we check that they check, the contractors check, I don't think so. No, it doesn't happen to any – No.* (BIM implementation leader)

For example, this can be observed with regards to the assessment and need stage of the information delivery cycle. The EIR has been produced as part of a wider set of documentation for use during project procurement, as recommended by clause 5.2.1 of PAS 1192-2:2013. However, the EIR was developed taking into account the employer's needs, defined by/in consultancy with contractors; it did not consider the perspective of the asset-users/operators. As per organisation's B current framework for capital delivery, the asset-operator only becomes involved in the later stages of the project. That is, although the implemented processes

comply with the standard, the intended goal of deploying an EIR for the production of information that supports decision-making across the asset life cycle is not realised.

Also, organisation B has a generic EIR document with a section for project particulars or particular requirements for the project. Clauses 5.1.2, 5.1.4 and 5.2.1 of PAS 1192-2:2013 state that the EIR should be incorporated into the tender documentation to enable suppliers to produce their initial BEP and should be produced as part of a wider set of documentation for use during project procurement. However, according to organisation B's current framework, the particular requirements are defined after the appointment is made and the lead contractor starts engaging with the asset-user. Thus, although the EIR has been incorporated into the tender documentation, this involves the generic EIR – not one specific to the project – to contractors to bid, which effectively leads to the production of valuable information to support decision-making.

Moreover, although the EIR covers aspects like a table aligning information exchange, work stages, and purposes and general formats, it does not specify specific formats (clause 5.3 b item 1). Another example related to the assessment and need stage and production of an EIR involves the level of detail. Although the EIR contains the recommended level of detail, complying with the 'letter' of the PAS 1192-2:2013 standard (as the client does not have the intention to use the information models during the operational phase), the level of detail is highly defined, but not in alignment with the purpose of producing information at a level that is useful to the final-users, as highlighted by a technical advisor:

> *The template calls for a very high level of definition at handover, and presumably that is to account for the fact that, as clients, you are not going to be taking advantage of that.*

In summary, it was observed that the same enactment pattern was followed for project 6, confirming the patterns identified for projects 1 to 5. The identified causes for such variance in implementation included both organisational and industry-related aspects, similarly to the previous projects, as described next.

4.3.4 The 'why' of BIM level 2 implementation

When exploring the conditions leading to enactment in the previously described ways, some similar causes to those identified for organisation A's projects were observed. There were also causes that did not appear before, which were added to the conditions leading to different types of enactment of the standards' processes. Table 4.17 lists the identified causes.

Table 4.17 – Causes for implementation of the clauses and respective processes for PAS 1192-2:2013 and PAS 1192-3:2014 (project 6)

	Project 6
Governance systems	40
Reward/cost structures	18
Role expectation	21
Codes of conduct	3
Authority systems	3
Procedures	39
Skills/experience/resources	6
Models of reality	6

4.3.4.1 Existing roles

The data revealed that many processes and activities were enacted in a certain way or were not implemented because of the way that the roles related to the execution of activities were managed, similar to those observed for the previous projects. Client organisation B has had a project-delivery framework in place since before BIM was adopted in projects, which is followed in all projects. This framework has a particular way of assigning roles and responsibilities.

Contractors are expected to conduct certain activities according to this framework, and the same role expectation was followed in project 6 for the new BIM-related roles. The same expectations for the roles of technical advisors were followed, and the information management roles were embedded in existing project roles. There has been no clarity on the roles, however, as recommended, which occurred because of the reproduction of expectations for existing roles or pre-defined social positions.

Existing shared understanding within the client organisation has been replicated with regard to role expectations. Although there are no recommendations within the PAS 1192-2:2013 standard regarding procurement and the client's role in selecting contractors, evaluation of the contractors' capability was carried out by the technical advisors, as occurred for organisation's B projects, also following authority systems in place. Those individuals, however, do not necessarily have the skills to conduct this type of assessment, as highlighted by one of them:

> *You're actually asking people who don't have the skill sets to actually evaluate the answers to that question? As mentioned earlier, there are an awful lot of people who are*

evaluating those questions. You have to expect a level of competence for somebody who is scoring that, and I don't know if that's necessarily there.

As another example, the technical advisor was automatically expected to carry out activities like signing off on the information produced to be shared for publication. It was expected that the TA role would incorporate this as an additional activity but without clarifying it. BIM implementation and effective multi-disciplinary collaboration indeed require changing the roles for project stakeholders (Akintola et al., 2020) to incorporate more responsibilities. However, there was an expectation that a new function (i.e. the information manager) to be assigned to existing stakeholders automatically represented a reproduction in the existing framework and/or social roles expectation at the client organisation level. This expectation that existing roles would cover new responsibilities without changing their scope led to implementation issues.

As another example, the information management function was assigned to the contractor, as all risks are assigned to the contractor according to the current ways of working, and the client does not have a formal information manager on its side. For this reason, some practices were not enacted completely. For example, although the EIR states that suppliers should be responsible for the cascade of information through the supply chain, as recommended by the PAS 1192-2:2013 standard, suppliers' information cascade processes are not verified, because the client does not have an information manager to perform that verification. Some other activities were not carried out because it was automatically expected that existing roles would be responsible for those activities. For instance, there have been no checks for the authorisation of information in compliance with the EIR (clause 9.2.2.5 of PAS 1192-2:2013), although the client automatically expected this activity to fall under the role of the technical advisor, as noted by the person responsible for BIM implementation across organisation B's estate:

It should be the technical advisors doing that. The technical advisors in theory have that in their scope of work. How specific that is… In one of the programmes, I think it's one line saying, you'll do everything necessary to do BIM.

Moreover, many of the activities that were supposed to be defined by the client, such as aspects related to EIR content (e.g. definition of an initial responsibility matrix setting out any discipline responsibilities for modelling or information production in line with the defined project stages), were assigned to the contractor to specify, as an expectation of its conventional role. In summary, the expectation that project stakeholders would automatically cover new functions was found to influence the enactment of 21 clauses. Table 4.18, similar to the other

clauses, provides examples of how the data was used to identify the underlying conditions of enactment.

Table 4.18 – Examples of clauses/processes where their enactment was influenced by existing roles

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
5.1.2	Implementation of the 'letter' of the clause only	A generic EIR, not particular to the project, is proposed, and particulars are only defined after the appointment is made. The EIR was developed by a consultancy and it does not cover the real needs of end-users/asset-operators.	*They were developed with consultancy X and myself, just thinking of sensible questions we should be asking. They haven't changed, nobody ever changes them. There is room in the project particulars to change them, but nobody ever does.* (BIM implementation leader)
5.1.5	Clause not fully implemented	The EIR highlights that the contractor should perform the role of information manager, but it does not provide details regarding the roles and responsibilities. The contractor is expected to define it.	EIR and interviews: *I think it's just one line saying, 'You'll do everything necessary to do BIM'.* (BIM implementation leader)
5.3a item 3	Implementation of the 'letter' of the clause only	The EIR highlights that the contractor should organise the CDE and manage it according to the standards	EIR
5.3b item 4	Non-implementation	There was no initial responsibility matrix setting out any discipline responsibilities; the EIR states that the contractor should carry out the role of information manager.	EIR

4.3.4.2 Existing authority systems

As previously mentioned, existing authority systems, as in decision-making regarding the selection of contractors, were not changed. The authority assigned to specific actors remained the same, although a change was necessary, for example, for asset-operators to start to have a voice in the specification of requirements, as noted by a technical advisor:

I suspect that one of the lessons learned from all of this would be how the client and the end-user in this type of construction project can work together earlier to look at what potential future asset management requirements the trust might need. At the moment, it's very much organisation B is client, the Trust is the end-user and stakeholder, and only organisation B makes the decisions on the specifications.

This led to an enactment of activities following the standards but not the realisation of the expected goal, as in the case of the above-assigned authority system in terms of the specification of meaningful information requirements and non-complete implementation of other processes, as exemplified in Table 4.19.

Table 4.19 – Examples of clauses/processes where their enactment was influenced by existing authority systems

Clause	Enactment	Description	Representative quotes/events/documents (antecedents)
5.1.2	Implementation of the 'letter' of the clause only	The EIR was developed by a consultancy, and it does not cover the real needs of end-users/asset-operators; because of existing authority systems, asset-operators do not get involved in the requirements specification.	*It's very much organisation B is the client, the Trust is the end-user and stakeholder, and only organisation B makes the decisions on the specification. However, sometimes the end-user might have a view on that.* (technical advisor)
5.1.3	Clause not fully implemented	The information requirements are not specific, because as per existing authority systems in place, the asset-operator does not get involved in the requirements specification for inclusion in the EIR.	*I suspect that one of the lessons learned from all of this would be how the client and the end-user in this type of construction project can work together earlier to look at what potential future asset management requirements the Trust might need.* (technical advisor)
5.2.1	Implementation of the 'letter' of the clause only	The EIR is issued as part of the employer's requirements and tender, but it is a generic EIR, not specific to the project. A specific one cannot be defined because asset-operators do not get involved in the information specification.	EIR and same as above

4.3.4.3 Existing governance systems

As previously mentioned, organisation B does not directly operate the assets within its estate. According to the person leading the interface with the government policy, the fact that they do not manage the buildings directly represents a challenge for BIM level 2 implementation across the whole life cycle of the asset:

> *We've always struggled a bit with not being owner–operators of our estate. That's always been a challenge, how we could implement it on the few hundred projects we manage directly. I think it's fair to say we've struggled with buy-in to BIM within the organisation generally. The same questions always come back, we don't operate the estate.*

Many of the processes/activities, especially with regards to PAS 1192-3:2014, have not been implemented because of the current governance system (the means by which the organisation is directed) related to asset management, as highlighted by the person leading the interface with government policy:

> *We see others who have got whole estates to manage. I think those ones tend to be the ones who have embraced BIM more fully. They've got a closer connection to, yes, 'This is our problem, and this is a solution for it.'*

As client organisation B does not operate the estate, and asset management is the responsibility of its asset-operators, it has not defined, for example, an information management process that considers governance processes to direct, control and ensure that asset information is managed effectively; nor has it defined an OIR document. Another example of an existing governance system in place within organisation B that led to the non-implementation of some processes/activities is related to the definition of the information systems for use by the asset-operator and the procurement of those systems. There is no unique CAFM system used across the entire estate. Conventionally, the facilities management system is defined and procured in the later stages of the project, and, for this reason, the interfaces for data exchange are not defined as part of the EIR and AIR at the beginning of the project, as required by PAS 1192-3:2014.

Moreover, the governance system, along with existing procedures (current framework) and authority systems, where the asset-user only becomes involved and can share input on the project in later stages, led to non-complete implementation of processes/activities, as in the case of the definition of specific asset information requirements (clause 5.1.3 of PAS 1192-2:2013), as noted by the BIM manager:

The COBie requirement, as defined by the client, isn't necessarily detailed enough. The EIR and AIR are kind of generic. Then, when it comes to a project level, the majority of the time they are not sort of filled in.

As highlighted by the technical advisor, the final-user was supposed to be involved in the earlier stages of the project:

I think the end-user needs to be involved, and a structure for the transfer to the end-user in there as well as part of the requirements.

Besides hindering the full implementation of processes, leading to non-implementation of others, the existing governance system also led to the enactment of processes and activities that did not lead to the expected goals. This occurred, for example, regarding the definition of information requirements as part of the tender documentation. Although clause 5.2.1 of PAS 1192-2:2013 has been fulfilled and the EIR issued as part of the tender documentation, the EIR does not contain all the requirements from a final-user perspective, as the final-user only becomes involved later in the project, as highlighted by a BIM manager:

From a framework point of view, it's not specific how we get there. When we have to engage with the project teams, we are sort of starting from zero knowledge, trying to explain to them what BIM is, and what benefits you have, and then fill in all the blanks as we go.

Thus, various aspects of the current governance system at client organisation level led to implementation issues in the project. In total, 41 clauses/processes were found to have enactment impacted by existing governance systems. As previously highlighted, the governance systems were aligned with existing procedures, which also ended up framing the enactment of the new information processes/activities.

4.3.4.4 Existing procedures

The data also revealed that the existence of the previously mentioned framework for project delivery (setting the work procedures) framed the implementation of processes in a way that they did not follow the standards' recommendations completely, or, if they did follow them, they did not lead to the achievement of what was originally intended by the standards. Table 4.20 shows some examples of the clauses and respective processes that have been enacted following existing procedures.

Table 4.20 – Clauses/processes where their enactment was influenced by existing procedures

Clauses	Enactment	Description	Representative quotes/events/documents
5.3a item 1	Implementation of the 'letter' of the clause only	The EIR contains the level of detail for submission at defined project stages but it is a very high level. The same procedures for requirements' specification have been followed, without including the asset-operators.	EIR and interview: *It's very much organisation b is the client, the Trust is the end-user and stakeholder, and only organisation b makes the decisions on the specification.* (TA)
5.3b item 1	Implementation of the 'letter' of the clause only	There is alignment of information exchanges and work stages in the EIR, but there is misalignment with the purposes of the asset-operator. Also, although information exchanges have been defined, formal exchange with the client only occurred at handover, as per following existing procedures.	*At this present moment we don't have any information to be able to use to format a procurement document for mechanical and electrical maintenance services. It's very difficult to receive a building and be responsible from day one when you don't actually get the information of what's in there until that day one.* (asset-operator)
4.3 item e	Non-implementation	The interfaces for exchange of data and information have not been defined, because the definition of the CAFM system to be used followed the existing framework.	*Before information is uploaded into PS Assets it needs some standardisation and cleaning up; that did not happen.* (CAFM provider)
4.3 item f	Non-implementation	The mechanisms for maintaining the AIM and for monitoring its quality were not defined, and the same procedures used before for asset maintenance have been followed.	Observations, AIR

This occurred, for example, when defining the project's particular requirements only after the project team was appointed and began engaging with the asset-user. The framework sets the procedures for interaction, which implies final-users becoming more involved only

after the project team has been defined instead of defining the requirements for inclusion in the tendering process. These procedures influenced the way the design process unfolded because of a lack of input specification, which led to changes later on and resulted in extra costs. As highlighted by a technical advisor, if the asset-user had been involved from the early stages of the project, better specification could have been made, thereby avoiding further remodelling leading to extra costs:

> *I suspect that one of the lessons learned from all of this would be how the client and the end-user in this type of construction project can work together earlier to look at what potential future asset management requirements the end-user might need, and how that could feed into the client's decision on the specification of the building, because a lot of the time, it's very much organisation b is the client, the Trust is the end-user and stakeholder, and only organisation b makes the decisions on the specification.*

Existing procedures for managing changes/variations were also reproduced in the project and led to extra costs to the contractor. Changes in the previous stages of the design process and procedures have not occurred to avoid further changes that would require rework in the models.

Other existing procedures for conducting activities were replicated when enacting certain processes and activities. Reviewing and authorising information in the client shared area of the CDE was done on a 2D output, as revealed by the technical advisor:

> *Our appointment is to review it on a 2D output. We are not appointed to review the 3D model and comment upon its accuracy in that regard.*

Thus, similar to organisation A's project, the procedures in place were reproduced instead of being reconfigured.

4.3.4.5 Reward and cost structures

Organisation's B existing framework and the assignment of risks to contractors (its reward and cost structures), similar to organisation's A projects, were found to influence enactment of a range of activities. Table 4.21 shows some examples. Under organisation's B framework, all risks and costs are assigned to the contractor; this led to some processes not being completely implemented (e.g. the submission of a post-contract BEP), as the risks would be the contractor's responsibility anyway.

Table 4.21 – Clauses/processes where their enactment was influenced by rewards and cost structures

Clauses	Enactment	Description	Representative quotes/events/documents
5.1.5	Clause not fully implemented	The EIR highlights that the contractor should perform the role of information manager and follow the standards; it does not provide details regarding the roles and responsibilities, as the risk is assigned to the contractor.	*Our approach, pretty much, has been… Contractor, you do everything BIM and take all the risk, we'll give you a fixed price, we'll give you lots of work. We're the third biggest client in the country.* (BIM implementation leader)
6.1.2	Clause not fully implemented	The BEP does not provide sufficient information to determine if the requirements within the EIR are achievable – the capabilities of the whole team are not clear. The main contractor is responsible for all risks, including the delivery of models, so its supply chain capabilities to delivery are also his responsibility.	BEP, same as above
7.2.1	Non-implementation	There was no post-contract BEP. As the responsibility lies with the contractor, only a pre-contract BEP was defined.	BEP, same as above

4.3.4.6 Existing duties' systems and codes of conduct

The data also revealed that, despite bidders being asked to demonstrate their capabilities and the EIR containing details of the competence assessment that bidders should respond to (clause 5.3 of PAS 1192-2:2013), the competence requirements were not followed when selecting the contractors, because of the established codes of conduct within the client organisation, as exemplified in Table 4.22.

Table 4.22 – Examples of clauses/processes where their enactment was influenced by existing duties systems and codes of conduct

Clause	Enactment	Description	Representative quotes/events/documents
5.3c item 1	Implementation of the 'letter' of the clause only	Details of the competence assessment that bidders should respond to were set up in the EIR but not followed in practice.	*We were harder on the bigger contractors, we had to balance it with… We get criticised if we don't allow smaller contractors onto our frameworks. We didn't want BIM to be a pass/fail kind of thing.* (BIM implementation leader)
5.3c item 2	Implementation of the 'letter' of the clause only	Changes to incorporate BIM questions were made but not strictly followed in practice.	*To get onto the framework, there are the pre-qualification questions. We ask some of the BIM questions from that, which contractors need to satisfy to get onto our frameworks. But we were harder on the bigger contractors, we had to balance it with… We get criticised if we don't allow smaller contractors onto our frameworks. We didn't want BIM to be a pass/fail kind of thing.* (BIM implementation leader)
5.3c item 3	Implementation of the 'letter' of the clause only	BIM tender assessment details were provided but not strictly followed in practice.	Same as above

Thus, some processes, such as the assessment of bidders, were not completely followed because the codes of conduct in place were not reconfigured.

4.3.4.7 Models of reality

The data revealed that, while the project information model was produced and delivered to the employer's decision-making processes, as defined by the EIR, more information was delivered than necessary with regards to non-graphical data. This occurred because of the common frames and patterns of belief, namely, a shared understanding and risk-avoidance culture of

over-production, as could be inferred from the comment of a BIM manager regarding the production of COBie data:

> *A very diligent contractor and design team will be putting forward all that information, you know. It's easier and better to strip something out and filter it for an end-user than it is to go back and find that information. If you've got access to it, put it in.*

Other frames that have been automatically replicated in the projects included, for example, existing ways of communicating, such as by email, as exemplified in Table 4.23.

Table 4.23 – Examples of clauses/processes where their enactment was influenced by existing models of reality

Clause	Enactment	Description	Representative quotes/events/documents
9.1.2	Implementation of the 'letter' of the clause only	The PIM was developed in accordance with the MIDP but more information than necessary was produced.	*A very diligent contractor and design team will be putting forward all that information, you know. It's easier and better to strip something out and filter it for an end-user than it is to go back and find that information. If you've got access to it, put it in.* (BIM manager)
9.1.6	Clause not fully implemented	The process of creation and sharing of information has not been consistent, with information exchange happening via email.	*One of the things that is notable on this project is there is still an awful lot of email communication. There is an awful lot of correspondence, and there is an awful lot of discussion. Even though we've all got access to the CDE, it's actually not the place where that discussion is typically taking place. It's still taking place in workshop environments and across those emails. It's quite useful having the emails because you've got a record of the correspondence.* (technical advisor)
9.2.2.1	Clause not fully implemented	The WIP section of the CDE was used to hold unapproved information, but not extensively, as information exchange also happened via email.	Same as above

In other words, existing frames and routines still made the project team consider particular directions for action.

4.3.4.8 Lack of skills and resources

A lack of resources, from an operational perspective, has also been cited as influencing the implementation of new processes/activities (specifically those related to the operational phase), as highlighted by the person responsible for the digital transformation strategy:

> *We haven't really got the resources to do much with that data; hopefully we're going to do something about that.*

Skills shortages in the marketplace have also been cited as a barrier for the use of data models during the operational phase, as noted by the person responsible for the digital transformation strategy:

> *It's not just about linking to the assets and all that sort of stuff. It's about having the skills set within your own organisation that can interpret the data correctly. In the case of extensions to schools or anything like that, there is a skills shortage in the marketplace within the school's estate to be able to use this data. I think that's a challenge.*

In summary, it was observed that implementation at project 6 followed the same patterns as projects 1 to 5 in terms of both the types of response employed and the causes leading to those responses. Implementation, however, did not necessarily occur in the same way; in other words, the projects of both organisations did not respond similarly to the same clauses; patterns in the forms of responses were found, not necessarily the same responses to the same process. Also, as it was not the early stages of adoption for organisation's B projects, and the contractor was also experienced in BIM implementation, the early stages of adoption were not found to be causal for non-holistic implementation. On the other hand, two other causes were identified: existing duties and codes of conduct and a lack of skills or resources. The data collection and analysis then proceeded to organisation's C projects, where implementation was mostly driven by technical reasons.

4.4 Client organisation C: BIM level 2 implementation in projects 7 and 8

4.4.1 Overview

Client organisation C committed to implementation of the BIM level 2 mandate to digitise its estate (which includes 138 buildings) and support many parts of its business, including the

development team, data information and system teams, and the operations and maintenance teams. The adoption of BIM level 2 and digital technologies included modelling assets to support both the organisation and design teams to achieve an optimal design. This further included the lowest overall costs to mitigate risks and liabilities, drive maintenance prioritisation, target investment in asset renewal, inform estate planning, provide input on environmental and sustainability assessments, and provide feedback on future construction procurement.

The digital transformation journey began in 2017 and included a plan to start examining existing buildings, surveying them and identifying the information that organisation C's estate department had access to at the time, including CAD and paper-based documents. Fourteen BIM models were created retrospectively, and the estate department was in the process of updating all their building information, CAD plans and drawings after surveying the existing buildings.

Organisation C wanted to shift from a physical to a digital archive, and, for this reason, it initially performed a major clean-up of its existing archives. The cleaning-up process included scanning documents, shredding unnecessary information and moving information to a common data environment. A BIM library was also created. To manage information and collaborate with its range of stakeholders, organisation C created a structured information environment and a range of documents to support BIM implementation, including a BIM policy document, templates (EIR and AIR) and implementation plan. BIM adoption and implementation at organisation C's projects, therefore, was completely driven by technical reasons. The aim was to produce structured information models that could be used over assets' entire life cycles. For this reason, organisation C took certain actions, such as developing a template that could take asset information and import it into its facility management system. Other initiatives included developing building-naming/numbering policies that could be used consistently.

The projects under analysis were some of the first projects to implement the BIM level 2 mandate. By the time of data collection, project 7 had already been completed, and project 8 was at RIBA stage 5 (construction). Project 7 was actually organisation C's first BIM level 2 project. However, the project was not initially meant to be a level 2 project, and the design was carried out following conventional ways of working. At some point, the project manager, an external consultancy company, suggested that the client could benefit from BIM level 2 mandate implementation. Then, the client requested implementation of BIM level 2 from the construction stage.

Project 8 consisted of a four-storey building to be linked to an existing building, a teaching block opened in 2012. BIM implementation for this project was guided by lessons learned with its adoption in project 7. As explained in Chapter 3, project 8 was selected to gain a broad understanding of mandate implementation across all stages. As patterns were observed when comparing it with projects 1 to 6, investigating only one project was found to be sufficient to confirm what had previously been observed in terms of enactment.

4.4.2 The 'what' or the content of BIM level 2 implementation

As previously mentioned, the principles of information modelling maturity level 2 were followed for project 8 but only partially applied in project 7. It was observed that almost all documents and standards stated in the EIR were used as guidance only. Some inconsistencies could be identified: PAS 1192-3 was stated as not applicable, and the only standard reported to be effectively used was BS 1192-4. Most of these documents and standards were, however, effectively applied in project 8. The standards not applied in any of the projects included the government soft landings, PAS 91:2012 and PAS 1192-5:2015. The CIC scope of services and the CIC BIM protocol were considered only partially (Appendices 1 and 2 only). Table 4.24 summarises the standards, documents and principles implemented.

Table 4.24 – Principles, standards and documents implemented in organisation C's projects

Information modelling maturity level 2	Impleme-tation	Data underlying the findings	Representative quotes/events/documents
Information models developed following enabling tools	x	Use of tools required in EIR	EIR (item 2)
Provision of a single environment to store shared asset data	x	Use of a CDE reported	EIR
Development of BEP by the supplier	x	Access to BEP produced by the main contractor	BEP
Evaluation of the proposed approach, capability and capacity of each supplier	x	Requirements set in EIR	EIR
Provision of a clear definition of the EIR and key decision points	x	Access to EIR	EIR

Information modelling maturity level 2	Impleme-tation	Data underlying the findings	Representative quotes/events/documents
Originators producing information in models	x	Use of tools and production of information in models	EIR
Application of BS 1192:2007	x	Reported in EIR	Clause 1.2.1 of EIR
Application of BS 7000-4:1996			
Application of BS 8541-1:2012	x	Reported in EIR	Clause 1.2.1 of EIR
Application of BS 8541-2:2011	x	Reported in EIR	Clause 1.2.1 of EIR
Application of BS 8541-3:2012	x	Reported in EIR	Clause 1.2.1 of EIR
Application of BS 8541-4:2012	x	Reported in EIR	Clause 1.2.1 of EIR
Application of PAS 1192-3:2013	x	Reported in EIR	Clause 1.2.1 of EIR
Application of PAS 1192-3:2014	x	Reported in EIR	Clause 1.2.1 of EIR
Application of BS 1192-4	x	Reported in EIR	Clause 1.2.1 of EIR
CPIx protocol	Partially	Reported in EIR	Clause 1.2.1 of EIR
CPI Uniclass	x	Reported in EIR and observed in COBie	Clause 1.2.1 of EIR
CIC BIM protocol	x	Reported in EIR	Clause 1.2.1 of EIR
CIC scope of services	Partially	Reported in EIR	Clause 1.2.1 of EIR
Government soft landings			
Institutional plans of work	x	Reported in EIR	Clause 1.2.1 of EIR

Regarding project 7, the appointed design team was not assessed for BIM capability, as the project only started applying the BIM level 2 mandate during the tender stage for construction. Moreover, project 7 did not initially have an EIR or AIR in place or key decision points in the early stages of the project. A BEP was not prepared by the design team either.

Because many processes and activities recommended by the standards were not implemented in project 7, such as the assessment and appointment of the supply chain with appropriate BIM capabilities, the project team had to expend extra effort later in the project, as explained by the lead contractor, with regards to inputting the necessary information from the subcontractors in the project information model:

With the asset information for the M&E consultants, I'm not going to lie, that took months and months and meetings and meetings to try and get them to understand what it was that we wanted.

For project 8, although most of the standards and documents were implemented, there were also processes and activities prescribed by those standards that were not implemented, which was similar to the other analysed projects (projects 1 to 6). Examples included clause 5.3a item 8 of PAS 1192-2:2013 regarding the EIR not covering specific information for either exclusion or inclusion from/in the information models. Other examples regarding PAS 1192-3:2014 included non-definition of the roles and responsibilities for information management during the operational phase, according to clause 6, and non-implementation of processes to provide the CDE. Thus, despite the goal of BIM level 2 implementation in projects 7 and 8 being technical and not only complying with the mandate, the same patterns of response were observed in terms of the content implemented. The non-adoption or non-implementation of specific clauses, however, especially in project 8, was less frequent than in the other projects. Table 4.25 shows some examples of clauses not being implemented, and how data was linked to enactment.

Table 4.25 – Examples of clauses/processes non-implemented in organisation C's projects

Clause	**Enactment**	**Representative quotes/events/documents underlying enactment**
5.3a item 8	The EIR does not cover any specific information for either exclusion or inclusion from/in the information models.	EIR
4.3 item a	Information governance processes have not been established yet.	*We're doing quite a big piece of work on that at the moment, because there are a lot of systems that have space data, but they have it in different formats, different naming conventions, etc*. (facilities manager)
4.3 item f	The mechanisms for maintaining the AIM have not been defined yet.	Same as above
5.1	Organisation C still does not have a CDE.	*We are still going through a procurement process to find the right CDE, to understand our information piece and what everybody needs from a CDE system.* (client's BIM manager)

4.4.3 The ‘how’ of BIM level 2 implementation

The practical enactment of the BIM level 2 mandate occurred more fully for project 8. For project 7, many of the proposed processes/activities were not implemented, or implementation did not occur in full.

Some processes/activities were carried out differently than in other projects. For example, the definition of the information requirements and development of the EIR took place collaboratively with the whole team for project 7, and it was amended later by the appointed information manager for future projects, including project 8. This was a positive aspect, as noted by the lead contractor for project 7:

> *The good thing about that was everybody was in the room that was involved. You had the clients, you had the facilities management guys and the people that were going to run the building. You had us as the contractors and the designers. There were several members from organisation C estates team. That stopped everybody from being selfish because if you've only got the architect in there, the architect will only wok for the EIR so they don't have to do any extra work. If the contractors are in there, they'll try and strip everything out to keep it minimal. If the facilities management guys are in there, the estates managers, they're only really interested in how the building is run. It's not how it's built. As far as I'm aware, it's been a very segmented process. Not everybody worries about the next stage or what it is that they're doing and how that's going to affect the end. Not wanting to pick on the architect but the architect doesn't care how the building is run.*

Moreover, the BIM manager for project 7 (client side) reported that organisation C appointed someone to undertake the information management function on its behalf for all projects, and, because of the knowledge and experience of this person, organisation C was a much better-informed client than others:

> *If you look at others, they'll say, ‘Right, we want the standard COBie 2012 UK,’ and then they don't set out how they want that data to look. Hadeel provided an exemplar EIR so we could see what the data fields needed to capture, so that was very good. It's necessary, and something that's missed with other clients.*

The facilities management team also has an information manager who liaises with the appointed information manager to manage capital delivery, and both have worked on an asset management strategy, which feeds back into the asset information requirements document. This led organisation C to ask for information deliverables aligned with its strategy and the

development of organisation information requirements, which were not produced for the other analysed projects. This streamlined the requirements, leading organisation C to ask only for information that was going to be effectively used. The information managers also worked on a range of aspects related to the asset information model and its use during the operational phase, which is in alignment with PAS 1192-3:2014. Thus, in comparison with the other projects, organisation C and its respective projects implemented the mandate more extensively.

However, although to a lesser extent than in other projects, it could also be observed that not all processes/activities were implemented fully. Examples include the EIR not having an initial responsibility matrix setting out the discipline's responsibilities for model or information production in line with the defined project stages, although it contains a high-level description of roles and responsibilities, as noted by a contractor (project 8):

> *The M&E systems: it's always the trickiest package in terms of where the design responsibility lies. I think it needs to be better defined by the client.*

Also, there is the production of information regarding the process of creation, sharing and issuing of production information in a consistent and lean way (clause 9.1.6). According to the BIM manager for project 8, there were problems with issuing information:

> *There have been some issues around the common data environment, that's a management thing: people uploading stuff to the wrong status code, the wrong naming convention.*

Other aspects involved the creation of the project information model not strictly in accordance with the MIDP. According to the BIM manager for project 8, engagement with the MIDP should have begun earlier:

> *I guess one lesson learned would be, probably, to engage with the MIDP earlier. Engaging with that earlier would have improved the flow of information from certain suppliers.*

The BIM manager reported that, although the suppliers compiled their TIDPs, they should have done it in a more refined way. The models were not developed appropriately, and remodelling was necessary for some services, as highlighted by the BIM manager:

> *The MEP consultant model was so far away from a construction model that we started again with the MEP model.*

The production of information was not truly lean, which is the end that PAS 1192-2:2013 was created for. In the case of the MEP model its future use was not considered when it was produced, leading to rework, as noted by the BIM manager:

The fundamentals of BIM are lean principles and avoiding the double handling of work. You shouldn't have to produce a fresh model, but that was because the MEP consultant's model was so far removed and the design had been through value engineering.

There were also requests for changes resulting from not fully complying with the standards, such as clause 4.5.2 of PAS 1192-3:2014 and the specification of an agreed classification system. Because the AIR template did not require any classification system in the first place, after the project team has been assembled for project 8, organisation C asked for the use of Uniclass, as noted by the BIM manager:

She wanted things in Uniclass later on because that's how Planon categorises the information, but that wasn't in the original AIR.

Also, the processes regarding management of the common data environment were not strictly followed, as highlighted by the contractor for project 7:

We used software called Livelink, which wasn't exactly geared up to fall in line with the BS1192 file-management system, or indeed the file-naming convention. We were literally having to hammer down on the designers for naming their files. We didn't actually have software in place that helped us manage that. Part of the design management process of whether a drawing got an A, B or C status included whether the file naming was correct.

In summary, 24 clauses were found not to have been fully implemented. Table 4.26 shows some examples of linking the data to enactment.

Table 4.26 – Examples of clauses/processes not fully implemented in organisation C's projects

Clause	Enactment	Representative quotes/events/documents underlying enactment
5.1.2	The employer specified in the EIR that the main contractor should provide tables of data drops as part of the BEP instead of specifying it.	EIR
6.1.3	The BEP does not provide information on the supply chain's capabilities and responsibilities.	BEP
6.1.4	The BEP does not provide information on the supply chain's capabilities and responsibilities.	BEP

Clause	Enactment	Representative quotes/events/documents underlying enactment
9.1.6	The process of sharing and issuing information was neither consistent nor done in a lean manner.	*There are some issues around the common data environment – that's a management thing: people uploading stuff to the wrong status code, the wrong naming convention.* (BIM manager)
4.3 item d	There are no mechanisms in place for archiving the information and data held in the AIM, as there is no CDE in place yet.	*We are still going through a procurement process to find the right CDE, to understand our information piece and what everybody needs from a CDE system*. (client's BIM manager)

Moreover, although some processes were implemented according to the standards, similarly to the other projects, they were not necessarily implemented in a way that would lead to achieving the expected purpose of the standard. For example, although the PIM was produced following the MIDP (clause 9.1.2 of PAS 1192-2:2013), it did not necessarily support decision-making across the stages in terms of the LOD of the models, as noted by the BIM manager:

> *You can write a model-production delivery table and say, 'Right, this is the LOD requirement for each system,' but I think there was room for interpretation in the LOD requirements between a stage 4A design and a stage 4B design.*

Although this type of enactment occurred for fewer clauses/processes in comparison to the other projects, it still happened for five clauses, thus showing the same patterns of implementation. In comparison to the other projects, however, BIM level 2 was more fully implemented in organisation's C projects.

The data for project 8 and the previous projects has also shown that when one activity is not fully implemented, in terms of either compliance with the standards' recommendations or full implementation, related activities in later stages might also not be fully implemented, not follow the recommendations (non-implemented) or simply be affected by the related activity, as the project's activities are inter-related. This occurred in project 8, for example, regarding the specification of information for exclusion or inclusion from/in the information models. As there was no specification in the EIR by the client, the MIDP did not provide any specific recommendation either, and, later on, the models were approved when checked for compliance with the EIR and authorised for sharing. When shared with the client, however, the information manager pointed out that the floors were missing from the architectural model. These were produced as part of the structural model, and not the architectural model, because it was not

specified initially. In other words, enactment related to the 'what' and 'how' had a 'knock-on effect' across the project life-cycle stages.

4.4.4 The 'why' of BIM level 2 implementation

Similar causes for non-implementation or non-extensive implementation of the coercive pressure could also be identified for organisation's C project. As they repeated for the projects and there were no new causes emerging, they were considered to be the ones leading to non-holistic implementation. Table 4.27 summarises the causes identified for non-holistic implementation in project 8, as project 7 had most of the clauses not implemented because it was not a full BIM level 2 project. The following sections briefly describe the identified causes, for the purpose of illustration.

Table 4.27 – Causes for implementation of the clauses and respective processes for PAS 1192-2:2013 and PAS 1192-3:2014 (project 8)

	Project 8
Reward/cost structures	14
Role expectation	5
Procedures	17
Skills/experience/resources	2
Early stages	8
Bodies of knowledge	1
Models of reality	2

4.4.4.1 Existing roles

The data revealed that the existing social positions of actors were re-enacted in the projects, leading to implementation issues, as previously identified for the other projects. Table 4.28 shows some examples of enactment influenced by repetition of existing social positions.

Table 4.28 – Examples of clauses/processes where their enactment was influenced by existing roles

Clause	**Enactment**	**Description**	**Representative quotes/events/documents**
5.1.2	Clause not fully implemented	The employer let the contractor specify the data drops in their BEP instead of specifying the decision	EIR

Clause	Enactment	Description	Representative quotes/events/documents
		points and plain language questions required at a particular stage.	
5.3b item 4	Clause not fully implemented	The EIR does not contain the discipline's responsibilities for model and information production, although it contains a high-level description of roles and responsibilities. It is the contractor's responsibility.	EIR
6.1.5	Clause not fully implemented	The contractor is responsible for the cascade of information through the supply chain, but their information cascade processes are not specified or required. It is assumed that it is their responsibility.	BEP, EIR
7.2.1	Clause not fully implemented	The BEP did not contain all the content specified in clause 7.2; some of the content was automatically assumed to be the contractor's responsibility.	BEP
8.3	Implementation of the 'letter' of the clause only	The EIR sets out that training needs should be identified by the contractor in the BEP, but there is no requirement for evidence of actions. Although it is in place, issues occurred in the project.	*There are some issues around the common data environment – that's a management thing: people uploading stuff to the wrong status code, the wrong naming convention; just teething problems like that. I guess you'd umbrella that into upskilling the project team because the requirements are slightly more strenuous.* (BIM manager)

For example, regarding the activity of defining the information exchange (clause 5.1.2 of PAS 1192-2:2013), although the definition of information exchange and collaborative working requirements were undertaken in parallel with other procurement and project definition activities for project 8, the employer let the contractor specify the data drops in their BEP instead of specifying the decision points and PLQs required at a particular stage. In other words, there was an expectation that the contractor would perform the activity under a common understanding that particular actions are associated with particular actors.

In comparison with the other projects, however, there have not been role expectations for existing actors in terms of, for example, defining the information requirements, as noted by the BIM manager for project 8:

> *In terms of client documentation, organisation C has been good compared to other clients, probably because they've got this lady there. She's the informed client, as in she knows what the client requires from BIM.*

4.4.4.2 Existing procedures

It was observed that existing procedures, such as those for health and safety management and CDM management, continued to be followed. A lack of reconfiguration of existing procedures led to non-complete implementation, such as for clause 5.3a item 6 of PAS 1192-2:2013. Also, organisational-level procedures, such as the decision-making process regarding the systems' performance, were not changed, leading to issues in the coordination process, for example, as noted by the BIM manager for project 8:

> *Performance requirements should be set out before we engage in the process. We can coordinate all the cable trays, the ductwork and the pipework, but when you've got a big system sat in the middle of your model that's a complete unknown, that hinders the coordination process because it's an unknown. We don't know if we'd have to size that system up and the specifics of it, the physical geometry of it.*

The management of changes was not reconfigured as well, which, in BIM projects, may create extra work because of the need for remodelling. This occurred, as noted by the project manager:

> *There was a huge change in where we brought a lot of the analytical labs from the fourth floor down to the third floor, which was a massive change and probably added four months to the project.*

The process of information creation, therefore, has not been consistent, in that the information could be managed and delivered in a lean manner.

The re-enactment of existing procedures and ways of working could also be observed for project 7 regarding the production of COBie information. Although a template for asset data collection was developed and provided, and the PIM was developed in accordance with the MIDP in terms of 'what' was implemented, the supply chain apparently struggled to gather the COBie data, because it did not change the way it collected it, as highlighted by the client information manager:

They said they were struggling to gather COBie data and, however, if they thought of something early, which is asking the COBie data in the spreadsheet that we provide from the providers at the point of ordering equipment, so whenever they order a piece of equipment, they will get the COBie data associated with it at the same time. So, that's one of the things we could have done better.

The re-enactment of procedures, mostly at organisational level, therefore, was observed to be a cause of non-holistic implementation and found to influence the enactment of 17 causes.

4.4.4.3 Scripts for action from bodies of knowledge (discipline-based focus)

Projects in the context under analysis follow a plan of work provided by the body of knowledge of the Royal Institute of British Architects (RIBA), in which the projects and respective activities are divided into stages. Following this division, according to the BIM manager, in terms of the LOD, it created room for interpretation:

You can write a model-production delivery table and say, 'Right, this is the LOD requirement for each system,' but I think there was room for interpretation in the LOD requirements between a stage 4A design and a stage 4B of design.

Thus, although the PIM was developed in accordance with the MIDP, it has not necessarily supported decision-making as expected across the stages, as existing models of work from the bodies of knowledge still frame the work in projects and influence the enactment of activities, such as clause 9.1.2 of PAS 1192-3.

4.4.4.4 Models of reality

The business behaviour in the construction industry is generally considered risk-averse (Akintoye et al., 2012). Reproduction of this risk-averse model led to an initial overspecification of the OIR and requirements for project 7, which has been further refined by organisation C and project 8, as noted by the information manager:

For project 7, we had way too much information that is not really necessary or useful, and we now realise that.

Even though the information-users were involved in the project, and existing roles were not re-enacted as for previous projects (i.e. contractors and consultants defining the requirements without involving those who would use the information in the process), there was

overspecification of requirements at the early stages of adoption because of following these existing frames.

Other processes enacted under the framing of existing models of reality involved clause 9.1.6 of PAS 1192-2:2013, which was not consistent, with naming issues happening as project team members responsible for controlling the issued documents tended to follow previously used templates for naming. Also, a formal handover (clause 10.2) was not defined in the EIR, although the content and structure of information to be exchanged were defined; the handover occurred following shared ways of doing it, without establishing a formal process.

4.4.4.5 Lack of skills/experience and resources

The BIM manager mentioned a lack of skills/experience as one of the reasons for non-extensive implementation of some clauses, such as aspects related to issuing and sharing information within the CDE (clause 9.1.6), although the supply chain has, in theory, been appointed given its capability and they have been trained.

For project 7, the same thing occurred, with the BIM manager attributing it to the fact that they did not have a proper CDE in place (i.e. a lack of resources) that could facilitate the management of document naming:

> *We used software called Livelink, which wasn't exactly geared up to fall in line with the BS1192 file-management system or indeed the file-naming convention. We were literally having to hammer down on the designers for naming their files. We didn't actually have software in place that helped us manage that. Part of the design management process of whether a drawing got an A, B or C status, included whether the file naming was correct.*

Although there was a commitment to implementing the process, the BIM managers noted that a lack of skills interfered with implementation:

> *There are some issues around the CDE, for example – people uploading stuff to the wrong status code, the wrong naming convention; just teething problems like that. I guess you'd umbrella that into upskilling the project team because the requirements are slightly more strenuous.*

4.4.4.6 Early in the adoption process

Organisation C's information manager also highlighted that the lessons learned in project 7 supported project 8 and avoided, for example, the overspecification of information requirements in project 8:

We learnt so much from the first handover of project 7 because we had way too much information that is not really necessary or useful.

In other words, the fact that it was the early stages of the adoption process led to some activities being carried out in a way that did not lead to the intended purpose – as in the case of specifying information and over-specifying it – or to other activities not being implemented, as in the case of soft landings not being implemented in project 7 but starting to be considered for project 8:

We did not have, for example, a soft-landings champion at the time, but for now we do.

4.4.4.7 Reward and cost structures

Similar to the previous projects, the data showed that the reward and cost structures in which a price is agreed before works begin played a role in how enactment of the mandate occurred. As the risk is assumed by the contractor, some processes were not completely implemented. This included, for example, clauses 6.1.3, which states that, post-contract award, the BEP shall be re-submitted, which has not occurred, and clause 6.1.4, which requires the contractor to submit a BEP on behalf of the whole supply chain, including a summary of their capabilities and responsibilities, which has not been submitted, as the risk is passed to the contractor anyway.

In summary, similar reasons for enactment to what has been observed in previous projects occurred. Although these causes do not appear with the same frequency, the same types of cause were observed, and no new causes were identified. It could then be concluded that the identified causes were the ones leading to enactment in the previous identified ways.

4.5 Within-case analysis initial findings

The within-case analysis revealed some aspects of BIM level 2 implementation that may indicate how projects respond to pressures (coercive) from the environment. First, it could be observed that implementation of a standard varies considerably from project to project regarding the recommended processes of the standard itself. While some clauses and processes are fully implemented, others may be only partially implemented (in terms of content and meaning) or not implemented at all. It was not identified that there was either 100% compliance with a standard and its recommended processes or full compliance with the whole mandate in terms of implementation of all standards (i.e. implementation of the whole structure). The identified patterns in responses were independent of the motivation for adoption – all projects

had similar types of response (even if to a different extent) independent of what motivated implementation in the setting. This may indicate that, given that projects involve a range of processes towards accomplishing their goals, imposed structures, when related to processes, might not follow a pattern of either 'implementation' or 'not'. Implementation of a coercive pressure may vary at ground level with regards to the extent of compliance.

Second, patterns on how clauses and their respective processes are implemented were identified within each standard, across standards, within each project and across projects. Third, it could be observed that the same causes were actually causes for different types of response within the cases, which indicated causal complexity. The same 'type' of response, for different clauses, had different and also multiple causes. One cause may be the cause for non-implementation or non-complete implementation, for example. As projects are embedded in multiple contexts (i.e. the organisational context, the industry context), it was also observed that the underlying reasons for enactment in certain ways sit within those multiple embedded contexts. Finally, as project activities are inter-related, a knock-on effect was observed, meaning that enactment in a certain way for a specific activity might have led to similar enactment in further inter-related activities.

4.6 Summary and final remarks of the chapter

The analysis of the BIM level 2 enactment in each project showed similar behaviour in terms of implementation and its underlying conditions, independent of specific aspects of each project. As previously mentioned, patterns in responses could be identified independent of the processes/activities involved. Although there were differences in the extent to which those patterns occurred among projects, they repeated. Project 8, however, had fewer unimplemented and non-extensively implemented processes/activities compared to the other projects, possibly showing that if project teams are motivated to adopt/implement a coercive pressure and its imposed structure, mostly because of the benefits it might bring, they might be more conscious about implementation and keen to fully implement it.

As explained in Chapter 3, following aspects of Gioia et al.'s (2013) and Eisenhardt's (1989) methodologies for cross-case data analysis, enactment was further compared across projects, and the identified similarities in enactment were then categorised into types of response (i.e. first-order coding), which were further clustered into second-order themes or two variances of an identified decoupling phenomenon.

The categorised types of response are presented in the following chapter. It is important to highlight, however, that the identified patterns and proposed types of response are related to general responses that repeated for enactment of the multiple processes and activities part of the structured imposed that is part of the coercive pressure, and they do not represent responses to implementation of the specific processes/activities of a specific standard. The goal was to identify not how the projects specifically responded to BIM implementation but possible ways that projects might respond to any institutional pressure imposing a new structure, including related to new processes. The underlying causes of such types of response identified for each case and presented in this chapter were also first categorised (first-order coding) and further clustered into second-order themes of underlying conditions of decoupling, in light of the institutional theory and organisational theory literature.

The initial findings presented in this chapter, followed by the cross-case analysis presented next, led to further analysis to identify how multiple causal attributes combine into distinct configurations to produce a type of response, which is also presented in the next chapter, and to assess whether multiple configurations are linked to the same outcome (equifinality). As explained in Chapter 3, QCA is employed here, as it is suitable for analysing causal processes in typologies, as the typology of responses presented next, because it is based on a configurational understanding of how causes combine to bring about outcomes and because it can handle significant levels of causal complexity (Fiss, 2011), as emerged in the within-case analysis.

Chapter 5 – Cross-case analysis: Projects' responses to institutional pressures, the underlying conditions and the decoupling phenomenon

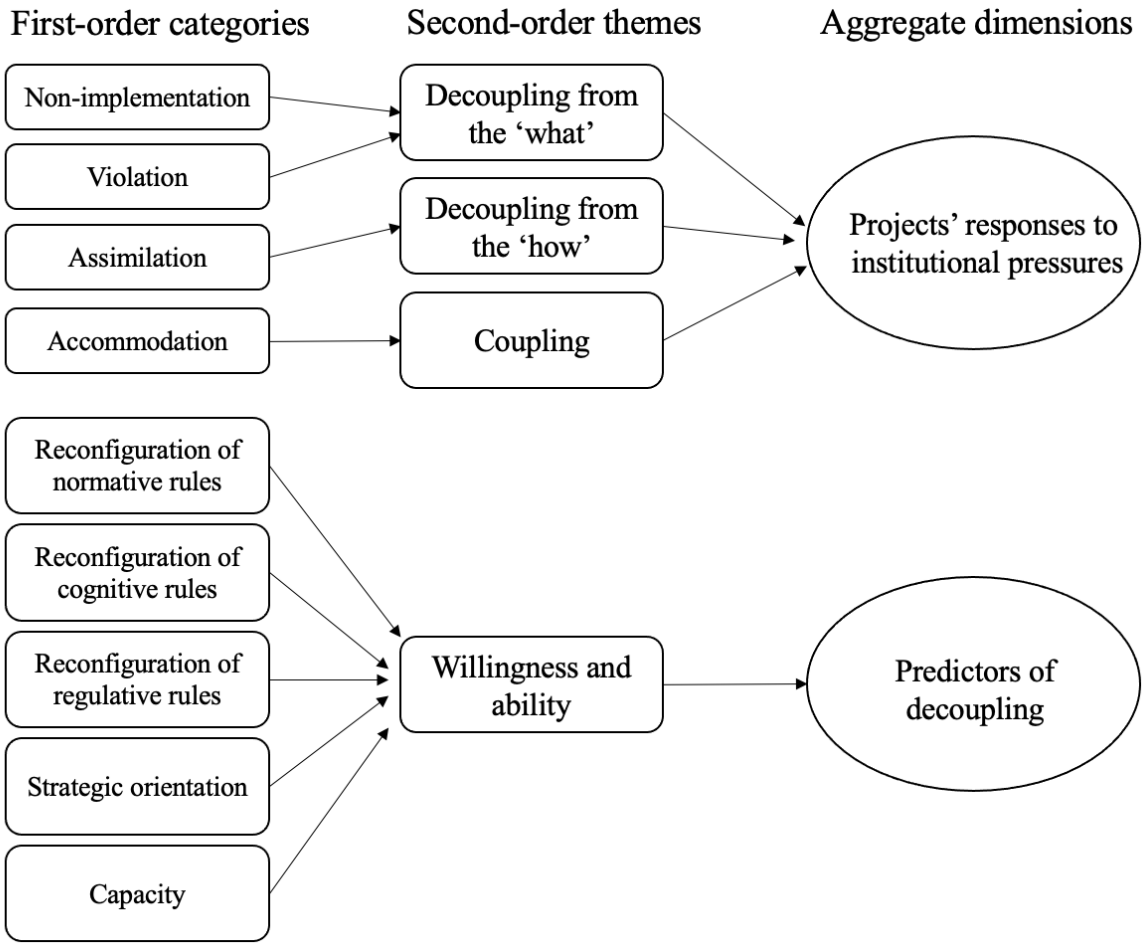
5.1 Chapter introduction

This chapter presents the results of the comparison of the 'what', 'how' and 'why' of BIM level 2 implementation across projects. This comparison led to the identification of patterns related to the implementation content, the way it was enacted and the underlying conditions. These patterns were categorised and labelled as different types of response employed by projects to coercive pressures, and further clustered into second-order themes. In moving to the theoretical realm in the coding process, the first-order categories were compared and clustered into a type of a phenomenon happening within the sector – a decoupling phenomenon, which can help to explain variance in implementation at ground level and, in turn, the pace of the transformation differing from the one envisaged by policy-makers. The underlying causes of the identified responses were also grouped into first-order categories and then into higher-order categories. They are the foundation for the application of the csQCA technique to systematically link the multiple causes to the two main outcomes of non-holistic implementation. The chapter starts with the exploratory cross-case comparison before moving to the application of the configurational comparative method.

5.2 The data structure

Figure 5.1 illustrates the structure of the data from specific, first-order categorisation, which was defined by reconstructing enactment within cases and comparing it across cases, to theoretical second-order themes, following the data-analysis procedure suggested by Gioia et al. (2013). The second-order themes served as the basis for the emergent theory on how projects might respond to institutional pressure.

Figure 5.1 – Data structure



As explained in Chapter 3, the within-case analysis and the enactment reconstructed for each setting/respective project (Chapter 4) served as input for the cross-case comparison. Enactment of each clause/process of the standards was first compared within cases and then across cases and categorised as types of response. These first-order categories are presented in the following sub-sections. The same was followed for the reasons; the causes identified as framing enactment for each case (presented in Chapter 4) were compared within cases and then across cases and categorised (first-order coding). The first-order categories were then further clustered into second-order themes of categories of response to coercive pressures and underlying conditions, in light of the literature.

5.3 Project responses to institutional pressure

The second-order themes that emerged by comparing the first-order categories (explained next), reveal that, when faced with coercive pressure from the environment imposing a new structure and new processes, projects both comply or couple with the imposed structure and

decouple from it. Projects 'adopt' the pressure because of its coercive nature, as they are dependent on those imposing the pressure to either exist or because of the societal expectations regarding its adoption. However, when it comes to implementation of an imposed structure involving change and new processes, it was observed that completely coupling with it might not be the immediate response. While coupling with some aspects of the imposed structure, projects might simultaneously decouple from others, characterising a 'hybrid' response.

As described in Chapter 2, policy–practice decoupling is conceptualised in the organisational theory literature as occurring when a new structure and practices are adopted by organisations but do not result in meaningful implementation, creating a gap between policy and practice (Bromley and Powell, 2012). According to the literature, in this case policies are adopted as ceremonial window dressing, not altering work routines (Bromley and Powell, 2012). The findings here revealed that, actually, a policy–practice decoupling phenomenon might occur at different 'levels', that is, in terms of decoupling from both the 'what' of the coercive pressure and its structure/respective prescriptions (i.e. its content) and from the 'how' of the structure/respective prescriptions (its meaning). This conceptualisation extends previous literature relating policy–practice decoupling as non-implementation or non-extensive implementation of adopted structures and practices (i.e. non-alteration of work routines); essentially, implementation that is related more to the 'what' has been proposed by the structure and its prescriptions, to also consider the meaning of the imposed structure.

The following sections describe the first-order categorisation within and across cases that substantiate the identified decoupling phenomenon and its variances, shown in Figure 5.1.

5.3.1 Second-order theme: decoupling

5.3.1.1 Decoupling from the 'what' of the imposed structure

As shown in Chapter 4 for the within-case analysis of each setting, it was identified that, when implementing the structure imposed by the coercive pressure, projects showed a behaviour of not implementing some of the standards or, when adopting a standard, not implementing all of its proposed clauses/respective processes. Additionally, it was identified across cases that, in other circumstances, implementation of clauses/processes did not occur fully; although some aspects of the proposed clause/process were implemented, they were not implemented in their full extension. These two types of enactment were categorised as 'non-implementation' and 'violation' in the first-order categorisation and were further characterised as decoupling from the 'what' of the imposed structure in the coding process towards second-order themes. Both

types of enactment have in common the decoupling from the imposed structure regarding the structure's content or from 'what' it proposes. Table 5.1 shows representative findings across cases that substantiate the second-order theme 'decoupling from the what'. Each first-order category is discussed in the subsequent sections.

Table 5.1 – Examples of cross-setting findings for the first-order categories underlying the second-order theme: decoupling from the 'what'

First-order category	Representative findings underlying first-order categories	Setting
Non-implementation	Non-implementation of government soft landings, CPIx protocol and PAS 91:2012 identified in the supplier BIM maturity, EIR and AIR.	A
	Clauses not implemented (e.g. clause 5.1.4 of PAS 1192-2:2013): *What we received to tender on and for us to review was a pre-contract BIM execution plan. There were references to COBie and to the workflows, but we didn't actually receive an EIR document.* (project 2)	A
	Non-implementation of government soft landings, CIC scope of services, BIM protocol, etc. identified in the project documentation.	B
	Clauses not implemented (e.g. 6.1.3 and the contractor not submitting a BEP) identified in the project documentation and interviews.	B
	Non-implementation of government soft landings, PAS 91:2012, and PAS 1192-5:2015 identified in the project documentation.	C
	Standards partially implemented (e.g. CIC BIM protocol), clauses not implemented (e.g. 4.3 and non-establishment of information governance processes) identified in the project documentation.	C
Violation	Clauses not fully implemented (e.g. 5.1.3, 5.2.1, 6.1.2), identified in the project documentation and interviews.	A
	Clauses not fully implemented (e.g. 5.1.3, 5.1.5, 6.1.5), identified in the project documentation and interviews.	B
	Clauses not fully implemented (e.g. 5.1.2, 6.1.3, 9.1.6), identified in the project documentation and interviews.	C

Extant literature has posited that policy–practice decoupling is more likely to occur when adoption is motivated by legitimacy rather than technical demands (Bromley and Powell, 2012). Thus, it could be assumed that decoupling from 'what' has been proposed by the policy mandate would be more likely in projects where the motivation for implementing the coercive pressure was purely to comply with the pressure. It was observed, however, that all projects had this type of response (even to a different extent), meaning that the motivation to adopt the

pressure might not be the only predictor of full implementation. As pointed out by Gondo and Amis (2013), there is a shared assumption in organisational theory literature that acceptance of a 'practice' is positively correlated with full implementation. Also, previous research has shown that policy–practice decoupling is more likely to occur when it is early in the adoption process (Bromley and Powell, 2012). The data showed that decoupling from the 'what' of the policy framework also occurred in projects that were not in the early phases of adoption within the client organisation, as seen with organisation B. In other words, it seems that decoupling actually might occur under the combination of multiple conditions and not exclusively because of one reason or another.

It was also observed that decoupling from policy was not necessarily or exclusively intentional or strategic, as highlighted by past research (Fiss and Zajac, 2004; Bromley and Powell, 2012). In fact, it was observed that variance on implementation might simultaneously occur intentionally and unintentionally. While project organisations may realise that the imposed structure is not completely aligned with their strategic goals or conflicts, influencing the extent of implementation, for example, non-holistic implementation may also occur as a consequence of project members not realising the changes that need to occur as part of implementing a new structure.

The literature also shows policy–practice decoupling occurring when evaluation and inspection are not present or happen purely symbolically. Indeed, at a national level, there has not been reinforcement or a mechanism of inspection of full compliance with the mandate. In fact, a lack of evaluation and inspection was common at project level. In the case of project 6, a public-sector project for which implementation was mandatory, evaluation and collection of lessons learnt was supposed to occur but did not. In the other projects (e.g. 1 to 5), it was a symbolic act. Policy–practice decoupling can indeed be attributed to a lack of inspection and reinforcement, but there were also projects, such as project 8, for which policy–practice decoupling occurred for fewer standards/clauses, despite there not being an inspection mechanism in place, showing that inspection might also not be a unique condition.

The factors that have been found to predict this type of response were actually multiple and varied, as discussed in Chapter 4. Decoupling from the 'what' did not occur for one reason only, but rather a combination, showing that decoupling at inter-organisational level might actually reveal characteristics of 'conjunctural causation', as will be discussed further. The first-order categories underlying this theme are discussed next.

5.3.1.1.1 Non-implementation

As presented in Chapter 4, the content of implementation varied in terms of both breadth and depth within and across cases. Non-implementation was a first-order category that occurred in two main forms: i) a lack of adoption/implementation of one or more principles, standards or documents of the proposed policy framework; and ii) incomplete adoption of a principle, standard or document, meaning that some of its clauses and prescriptions and respective processes and activities were not implemented.

Projects decoupled the formal policy and prescriptions that follow it from actual practice by not implementing the prescriptions. It was observed that standards, documents and procedures related to information management during the operational phase of the asset, such as government soft landings and PAS 1192-3:2014, were implemented less often. It was also observed that some processes and activities of some standards, such as PAS 1192-3:2014, were not implemented in the majority of projects. Table 5.2 shows the clauses/processes non-implemented across cases.

Table 5.2 – Clauses non-implemented across cases

Projects	Number of clauses non-implemented	Clauses
Project 1	12	5.1.4, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 6
Project 2	12	5.1.4, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 6
Project 3	12	5.1.4, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 6
Project 4	11	10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 6
Project 5	11	10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 6
Project 6	18	5.3a item 6, 5.3b item 4, 6.1.3, 6.1.4, 7.2.1, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3 item e, 4.3 item f, 4.4, 4.5.3, 4.5.4, 4.6.4, 5.1, 6
Project 8	7	5.3a item 8, 10.2, 4.1, 4.3 item a, 4.3 item f, 5.1, 6

When non-implementing, it was observed that some projects actually reported having implemented some of the processes. In the cases of projects 1 to 5, for example, it was stated in their EIRs that the government soft-landings framework was in place, but it was not

implemented in practice. This was also observed, for example, in EIRs indicating the implementation of things that had not in fact been implemented, such as the EIR of organisation A's projects stating that the client would provide a CDE, when actually this did not occur in practice and remained the contractor's responsibility. Thus, while non-implementation was explicit for some standards/clauses, for others projects it was not.

5.3.1.1.2 Violation

In other circumstances, standards and their respective clauses, processes/activities were adopted, but extensive implementation did not occur. Implementation of a clause, process or activity was 'violated' or did not fully comply with the 'letter' of the imposed structure. Analysis of the 'how' of implementation across cases saw this pattern of response across a range of processes/activities. Table 5.3 summarises the clauses/processes violated across cases, as presented in Chapter 4.

Table 5.3 – Clauses violated across cases

Projects	Number of violated clauses	Clauses
Project 1	32	5.1.3, 5.2.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.5.1.1, 8.2, 9.1.5, 9.1.6, 9.2.2.1, 9.2.2.9, 9.4.9, 9.9.7, 4.3. item c, 4.3 item d, 4.3 item e, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2
Project 2	32	5.1.3, 5.2.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.5.1.1, 8.2, 9.1.5, 9.1.6, 9.2.2.1, 9.2.2.9, 9.4.9, 9.9.7, 4.3. item c, 4.3 item d, 4.3 item e, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2
Project 3	30	5.1.3, 5.2.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.5.1.1, 8.2, 9.1.5, 9.1.6, 9.4.9, 9.9.7, 4.3. item c, 4.3 item d, 4.3 item e, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2
Project 4	31	5.1.3, 5.2.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.5.1.1, 8.2, 9.1.5, 9.1.6, 9.2.2.9, 9.4.9, 9.9.7, 4.3. item c, 4.3 item d, 4.3 item e, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2
Project 5	15	5.1.3, 6.1.5, 7.5.1.1, 8.2, 9.1.6, 9.4.9, 9.9.7, 4.3. item c, 4.3 item d, 4.3 item e, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2

Project 6	40	5.1.3, 5.1.5, 5.3a item 11, 6.1.2, 6.1.5, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.5.1, 7.5.1.1, 7.5.1.2, 7.5.1.3, 7.5.1.4, 8.2, 9.1.1, 9.1.5, 9.1.6, 9.2.2.1, 9.2.2.9, 9.2.2.11, 9.4.9, 9.5.1, 9.5.3, 9.9.5, 9.9.6, 9.9.7, 4.3. item c, 4.3 item d, 4.5.1, 4.6.2, 4.7.2, 5.2, 7.1.2
Project 8	23	5.1.2, 5.3a item 6, 5.3b item 4, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.3.2, 9.1.6, 4.2, 4.3 item d, 4.6.4

The data revealed that non-extensive implementation is not tied to a specific standard and all of its prescriptions; instead, it occurs at process level, meaning that some processes of the same standard were violated while others were not, which can also happen concurrent to other types of response. Previous research at organisational level has not identified this hybridisation; organisations are usually identified as employing a type of holistic response to a pressure. Previous studies have also posited that a lack of implementation of adopted practices is often a pre-conceived response (Westphal and Zajac, 2001). Conversely, the data suggests that violation of what has been prescribed might not necessarily be a pre-conceived response and might also be a result of, for example, an unintended reproduction of institutionalised rules that needed to change, or a lack of capacity to holistically implement a process.

5.3.1.2 Decoupling from the 'how' of the imposed structure

Existing literature on organisational policy–practice decoupling has conceptualised the phenomenon considering the implementation or non-implementation of the imposed structures. However, as presented in Chapter 4, the data has shown that organisations and projects sometimes adopt and implement practices, but not in the way the policy designers intended, that is, not holistically in terms of content and implicit meaning. This pattern of implementation is referred to here as the 'assimilation' type of response (first-order category presented next). In this case, decoupling is conceptualised as a distancing from the 'how' of the mandate and imposed prescriptions, a decoupling from the implicit meaning of the policy.

This conceptualisation is aligned with another theorical lens in organisational research, the 'practice theory' lens and its current theoretical developments (Jarzabkowski et al., 2016). Recently, practice scholars have started to challenge the concept of practices as stand-alone phenomena and posited that considering practice adoption in isolation is likely to misattribute performance effects (Jarzabkowski et al., 2016). A new and more integrated view of practices posits that the situated enactment of practices should be considered when analysing the link

between adapted practices and realisation of their intended outcomes (Jarzabkowski et al., 2016). In other words, practice scholars acknowledge that practices are composed of 'what', 'how' and 'who' elements, and performance effects can only be attributed accurately if all these elements are considered in an integrated way (Jarzabkowski et al., 2016). The same can be applied when analysing the coupling of implemented practices with imposed structures. From the data analysis, it could be observed that simply implementing the content of practices, but not its meaning, creates a disconnect between implementation and its expected outcomes. This conceptualisation, thus, extends the previous concept of decoupling between policy adoption and implementation to include a decoupling phenomenon that may occur because of the 'how' aspect. Essentially, the 'how' of practice enactment transforms the 'what' of the original practices (Jarzabkowski et al., 2016), and so decoupling might occur when practices are adopted, implemented and alter existing work/routines but are enacted in a way that does not take into account the underlying meaning of the imposed structure. Previous research shows decoupling occurring only when practices do not alter the status quo (Bromley and Powell, 2012) and are adopted ceremonially or as window dressing, and this data shows that it might also happen when work routines are changed and new work practices adopted but implementation does not comply with the intrinsic meaning. Table 5.4 shows representative findings across cases that substantiate the second-order theme 'decoupling from the how'. The first-order category 'assimilation' underlying this theme is discussed next.

Table 5.4 – Examples of cross-setting findings for the first-order category underlying the second-order theme: decoupling from the 'how'

Category	Representative quotes, events and archival entries underlying first-order categories	Setting
Assimilation	Letter of clauses implemented but not its meaning (e.g. 5.1.2, 5.1.5, 9.2.2.12). For example, information requirements asking for information about everything: *They tended to ask for nearly all of the information, and then people might come in later and say: 'Actually, I don't want to know about everything.'* (project 3)	A
	Letter of clauses implemented but not its meaning (e.g. 5.1.2, 5.1.4, 9.1.5). For example, a generic EIR was developed by consultants that does not cover the real needs of end-users: *It's very much organisation B is the client, the Trust is the end-user and stakeholder, and only organisation B makes the decisions on the specification. However, sometimes the end-user might have a view on that.* (asset-operator)	B

Category	Representative quotes, events and archival entries underlying first-order categories	Setting
	Letter of clauses implemented but not its meaning. For example, although the PIM was produced following the MIDP (clause 9.1.2 of PAS 1192-2:2013), it did not necessarily support decision-making across the stages in terms of the LOD of the models, as noted by the BIM manager: *You can write a model-production delivery table and say, 'Right, this is the LOD requirement for each system,' but I think there's room for interpretation in the LOD requirements between a stage 4A design and a stage 4B design.* (BIM manager)	C

5.3.1.2.1 Assimilation

'Superficial' implementation of some processes and activities was seen to be a common characteristic of practical implementation, as described in Chapter 4. While some processes and activities were implemented, their envisioned goals were not always achieved because they were not holistically implemented. In this case, the 'letter' of the processes and activities implementation was achieved but not the 'spirit', which was categorised as an 'assimilation' response. In other words, projects 'assimilated' the structure but did not implement its real 'meaning' in terms of the actual 'how' of enactment. The new processes and activities were implemented by assimilating them into existing ways of doing things, and so the focus has mostly been on surface-level aspects of the structure and expected change.

Thus, when a process or activity has been implemented and complies with the standards, but the situated enactment is different from the underlying objective of the imposed structure, it is defined as an 'assimilation' response. Table 5.5 provides a summary of the clauses/processes assimilated across cases.

Table 5.5 – Clauses assimilated across cases

Projects	Number of clauses assimilated	Clauses
Project 1	19	5.1.2, 5.1.5, 5.3b item 1, 7.4.5, 7.5.1, 7.5.1.2, 7.5.1.4, 7.5.1.6, 8.3, 9.1.1, 9.1.2, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.5.1, 9.9.6, 4.7.1, 5.1, 7.1.1
Project 2	19	5.1.2, 5.1.5, 5.3b item 1, 7.4.5, 7.5.1, 7.5.1.2, 7.5.1.4, 7.5.1.6, 8.3, 9.1.1, 9.1.2, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.5.1, 9.9.6, 4.7.1, 5.1, 7.1.1
Project 3	19	5.1.2, 5.1.5, 5.3b item 1, 7.4.5, 7.5.1, 7.5.1.2, 7.5.1.4, 7.5.1.6, 8.3, 9.1.1, 9.1.2, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.5.1, 9.9.6, 4.7.1, 5.1, 7.1.1

Project 4	18	5.1.2, 5.1.5, 5.3b item 1, 7.4.5, 7.5.1, 7.5.1.2, 7.5.1.6, 8.3, 9.1.1, 9.1.2, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.5.1, 9.9.6, 4.7.1, 5.1, 7.1.1
Project 5	17	5.1.2, 5.1.5, 5.3b item 1, 7.4.5, 7.5.1, 7.5.1.2, 8.3, 9.1.1, 9.1.2, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.5.1, 9.9.6, 4.7.1, 5.1, 7.1.1
Project 6	22	5.1.2, 5.1.4, 5.2.1, 5.3a item 1, 5.3a item 3, 5.3b item 1, 5.3c item 1, 5.3c item 2, 5.3c item 3, 7.5.1.6, 7.6.3, 8.3, 9.1.2, 9.1.5, 9.2.2.4, 9.2.2.5, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.8.1, 4.7.1, 7.1.1
Project 8	5	7.4.1, 7.4.2, 8.3, 9.1.2, 9.2.2.10

The previously discussed types of enactment characterise a decoupling phenomenon and show hybridisation in implementation of the imposed structure, which also occurred concurrently with coupling, as outlined next.

5.3.2 Second-order theme: compliance or coupling

While a range of clauses/processes were decoupled, the data has also shown compliance or coupling with the imposed structure for others, in terms of both content and meaning. This second-order theme is underlined by the first-order category ‘accommodation’.

5.3.2.1 Accommodation

When the processes and activities suggested by the standards were fully implemented, meaning the prescriptions were implemented in the way they should be, they were categorised as an ‘accommodation’ response. In other words, rather than focusing on the surface level only, or not embracing it completely, the underlying ‘how’ of the pressure was also considered. This pattern of implementation, however, was not observed for the entire imposed structure, in any of the cases.

In summary, the findings across cases showed that broad diffusion of a mandate as a coercive pressure may generate variety in implementation at ground level, which, in turn, impacts the envisaged isomorphism and, in the case of a coercive pressure aimed at transformation, the pace of transformation. The broad diffusion leads to the perception that the entire sector has implemented the coercive pressure and change is happening, not revealing what is ‘underneath’. That leads to the perception that coercive pressures are effective in leading to rapid transformation. In alignment with findings from organisational theory literature, the results here show that decoupling also occurs under the influence of coercive

pressure. The conditions leading to this hybridisation were identified as conjunctural and causally complex, as discussed later.

5.4 Predictors of decoupling

As shown in Chapter 4, the data revealed a range of conditions underlying decoupling: aspects related to the taken-for-granted character of institutionalised rules or structures, myths and beliefs as shared social reality at both project organisation and industry levels; and aspects related to variables at organisational level. These identified causes were compared within cases, and then across cases, as they were repeating and clustered to form categories in the first-order coding, which are described further. Moving to the theoretical realm in the coding processes, these conditions were compared with the literature and clustered in two main predictors of compliance or decoupling from the imposed structure – the willingness and ability of projects to respond to exogeneous pressures.

5.4.1 Willingness and ability to respond to institutional pressure

The first-order categories of causes influencing how implementation of an imposed structure may unfold were categorised as related to the willingness and ability of projects to respond to pressure from the environment, in alignment with organisational theory research, which has identified such aspects as predictors of organisational responses (Oliver, 1991). Other studies in the construction sector have also posited that construction actors involved in change efforts may be both unwilling and unable to implement change (Bresnen et al., 2005); the findings here elaborate on the willingness and ability and their influence on how change related to implementation of a new structure unfolds.

The ability of projects to respond was identified as surrounded by capacity, conflict and awareness. As shown in Chapter 4, a lack of resources, skills, experience (early stages of adoption for some projects) or capacity influenced implementation across cases and settings; in other words, they limited projects' ability to respond to environmental pressures. In terms of awareness, it was observed that many institutionalised rules or structures within the context that projects are embedded were still in place and shaped enactment of the new imposed structure. Actually, scholars have posited that projects need to be conceptualised as history-dependent and organisationally embedded units of analysis (Engwall, 2003). When taking the context into account, project processes can be seen as guided by field-level institutions and also by organisational social structures (Soderlund and Sydow, 2019).

According to structuration theory, actors produce and reproduce the institutionalised structures that persist over time and space and provide guidelines for actions, which is known as the 'duality of structure' (Giddens, 1984). Change, from the perspective of structuration theory, occurs when actors modify existing structures through action. Nevertheless, in the case of projects, it was observed that project actors were, instead, reproducing structures from the organisational context (e.g. client organisation) and from the industry contexts when implementing new processes related to the BIM mandate, which influenced enactment and, in turn, holistic implementation. This 'reproduction' behaviour was found to be passive and/or active. Project members simply reproduced some of the existing structures, without necessarily being aware of it, thus limiting the ability to implement the imposed structure. In other words, a lack of awareness that existing rules need to be reconfigured limits the ability to implement a new structure imposed by an external pressure. On other occasions, project members reproduced existing structures because of conflict between the new structure and existing institutionalised rules, also showing that conflict might influence the ability to respond.

The data has also shown that how projects respond to institutional pressure depends on the 'willingness' to conform to the institutional environment. The willingness was identified regarding the client organisation, which has already been acknowledged in previous BIM research as moderating the extent of BIM adoption. The findings here show 'how' this willingness relates to implementation and its unfolding.

In combination, these two groups of condition were found to predict how implementation unfolds and the extent of projects' hybrid response to environmental pressures. Table 5.6 shows some representative findings across cases that substantiate the second-order theme 'willingness and ability'. Each first-order category underlying this second-order theme is discussed in the subsequent sections, before briefly introducing the concept of institutionalised rules or institutionalised structures next.

Table 5.6 – Examples of cross-setting findings for the first-order categories underlying the second-order theme: willingness and ability

Category	Representative quotes, events and archival entries underlying first-order categories	Setting
A lack of reconfiguration of normative rules (i.e. maintaining existing roles, norms of conduct, authority systems, procedures)	Consultants defining requirements and repetition of previous roles (e.g. interviews: *I think a lot of it is written by a BIM consultant, and it maybe needs someone to look through it from the client's eyes and say: 'Actually, no, we don't want this'*), existing authority systems influencing communication in the team, existing procedures such as change management shaping work and leading to rework (e.g. interviews: *Because of the changes here we've had to go in and remodel, and I think that's the bit that's taken the time and the cost).*	A
	Contractors expected to conduct certain activities according to the existing framework, technical advisors automatically expected to carry out new activities (e.g. interviews: *It should be the technical advisors doing that. The technical advisors in theory have that in their scope of work),* existing authority systems still framing activities such as requirements' specification and involvement of information-users.	B
	Contractors expected to conduct certain activities, such as those related to specification (EIR), organisational-level procedures, such as the decision-making process regarding systems' performance, were not changed.	C
A lack of reconfiguration of regulative rules (i.e. maintaining governance systems and reward and cost structures)	Maintaining the same reward and cost structure, and as the risk is assumed by the contractor, and governance systems with regards to contractors' involvement.	A
	Many of the processes, especially related to the operational stage, were not implemented because of the current governance system related to asset management (e.g. interviews: *We see others who have got whole estates to manage. I think those ones tend to be the ones who have embraced BIM more fully*).	B
A lack of reconfiguration of cultural–cognitive rules (i.e. following bodies of knowledge, models of reality)	Discipline-based focus shown in the EIR, MPDT, evidence of repetition of habitual dispositions such as for communication (e.g. interviews: *it's difficult to get them out of the habit of just sharing drawings before uploading onto a system*).	A
	Risk-avoidance culture of over-production influencing activities such as information production (e.g. interviews: *A very diligent contractor and design team will be putting forward all that information, you know).*	B

Category	Representative quotes, events and archival entries underlying first-order categories	Setting
	Frames from bodies of knowledge related to the division of work into stages influencing activities (e.g. interviews: *You can write a model-production delivery table and say, 'Right, this is the LOD requirement for each system,' but I think there was room for interpretation).*	C
A lack of capacity (i.e. lack of resources, skills, experience)	Early stages of adoption leading to uncertain specification of requirements (e.g. interviews: *I think only after a year or a year-and-a-half we received a project-specific EIR. I get the impression that that was because it was being developed as they were going along).*	A
	A lack of resources to use information models (e.g. interviews: *We haven't really got the resources to do much with that data; hopefully we're going to do something about that).*	B
	A lack of sufficient skills to use technologies and perform new processes (e.g. interviews: *There are some issues around the CDE, for example – people uploading stuff to the wrong status code, the wrong naming convention; just teething problems like that. I guess you'd umbrella that into upskilling the project team).*	C
Strategic orientation	Focus on capital delivery (internal report): *Estate management identified that BIM, as defined in government's construction strategy of 2011, was necessary to support capital delivery.* And non-implementation of processes related to the operational stage.	A

5.4.2 Structural conditions

Chapter 4 showed a range of aspects influencing the enactment of the new processes and activities part of the mandate. Some were identified as three groups of 'institutionalised rules' from the embedded contexts of projects that form a regime in the field (Geels, 2004), and which were reproduced instead of reconfigured when the new processes part of the mandate was introduced. Reconfiguration means the integration of expectations related to institutional pressures leading to a change in the existing rules (Battard et al., 2017).

As argued by Geels (2004), the rules part of a regime is linked together. When one of these rules changes, as in the case of the regulative rules at industry level and the respective mandate, the other interrelated rules of the system also need to change. As previously mentioned, according to structuration theory (Giddens, 1984), changes in structural rules that shape actors' actions occur through actors' actions or agency. The data revealed that project team members, instead, reproduced some of the previous institutionalised rules that shaped the work in projects and that needed to be reconfigured to be aligned with the new structure

imposed by the mandate and for implementation to occur holistically. Inter-related rules have not, in fact, changed, and still framed the interior processes in the same way, leading to the identified decoupling responses. The identified rules that are still shaping project activities, which have been described in Chapter 4, have been categorised into three main groups (first-order categories) according to institutional theory (Scott, 2014): i) regulative, ii) normative, and iii) cultural–cognitive rules, as shown in Figure 5.1. From a structuration theory point of view (Giddens, 1984), the institutional realm, also referred to as the structure in the duality of structure, comprises three structures – signification, domination and legitimation (Giddens, 1984) – which are similar to the three groups of institutional rules. Drawing on both institutional and structuration theories, the terms institutionalised rules and institutionalised structures have a similar meaning and are used here. These first-order categories, namely, the reconfiguration of these three groups of rules, were related to projects' ability to respond to institutional pressures, and they are described next.

5.4.3 A lack of reconfiguration of normative rules

Work and social behaviour in projects are shaped by imposed constraints from organisational and industry environments. Some of these constraints introduce a prescriptive, evaluative and obligatory dimension to project work. Some of the previous norms remained in place with the introduction of BIM and continued to shape how the work unfolded. This included existing role expectations, authority systems, duties and codes of conduct and procedures, which, according to institutional theory, form the normative pillar of institutions (Geels, 2004; Scott, 2014). From a structuration perspective, they constitute the structures of legitimation – the institutionalised norms – in the tacitly understood moral imperatives and normative sanctions through which people exercise social obligations (Giddens, 1984; Jarzabkowski, 2008).

As discussed in Chapter 4, conceptions of appropriate goals and activities for project team members (role expectations) remained and were observed within and across projects. These beliefs act as normative prescriptions for how specific actors are supposed to behave. This involved, for example, the expectation that contractors and consultants are the ones who should establish information requirements for the client, as conventionally occurs for other project requirements in a non-BIM project. The well-established role of facilities managers and their involvement in projects has also been maintained. Existing conceptions at client organisation level of the proper activities of some project members, such as for technical advisors, for example, were also repeated.

The data also revealed that some conceptions of roles were reproduced because of the authority systems in place at organisational level, which did not change. Organisation B and project 6 are good examples of this. Existing hierarchy and rules of who is involved in decisions remained. Certain duties and codes of conduct were also followed, even if they involved non-compliance with the prescriptions of the standards.

In other words, role expectations, existing authority systems, procedures, duty and codes of conduct constraining or enabling the work in projects or the existing logic of 'appropriateness' that exist and are shared at industry and organisational levels were not adapted when new processes were introduced, influencing how implementation of those new processes occurred in practice. These aspects, according to institutional theory literature (Scott, 2014), are part of a normative system of rules, and a lack of their reconfiguration was clustered together (first-order categorisation) as an underlying condition of decoupling. Table 5.7 summarises the re-enactment of existing normative rules across cases.

Table 5.7 – Enactment influenced by existing normative rules

Projects	**Number of clauses for which enactment was influenced by normative rules**	**Clauses**
Project 1	37	5.1.2, 5.1.3, 5.1.5, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.6, 6.7, 7.2.1, 7.5.1, 7.5.1.1, 7.5.1.2, 7.5.1.4, 8.2, 8.3, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.6, 4.3 item d, 4.3 item e, 4.3 item f, 4.5.1, 4.7.1, 4.7.2, 7.1.1, 7.1.2
Project 2	37	5.1.2, 5.1.3, 5.1.5, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.6, 6.7, 7.2.1, 7.5.1, 7.5.1.1, 7.5.1.2, 7.5.1.4, 8.2, 8.3, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.6, 4.3 item d, 4.3 item e, 4.3 item f, 4.5.1, 4.7.1, 4.7.2, 7.1.1, 7.1.2
Project 3	37	5.1.2, 5.1.3, 5.1.5, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.6, 6.7, 7.2.1, 7.5.1, 7.5.1.1, 7.5.1.2, 7.5.1.4, 8.2, 8.3, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.6, 4.3 item d, 4.3 item e, 4.3 item f, 4.5.1, 4.7.1, 4.7.2, 7.1.1, 7.1.2

Projects	Number of clauses for which enactment was influenced by normative rules	Clauses
Project 4	36	5.1.2, 5.1.3, 5.1.5, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.6, 6.7, 7.2.1, 7.5.1, 7.5.1.1, 7.5.1.2, 8.2, 8.3, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.6, 4.3 item d, 4.3 item e, 4.3 item f, 4.5.1, 4.7.1, 4.7.2, 7.1.1, 7.1.2
Project 5	24	5.1.2, 5.1.3, 5.1.5, 6.1.5, 7.5.1, 7.5.1.1, 7.5.1.2, 8.2, 8.3, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.6, 4.3 item d, 4.3 item e, 4.3 item f, 4.7.1, 4.7.2, 7.1.1, 7.1.2
Project 6	51	5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2.1, 5.3a item 1, 5.3a item 3, 5.3a item 6, 5.3a item 11, 5.3b item 1, 5.3b item 4, 5.3c item 1, 5.3c item 2, 5.3c item 3, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 7.2.1, 7.5.1, 7.5.1.1, 7.5.1.2, 7.5.1.3, 7.5.1.4, 7.5.1.6, 7.6.3, 8.3, 9.1.1, 9.1.5, 9.2.2.4, 9.2.2.5, 9.2.2.8, 9.2.2.10, 9.2.2.12, 9.4.9, 9.5.1, 9.9.5, 9.9.6, 4.3 item e, 4.3 item f, 4.7.1, 4.7.2, 7.1.1, 7.1.2
Project 8	22	5.1.2, 5.3a item 6, 5.3a item 8, 5.3b item 4, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 7.2.1, 7.3.2, 7.4.1, 7.4.2, 8.3, 9.1.2, 9.2.2.10

Nevertheless, this lack of reconfiguration was not necessarily a pre-conceived action. The findings actually revealed that the imposed structure – in this case, the standards – might actually influence the reconfiguration of associated rules in the system. In terms of the reconfiguration of expected roles, for example, while the standards state that existing roles and responsibilities should be redefined and the information management function undertaken, the way this should occur is not specified. This led to various forms and levels of reconfiguration by projects, resulting in decoupling, also because of different interpretation (and awareness). The data revealed that when the imposed structure does not provide clear guidance on 'what' and 'how' such reconfiguration should occur, decoupling might occur as an unintentional outcome because of a lack of awareness. The imposed structure also comprises a range of separated documents and standards that make understanding the necessary reconfiguration much more complex.

It was also observed that the imposed structure might even unintentionally reinforce re-enactment of existing structures that were meant to change. For example, the PAS 1192 standards stated that the client should appoint someone to fill the information management role and should assign the activity of defining the information requirements to the individual in this role. That is, the imposed structure is re-enforcing an existing expectation that appointed and external parties are the ones mostly responsible for requirements' specifications, without reinforcing the relevance of the input of all clients of the information requirements, as highlighted by a BIM manager:

> *You quite often find they'll get an architect to write the EIRs. Then, you get this EIR that's just completely generic. Does the client understand what they're getting out of this? That's where the EIRs are unrealistic: when the client doesn't understand what they're asking for and they've got a consultant in to tell them what they need.*

This point illustrates that the imposed structure might also impact the responses. As pointed out by Suchman and Edelman (1996), while institutional theory is quite subtle in the treatment of an organisation's rules or structure, there is a lack of similar subtlety in the treatment of the rules themselves. The underlying assumption is that the imposed structures are explicit, authoritative and coercive. But the findings demonstrate that the formal structure might not be comprehensive enough to induce the actions necessary to completely implement it and its intended meaning.

5.4.4 A lack of reconfiguration of cultural–cognitive rules

The data also revealed that there were shared conceptions constituting the nature of social reality in projects reproduced in BIM projects when new practices were implemented, also leading to decoupled responses. External cultural frameworks shape internal interpretative processes (Scott, 2014), and these were reproduced. These shared conceptions included, as discussed in Chapter 4, scripts of action from bodies of knowledge at professional level and models of reality categorised in the coding process as cultural–cognitive rules. Habitual and shared dispositions, such as those regarding communication, have been seen to be persisting, leading to decoupled responses. Indeed, previous literature has already posited that the broader belief system within the construction industry is known for shaping and influencing the actions of individual actors (Jacobsson et al., 2017). From a structuration theory perspective, these are identified as structures of signification (Jarzabkowski, 2008).

As for the other types of rule, cultural–cognitive rules operate at multiple levels, from the ideas that comprise organisations' culture to the organising logic that structures the industry (Scott, 2014). The data revealed that besides the common ideas and patterns of belief comprising the organising logic that structures the field, cultural systems are part of organisations (the client), such as those related to the shared understanding that particular actions are associated with particular actors, which were also reproduced. Table 5.8 summarises the re-enactment of existing cultural–cognitive rules across cases.

Table 5.8 – Enactment influenced by existing cultural–cognitive rules

Projects	Number of clauses for which enactment was influenced by cultural–cognitive rules	Clauses
Project 1	8	5.3b item 1, 7.4.5, 7.5.1.6, 9.1.2, 9.1.5, 9.1.6, 9.2.2.1, 9.2.2.9
Project 2	8	5.3b item 1, 7.4.5, 7.5.1.6, 9.1.2, 9.1.5, 9.1.6, 9.2.2.1, 9.2.2.9
Project 3	6	5.3b item 1, 7.4.5, 7.5.1.6, 9.1.2, 9.1.5, 9.1.6
Project 4	7	5.3b item 1, 7.4.5, 7.5.1.6, 9.1.2, 9.1.5, 9.1.6, 9.2.2.9
Project 5	4	5.3b item 1, 7.4.5, 9.1.2, 9.1.6
Project 6	6	9.1.2, 9.1.6, 9.2.2.1, 9.2.2.9, 9.2.2.11, 9.5.3
Project 8	4	9.1.2, 9.1.6, 9.2.2.11, 10.2

5.4.5 A lack of reconfiguration of regulative rules

From an institutional theory perspective, the mandate and prescriptions that follow it represent new regulative rules at industry level. As previously mentioned, rules do not exist as single autonomous entities, being linked together and organised into rules systems. Other regulative elements that are part of the existing rules system, especially at organisational level, and which also shape work in projects, were supposed to change to align with the new rules, but the data revealed that they were not updated. Regulative elements such as the governance systems and rewards and cost structure in place were reproduced. These elements were clustered as regulative rules in the first-order categorisation. Existing governance systems are related, for example, to how assets are managed, and they influenced the implementation of processes related to the operational phase. In other words, formal rules that regulate interactions remained in place and were not updated considering the new interactions that are part of the new

processes and activities implemented, leading to non-holistic implementation. Table 5.9 summarises the re-enactment of existing regulative rules across cases.

Table 5.9 – Enactment influenced by existing regulative rules

Projects	Number of clauses for which enactment was influenced by regulative rules	Clauses
Project 1	35	6.5.3, 6.6, 6.7, 7.4.5, 7.5.1.1, 7.5.1.6, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.12, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1
Project 2	35	6.5.3, 6.6, 6.7, 7.4.5, 7.5.1.1, 7.5.1.6, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.12, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1
Project 3	35	6.5.3, 6.6, 6.7, 7.4.5, 7.5.1.1, 7.5.1.6, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.12, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1
Project 4	35	6.5.3, 6.6, 6.7, 7.4.5, 7.5.1.1, 7.5.1.6, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.12, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1
Project 5	31	7.4.5, 7.5.1.1, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.6, 9.2.2.8, 9.2.2.12, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1
Project 6	56	5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2.1, 5.3a item 1, 5.3a item 11, 5.3b item 1, 6.1.2, 6.1.3, 6.1.4, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1, 7.6.3, 8.2, 8.3, 9.1.1, 9.1.5, 9.2.2.4, 9.2.2.5, 9.4.9, 9.8.1, 9.9.5, 9.9.6, 9.9.7, 10.2, 4.1, 4.2, 4.3 item a, 4.3 item b, 4.3. item c, 4.3 item d, 4.3 item e, 4.3 item f, 4.4, 4.5.1, 4.5.3, 4.5.4, 4.6.2, 4.6.4, 4.7.1, 4.7.2, 5.1, 5.2, 6, 7.1.1, 7.1.2

Projects	Number of clauses for which enactment was influenced by regulative rules	Clauses
Project 8	14	6.1.2, 6.1.3, 6.1.4, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.7, 7.2.1

In summary, it was observed that many of the new processes and activities related to mandate implementation were enacted in such a way that they are still maintainers of the aforementioned existing institutional elements.

5.4.6 Capacity

The data revealed that a lack of resources, skills and experience (a lack of capacity) were also associated with decoupling, especially regarding non-implementation; in other words, a lack of capacity limited the ability to comply. Also, the data revealed that in the early stages of adoption of some processes, namely, in the transition to using the information models in the operational phase, non-implementation, or less extensive implementation, occurred (even when there was willingness to implement it), as noted by a BIM manager:

> *It is implemented in the construction phase, the design phase, and also on an end phase, but maybe not as much on an end phase as we see because designers and contractors adopted this earlier than operation managers.*

This is in alignment with the current decoupling literature stating that decoupling from policy might occur in the early stages of adoption because there is insufficient capacity (Bromley and Powell, 2012). There were projects, however, such as project 6, that were not in the early stages of implementation for the client and supply chain, even though they had decoupled responses because of being unable to implement it regarding, for example, available resources and skills. Table 5.10 summarises enactments influenced by a lack of capacity across cases.

Table 5.10 – Enactment influenced by a lack of capacity

Projects	Number of clauses for which enactment was influenced by a lack of capacity	Clauses
Project 1	10	5.1.2, 5.1.3, 5.1.4, 5.2.1, 6.2, 9.1.5, 9.2.2.1, 9.2.2.9, 7.1.1, 7.1.2
Project 2	10	5.1.2, 5.1.3, 5.1.4, 5.2.1, 6.2, 9.1.5, 9.2.2.1, 9.2.2.9, 7.1.1, 7.1.2

Projects	Number of clauses for which enactment was influenced by a lack of capacity	Clauses
Project 3	8	5.1.2, 5.1.3, 5.1.4, 5.2.1, 6.2, 9.1.5, 7.1.1, 7.1.2
Project 4	9	5.1.2, 5.1.3, 5.1.4, 5.2.1, 6.2, 9.1.5, 9.2.2.9, 7.1.1, 7.1.2
Project 5	4	5.1.2, 5.1.3, 7.1.1, 7.1.2
Project 6	6	9.1.6, 9.2.2.1, 9.2.2.9, 9.9.7, 4.3 item f, 5.2
Project 8	10	8.3, 9.1.6, 4.1, 4.2, 4.3 item a, 4.3 item d, 4.3 item f, 4.6.4, 5.1, 6

The data has also shown that a lack of capacity might not necessarily be an organisational issue, that is, a lack of capacity purely at organisational level, for example, at the level of the client organisation, but also at field level. For organisation's B project, for example, the asset-operator reported that there is a scarcity of human resources in the market with the skills to operate assets using asset information models. A lack of skills and resources has already been identified in the BIM literature as influencing adoption and implementation, but the findings here show how these aspects, in combination with other conditions, influence 'how' implementation unfolds.

5.4.7 Strategic orientation

The data also revealed that alignment of an institutional pressure with the client organisation's strategic objectives influenced how implementation unfolded. This was categorised as related to the 'willingness' to respond to the coercive pressure in the first-order coding, by considering that organisational interests and control are scope conditions under which organisations are willing to conform to external pressure (Oliver, 1991).

Previous research on organisational responses has identified that the degree to which the pressure resonates with, and is prioritised by, management is an antecedent to responsiveness (Durand et al., 2019). In the case of the BIM mandate, willingness was related to the client organisation. The role of clients in the adoption of innovation in construction, and in the case of BIM, is already documented in the literature (Lindblad et al., 2020; Lindblad and Gustavsson, 2021). In alignment with these studies, the findings across cases demonstrate that, actually, the client influences not only the extent of adoption in terms of BIM use (Cao et al., 2014) but also the modes of implementation of the imposed structure.

In summary, although some aspects of the willingness and ability of organisations and projects to adopt/implement BIM have been reported by previous studies, the findings here show the combined effect of aspects related to these two dimensions on 'how' implementation of an accompanying structure unfolds. Previous research has mostly identified 'what' influences adoption and implementation without necessarily unpacking 'how' that might occur, which, when seen through the lens of BIM as a mandate, may reveal broader findings of how projects react to institutional pressures.

5.5 Cross-case analysis initial findings

Grounded on the data from the cross-case analysis, Figure 5.1 helps to conceptualise how projects may respond to institutional pressures from the environment and why such responses may occur. The data has shown that a hybrid response may occur, involving decoupling in two potential forms: from the 'content' and/or the 'meaning' of the imposed structure.

In other words, the cross-case analysis findings showed that, when faced with an institutional pressure imposing a new structure, projects might adopt four different types of response. It was observed that multiple responses might emerge simultaneously; in other words, it is not necessarily one or another type of response, as observed and conceptualised by most organisational studies.

While the content analysis revealed patterns in the employed responses and underlying conditions for such responses, the analysis revealed some other characteristics. First, it was observed that projects employed different responses to the same clause, namely, to implementation of the same processes. The causes leading to those different responses might be the same or different for a specific clause and then vary for other clauses. In other circumstances (for example, clause 5.1.3) projects employed the same type of response, but the causes leading to the response across projects are not the same. It was observed that the same group of causes leads to different types of outcome. It was also found that there is conjunction, which means that the outcomes – the two types of decoupling – do not have a single cause but result from the combination of multiple conditions. As projects are embedded in multiple contexts, it was observed that the underlying reasons for enactment in certain ways sit within those multiple embedded contexts; that is, the combination of conditions come from multiple contexts. It was also observed that the identified conditions might be combined in multiple ways to produce the same outcome, meaning that equifinality might occur. In other words, it was found that the observed decoupling phenomenon is underlined by causal complexity,

which would require further investigation to build on the interrelationships at second-order level, as shown in Figure 5.1.

The observed decoupling phenomenon seems not to occur under the conditions of a 'general linear reality', requiring a configurational perspective to conceptualise and analyse the apparent causal complexity. Thus, as explained in Chapter 3, the csQCA technique was applied in the multi-method approach adopted in this research to identify how multiple causal attributes combine into distinct configurations to produce a response (conjunctural causation) and assess whether multiple configurations are linked to the same outcome (equifinality), as well as if there is relative empirical importance of each configuration.

Because of its power to identify how effects combine to produce outcomes, QCA is particularly appropriate for advancing multi-level theory, as in this case, with the aim of understanding the interplay between factors at multiple levels in shaping responses (Lacey and Fiss, 2009; Crilly et al., 2012). The within-case analysis and initial cross-case analysis findings presented before therefore served as the first step in identification of the conditions and outcomes in the csQCA methodology, as the analysis must be theoretically informed (Berg-Schlosser and De Meur, 2012). The results of the QCA application are presented next.

5.6 A configurational perspective on projects' responses to institutional pressure

As previously mentioned, QCA broadens the usual frame in the analysis of causality, by relaxing several common assumptions that would be insufficient to explain the observed causation of decoupling in projects, based on the conclusions reached in the first stage of the research. Previous BIM research analysing the influence of factors on BIM adoption and implementation has not captured the combined effect of multiple causes, which represents a limitation, as it could be observed that non-holistic implementation results from the combination of multiple aspects. The analysis presented next identifies commonalities across projects in the form of subset relations between the causes previously discussed in this chapter, and the types of response employed (variance of the decoupling phenomenon) by using csQCA. The sub-sections below explain the procedures adopted to reach conclusions, the decisions made and the results achieved at each stage of the csQCA application.

5.6.1 The configurational model

5.6.1.1 Cases, conditions and outcomes selection

Cases are the unit of analysis within QCA, but they do not necessarily mean the cases as the unit of analysis in the case-study procedure itself. The unit of analysis in the previous stage of this research was the projects from the three different settings, selected through theoretical sampling. In the context of the application of QCA, the cases constitute each project and implementation of each clause of each standard analysed, as the goal is to explain the causes leading to implementation and the responses adopted when implementing each new process/activity.

The process of case selection in QCA is tentative and iterative as the variable selection and model specification in statistically oriented research. The outcome that will be explained here is the occurrence of decoupling (from the 'what' and the 'how') or non-occurrence of decoupling (i.e. compliance/coupling), as identified in the exploratory case analysis. The initial data set built at the previous stage (i.e. the tables with the responses employed by projects to the implementation of each clause and the respective causes for it) guided the creation of raw data tables with all possible cases and then the selection of cases related to the outcomes under investigation.

The possible cases then represented each project (projects 1 to 5, 6 and 8, as project 7 was not a fully BIM level 2 project and it was not considered in the csQCA) for implementation of each clause of PAS 1192-2:2013 and PAS 1192-3:2014, leading to the outcomes analysed. A case, for example, would be clause 5.1.2 of PAS 1192-2:2013 for project 1, another case would be clause 5.1.2 of PAS 1192-2:2013 for project 6, and so on.

The procedures for case selection consisted of looking at each clause and the responses employed by projects for that clause. Initially, a sample of 1,001 possible cases were considered. Of these, there were 286 cases with decoupling from the what, and 119 cases with decoupling from the how. Clauses with both types of outcome (decoupling and non-decoupling) were selected, in order to have cases with both a 'positive' and a 'negative' outcome. The [1] outcome value stands for 'decoupling from the what' and 'decoupling from the how'. The [0] outcome value stands for 'non-decoupling'. The conditions leading to the outcomes identified in the previous research stage and organised into five categories – i) reconfiguration of normative rules, ii) reconfiguration of regulative rules, iii) reconfiguration of cultural–cognitive rules, iv) capacity and v) alignment with the client's strategic orientation

– represent the conditions. The [1] value stands for the presence of the condition (i.e. in the case of the rules: 'reconfiguration of the rules') and the [0] value stands for the absence of the condition. Table 5.11 and Table 5.12 summarise the number of cases considered in each step of building the model, which also involves the step described next.

Table 5.11 – Decoupling from the 'what'

	# Cases with decoupling	**# Cases without decoupling**	**# Total cases**
Raw data	286	715	1001
After selecting cases	213	144	357
Truth table	141	214	355

Table 5.12 – Decoupling from the 'how'

	# Cases with decoupling	**# Cases without decoupling**	**# Total cases**
Raw data	119	882	1001
After selecting cases	87	109	196
Truth table	94	102	196

5.6.1.2 Creating the truth table

The first step in preparing for the analysis entailed transforming the matrices of set membership values generated from raw data (the tables with the selected cases) into truth tables, which is the central analytical device for QCA. The truth table is a table of configurations or a combination of conditions associated with the outcomes. This process involved three steps: i) creating a truth-table shell; ii) assigning cases from the data matrices to truth-table rows; and iii) assigning an outcome value to each truth-table row.

Creation of the truth-table shell involved constructing a table of all possible combinations of conditions (i.e. configurations) in an analysis. The truth table is a data matrix with 2^k rows, where K is the number of causal conditions (Fiss, 2011). With five causal conditions, the table involves 32 possible combinations of condition (i.e. configurations) in the analysis for each type of decoupling, as shown in Table 5.13 and Table 5.14. The next step involved assigning the cases to the truth-table rows, that is, matching the configuration of membership values from the selected cases table with the appropriate truth-table rows. This process was repeated for all cases until each one had been assigned to the truth-table row representing its configuration set

membership values. At the end of this step, some rows had multiple cases assigned to them, meaning they shared the same configuration for the specified conditions. Other rows in the truth table did not have cases assigned to them, meaning there were no cases with the configuration represented by them, and these empty rows constitute the logical remainders, meaning that the truth table has limited diversity. This can be seen in Table 5.13 and Table 5.14.

Table 5.13 – Initial truth table (decoupling from the 'what')

Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	Number of cases	Raw consist.
1	1	1	1	1	107	0.000
1	0	1	1	1	81	0.654
0	0	1	1	1	63	0.968
0	1	1	1	0	41	1.000
0	1	1	1	1	23	0.783
1	1	0	1	1	12	0.917
1	1	0	0	1	11	1.000
1	0	0	1	0	5	1.000
1	0	0	1	1	5	1.000
0	0	1	1	0	4	1.000
1	1	1	0	1	3	0.667
0	1	0	1	1	2	1.000
0	0	0	0	0	0	0.000
1	0	0	0	0	0	0.000
0	1	0	0	0	0	0.000
1	1	0	0	0	0	0.000
0	0	1	0	0	0	0.000
1	0	1	0	0	0	0.000
0	1	1	0	0	0	0.000
1	1	1	0	0	0	0.000
0	0	0	1	0	0	0.000
0	1	0	1	0	0	0.000
1	1	0	1	0	0	0.000
1	0	1	1	0	0	0.000
1	1	1	1	0	0	0.000
0	0	0	0	1	0	0.000
1	0	0	0	1	0	0.000
0	1	0	0	1	0	0.000
0	0	1	0	1	0	0.000
1	0	1	0	1	0	0.000
0	1	1	0	1	0	0.000
0	0	0	1	1	0	0.000

Table 5.14 – Initial truth table (decoupling from the 'how')

Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	Number of cases	Raw consist.
1	1	1	1	1	90	0.000
1	0	1	1	1	41	0.902
0	0	1	1	1	28	0.893
0	1	1	0	1	9	1.000
1	1	0	1	1	8	0.000
0	1	1	1	1	6	1.000
0	0	0	1	0	5	1.000
1	1	1	0	1	5	1.000
1	1	0	0	1	4	0.000
0	0	0	0	0	0	0.000
1	0	0	0	0	0	0.000
0	1	0	0	0	0	0.000
1	1	0	0	0	0	0.000
0	0	1	0	0	0	0.000
1	0	1	0	0	0	0.000
0	1	1	0	0	0	0.000
1	1	1	0	0	0	0.000
1	0	0	1	0	0	0.000
0	1	0	1	0	0	0.000
1	1	0	1	0	0	0.000
0	0	1	1	0	0	0.000
1	0	1	1	0	0	0.000
0	1	1	1	0	0	0.000
1	1	1	1	0	0	0.000
0	0	0	0	1	0	0.000
1	0	0	0	1	0	0.000
0	1	0	0	1	0	0.000
0	0	1	0	1	0	0.000
1	0	1	0	1	0	0.000
0	0	0	1	1	0	0.000
1	0	0	1	1	0	0.000
0	1	0	1	1	0	0.000

The last step entailed using the outcomes set membership value from the cases within each row to assign an outcome value for the row. Each row now represents a set of cases with membership in a particular configuration of conditions. The outcome value of the row is

defined by a parameter called 'raw consistency', which entails the consistency of the sufficiency relationship between the configuration represented by the truth-table row and the outcome set. The raw consistency for each row in Table 5.13 and Table 5.14 represents the proportion of cases in the configuration that are also in the outcome set. Consistency 0 means no subset relationship and thus no relationship of sufficiency, and 1 indicates a perfect subset relationship and strong relationship of sufficiency. Other rows with a consistency of 0.8 or more demonstrate a strong sufficiency relationship, meaning nearly all cases with the configuration of conditions are in the outcome set. Consistency between 0.6 to 0.8 indicates a modest sufficiency relationship. The values below 0.6 represent weak sufficiency relationships (Kahwati and Kane, 2019).

The number of rows to which the outcome value is assigned is reduced in line with two conditions (Fiss, 2011; Ragin, 2008): i) the minimum number of cases required for a solution to be considered, and ii) the minimum consistency level of a given solution. The minimum acceptable solution frequency was set at three, as the analysed sample is large, similarly to previous studies (Fiss, 2011). Rows that did not meet the frequency threshold were then deleted, and those that had at least three cases were further considered.

When assigning an outcome value to a row, the row consistency is compared against a pre-defined row consistency threshold, which is the chosen strength of the sufficiency relationship. The row consistency threshold is used to assign either a 1 or a 0 to the row; if the row consistency is below the threshold, 0 is assigned as the outcome value; if it is above, a value of 1 is assigned. The recommended threshold of 0.80 used by Fiss (2011), which is slightly above the minimum of 0.75 recommended in the literature, was considered here, and it gives small penalties for minor inconsistencies and large penalties for major inconsistencies.

The configuration of conditions in rows 4, 7, 8, 9 and 10 of Table 5.13 have perfect consistency. Rows 3 and 6 also demonstrate a strong sufficiency relationship, and 1 was assigned the outcome value. On the other hand, row 1 demonstrated a consistency of 0, meaning there are no cases within the row with membership in the outcome set, so 0 was assigned as the outcome value. Row 5 has a consistency of 0.783, which is slightly below the threshold, indicating a modest sufficiency relationship. The 0 value was then assigned as the outcome. Row 2 has a 0.654 consistency, and row 11 has a 0.667 consistency, meaning that the configuration of conditions in row 2 also has a modest sufficiency relationship with decoupling from the 'how'. The 0 value was assigned to the outcome column.

For Table 5.14, rows 4, 6, 7 and 8 have perfect consistency, and rows 2 and 3 have a strong sufficiency relationship, receiving outcome 1. Rows 1, 5 and 9 have a consistency of 0,

meaning there are no cases within the row with membership in the outcome set. Table 5.15 and Table 5.16 represent the resulting truth tables that will be used in the next step of the sufficiency analysis. As mentioned in Chapter 3, the QCA R package was used to conduct the truth-table analysis, using the Quine-McCluskey algorithm.

Table 5.15 – Resulting truth table (decoupling from the 'what')

Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	# Cases	Decoupling What?	Raw consist.
1	1	1	1	1	107	0	0.000
1	0	1	1	1	81	0	0.654
0	0	1	1	1	63	1	0.968
0	1	1	1	0	41	1	1.000
0	1	1	1	1	23	0	0.783
1	1	0	1	1	12	1	0.917
1	1	0	0	1	11	1	1.000
1	0	0	1	0	5	1	1.000
1	0	0	1	1	5	1	1.000
0	0	1	1	0	4	1	1.000
1	1	1	0	1	3	0	0.667

Table 5.16 – Resulting truth table (decoupling from the 'how')

Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	# Cases	Decoupling how?	Raw consist.
1	1	1	1	1	90	0	0.000
1	0	1	1	1	41	1	0.902
0	0	1	1	1	28	1	0.893
0	1	1	0	1	9	1	1.000
1	1	0	1	1	8	0	0.000
0	1	1	1	1	6	1	1.000
0	0	0	1	0	5	1	1.000
1	1	1	0	1	5	1	1.000
1	1	0	0	1	4	0	0.000
0	0	0	0	0	0	0	0.000

After the truth table is ready, it is possible to proceed to the analysis, which involves analysis for necessary conditions, followed by analysis of sufficient conditions. In previous research, when analysing necessary and sufficient conditions, researchers usually derived the necessary conditions from their analysis of sufficient conditions, but this can lead to two

problems (Schneider and Wagemann, 2012). First, a condition that has been identified as necessary may not appear in all paths of the analysis of sufficient conditions (called a hidden necessary condition), because of the inclusion in the logical minimisation either of remainder rows that contradict the statement of necessity or of not fully consistent truth-table rows (Schneider and Wagemann, 2012). Second, a condition might be present in all sufficient paths but might not be a necessary condition (a false necessary condition). This might happen if only those rows that include the false necessary condition are included in the logical minimisation (Schneider and Wagemann, 2012). To avoid those pitfalls, the necessary and sufficient conditions should be analysed in two separate steps, with necessary conditions analysed first, followed by analysis of the model analytics in order to not consider any incoherent assumptions about logical remainders.

5.6.2 Necessary conditions for decoupling

QCA differentiates between two types of causal condition or combinations of causal condition: necessary and sufficient. The necessary conditions denotate conditions that are present in every case in which the outcome in question is present (Ragin, 2000, p. 203). It accounts for asymmetrical causality. Necessary set relationships between individual conditions and the outcome set, and set relationships between combinations of condition and the outcome set, should then be considered.

In the initial applications of QCA, as previously mentioned, the idea was that if a single condition is present in every path of the minimal formula, it could be considered necessary for the outcome (Ragin, 1987). Recent studies, however, have shown that this property only holds in the absence of limited diversity and inconsistent truth-table rows (Schneider and Wagemann, 2012; Bol and Luppi, 2013), which is not the case here, as limited diversity is observed. Bol and Luppi (2013) propose a 'systematic necessity assessment' approach for identifying necessary conditions and dealing with the previously mentioned issues, which entails asking which unions of two or more sets (disjunctions) are consistent with a necessity subset/superset relation. In the following, Bol and Luppi's (2013) method was applied to the data, as specific requirements for standard practice in QCA are not held. The systematic necessity assessment facilitates identification of how some conditions are combined to form SUIN conditions (sufficient but unnecessary part of a configuration that is insufficient but necessary for the outcome). As the starting point in the application of the approach, the necessary consistency of the least restrictive set is calculated for both types of outcome (Bol and Luppi, 2013). This pre-

test establishes whether at least one configuration of conditions that is necessary for the outcome is present (Bol and Luppi, 2013). This set is the configuration of all the conditions joined by the logical OR. As the necessary condition is 1 for both outcomes, the other steps of the procedure proposed by Bol and Luppi (2013) could be followed, as described next.

5.6.2.1 Systematic necessity – decoupling from the 'what'

The necessary consistency of each individual condition was initially calculated. As previously mentioned, consistency is calculated by dividing the number of cases with membership in both the condition and the outcome set by the number of cases with membership in the outcome set. The literature recommends using a consistency threshold of 0.9 for establishing necessity relationships (Ragin, 2008; Kahwati and Kane, 2019). However, no individual condition in the analysis of decoupling from the 'what' meets the criteria for constructing causal necessity, as shown in Table 5.17. A high threshold of consistency is advisable in the literature, but it could be noticed that even if the threshold were lower, none of the conditions would satisfy it, meaning the problem was not with the subset relationships.

This first general finding seems consistent with the complex nature of the response under analysis. It seems reasonable that no single condition can so regularly account for decoupling from the imposed structure, as projects are complex systems. However, when calculating the necessary consistency of multiple conditions joined by the logical OR, a disjunction or substitutable necessary conditions are consistent at the 0.9% level and with high coverage (coverage captures the degree to which a necessary condition is empirically relevant, and values closer to 1 indicate that a necessary condition is empirically relevant), as shown in Table 5.17.

Table 5.17 – Results obtained through systematisation of the test of necessary conditions (decoupling from the 'what')

	Configurations	**Consistency**	**Relevance of necessity**	**Coverage**
Step 1	~reg_rules + ~norm_rules + ~capacity + ~cog_rules + ~strategic	1.00	0.74	0.85
Step 2	~reg_rules	0.59	0.97	0.95
	~norm_rules	0.60	0.87	0.81
	~capacity	0.16	1.00	0.97

	Configurations	Consistency	Relevance of necessity	Coverage
	~cog_rules	0.06	1.00	0.93
	~strategic	0.23	1.00	1.00
	~reg_rules+~norm_rules	0.89	0.79	0.84
	~reg_rules+~capacity	0.74	0.96	0.95
	~reg_rules+~cog_rules	0.65	0.96	0.95
	~reg_rules+~strategic	0.62	0.97	0.95
	~norm_rules+~capacity	0.71	0.85	0.83
	~norm_rules+~cog_rules	0.66	0.86	0.82
	~norm_rules+~strategic	0.79	0.84	0.85
	~capacity+~cog_rules	0.17	0.99	0.95
	~capacity+~strategic	0.37	1.00	0.99
	~cog_rules+~strategic	0.30	1.00	0.98
Step 3	**~reg_rules+~norm_rules+~capacity**	**0.99**	**0.75**	**0.85**
	~reg_rules+~norm_rules+~cog_rules	**0.95**	**0.77**	**0.85**
	~reg_rules+~norm_rules+~strategic	0.89	0.79	0.84
	~reg_rules+~capacity+~cog_rules	0.75	0.95	0.95
	~reg_rules+~capacity+~strategic	0.74	0.96	0.95
	~reg_rules+~cog_rules+~strategic	0.68	0.96	0.95
	~norm_rules+~capacity+~cog_rules	0.72	0.84	0.83
	~norm_rules+~capacity+~strategic	**0.91**	**0.81**	**0.86**
	~norm_rules+~cog_rules+~strategic	0.85	0.82	0.85
	~capacity+~cog_rules+~strategic	0.38	0.99	0.98
	~reg_rules+~capacity+~cog_rules+~strategic	0.75	0.95	0.95

It could be observed that either a lack of reconfiguration of normative rules or regulative rules (consistency of 0.89) is almost necessary for decoupling from the 'what' of the imposed structure. Other highly consistent disjunctions with high coverage involved lack of reconfiguration of normative rules, regulative rules or a lack of capacity or lack reconfiguration of cognitive rules, normative rules or regulative rules or a lack of strategic alignment, capacity or lack of reconfiguration of normative rules. In other words, there might be different

combinations of organisational aspects and institutional rules leading to a decoupling from the 'letter', but in all of them there will possibly be a lack of reconfiguration of normative rules (i.e. as previously mentioned, a lack of reconfiguration of role expectations, procedures, codes of conduct and authority systems). Normative rules are a sufficient but unnecessary part of a factor that is insufficient but necessary for the outcome.

This finding is consistent with expectations; on the one hand, if there is no capacity or willingness to implement coercive pressure, there might be non-implementation of processes or non-complete implementation. On the other hand, if one of the categories of rules, as part of the rules system, is not reconfigured, what needs to be implemented will not necessarily be implemented holistically.

5.6.2.2 Systematic necessity – decoupling from the 'how'

Similar to what has been observed for decoupling from the 'what', no condition in the analysis of decoupling from the 'how' meets the criteria for constructing causal necessity with a high consistency of at least 0.9, as shown in Table 5.18. However, a lack of reconfiguration of normative rules was a condition with a high consistency level (0.77). This condition was also present in the other two disjunctions identified, meaning that when decoupling from the 'how' happens, there might be a lack of reconfiguration of normative rules or another category of rules. This finding is consistent with the literature highlighting the interdependence of the rules system. The rules system is the deep structure, or grammar, of the system that causes stability (Geels, 2004). If one of the existing rules' categories remains stable and does not change, the project stakeholders' actions would be guided partially by old structures in place that have not been reconfigured and partially by rules that have been reconfigured. Implementation would not occur holistically, also in terms of 'how' the new processes should be implemented; the new ways of doing would possibly be framed by old structures.

Table 5.18 – Results obtained through systematisation of the test of necessary conditions (decoupling from the 'how')

	Configurations	**Consistency**	**Relevance of necessity**	**Coverage**
Step 1	~reg_rules + ~norm_rules + ~capacity + ~cog_rules + ~strategic	1.00	0.83	0.82
Step 2	~reg_rules	0.52	0.98	0.94

	Configurations	Consistency	Relevance of necessity	Coverage
	~norm_rules	0.77	0.95	0.91
	~capacity	0.06	0.94	0.29
	~cog_rules	0.16	0.98	0.78
	~strategic	0.06	1.00	1.00
	~reg_rules+~norm_rules	**0.94**	**0.94**	**0.92**
	~reg_rules+~capacity	0.52	0.90	0.75
	~reg_rules+~cog_rules	0.57	0.95	0.88
	~reg_rules+~strategic	0.52	0.98	0.94
	~norm_rules+~capacity	0.77	0.85	0.78
	~norm_rules+~cog_rules	**0.93**	**0.90**	**0.88**
	~norm_rules+~strategic	0.77	0.95	0.91
Step 3	~capacity+~cog_rules	0.22	0.93	0.61
	~capacity+~strategic	0.06	0.94	0.29
	~cog_rules+~strategic	0.22	0.98	0.83
	~reg_rules+~capacity+~cog_rules	0.57	0.90	0.77
	~reg_rules+~capacity+~strategic	0.52	0.90	0.75
	~reg_rules+~cog_rules+~strategic	0.57	0.95	0.88
	~norm_rules+~capacity+~strategic	0.77	0.85	0.78
	~capacity+~cog_rules+~strategic	0.22	0.93	0.61
	~reg_rules+~capacity+~cog_rules+~strategic	0.57	0.90	0.77

5.6.3 Sufficient conditions for decoupling

The next stage of analysis consisted of minimising the truth table to identify sufficient conditions, or combinations of condition, leading to both types of decoupling. The minimisation process consists of reducing a complex expression into a shorter, more parsimonious expression. In the minimisation process, decisions need to be made regarding the logical remainder rows. Each truth-table row with a high level of consistency is a sufficient combination, and combining all sufficient combinations with an OR represents the most complex solution possible (Kahwati and Kane, 2019). Including each truth-table row as a term in the solution would create a very complex solution and merely describe the cases, rather than

identifying the most significant combinations of condition for the outcome (Kahwati and Kane, 2019). The truth-table analysis involves simplifying sufficient rows into fewer terms with a smaller number of conditions, which is known as minimisation of the truth table.

In the minimisation process the software uses the Quine-McCluskey algorithm that pairs rows with an outcome value of 1 and determines whether a condition can be eliminated or reduced from the combination. When conducting truth-table minimisation, three solutions can be generated: i) the conservative or complex solution; the ii) parsimonious solution; and iii) the intermediate solution. These solutions are generated based on how the algorithm handles the logical remainder rows (i.e. the rows without cases where the outcome value is indeterminate). One challenge of configurational approaches is the 'limited diversity' of empirical instances of all configurations, and the counterfactual analysis provides a way to overcome the limitations of a lack of empirical instances of all configurations.

Complex solutions are subsets of intermediate solutions, and intermediate solutions are subsets of parsimonious solutions (Kahwati and Kane, 2019). Complex solutions are solutions where all logical remainders are set to false; in other words, there are no counterfactuals or non-observed cases. The truth table is minimised using only those rows with cases that have outcome values equal to 1, which are the rows deemed to be sufficient based on the value above the selected row consistency threshold. Parsimonious solutions are solutions in which any remainder that will help to generate a simpler solution is used, regardless of whether it constitutes an 'easy' or 'difficult' counterfactual case. 'Easy' counterfactuals refer to situations in which a redundant causal condition is added to a set of causal conditions that, by themselves, already lead to the outcome in question (Fiss, 2011). On the other hand, 'difficult' counterfactuals refer to situations in which a condition is removed from a set of causal conditions, leading to an outcome on the assumption that this condition is redundant (Fiss, 2011). In other words, the algorithm is configured to use the logical remainder rows in ways that it could achieve the fewest terms in the solution. A logical remainder used by the algorithm to minimise the truth table is called a simplifying assumption (Kahwati and Kane, 2019). It is simplifying because it usually helps to create a less complex solution, and it is an assumption because for the rows with any cases it is necessary to decide whether hypothetical cases that would belong to that row would have membership in the outcome set or not (Kahwati and Kane, 2019). The algorithm makes the assumption regarding membership that yields a simpler solution.

Finally, intermediate solutions are solutions that only include remainders that are 'easy' counterfactual cases. Intermediate solutions are situated on the continuum between the two

former solutions and balance out the two extremes (Ragin, 2008, p. 170). These solutions are preferable, offering the best opportunity for meaningful interpretation (Ragin, 2008, p. 175; Schmitt et al., 2017), and are the solutions considered here, similarly to previous studies (Fiss, 2011; Schmitt et al., 2017). The designation of 'easy' versus 'difficult' is a decision based on supplied information regarding the connection between each causal condition and the outcome. The logical remainders used in the derivation of the parsimonious solution are filtered according to directional expectations about the impact of each single condition set value on the overall sufficiency relation of the configuration of which it is part and the outcome set. Fewer remainders are then used in the minimisation process.

Similar to previous exploratory studies in other fields (e.g. Schmitt et al., 2017), this study is the first to explore the causation behind inter-organisational responses to institutional pressures, so just two directional assumptions for the connection between causal conditions and outcomes were made based on previous literature on decoupling at organisational level. Bromley and Powell (2012) identified that policy–practice decoupling is more likely to occur when it is early in the adoption process, there is weak capacity to implement the policy and there is no motivation to adopt it. Thus, the directional expectation adopted here, in line with previous literature, is that a lack of alignment with the strategic orientation of the client organisation and a lack of capacity would lead to decoupling from both the 'what' and the 'how'.

Ragin and Sonnett (2005) explain in detail how to derive these intermediate solutions, based on the comparison between complex and parsimonious solutions, which is discussed here further. Their procedure is implemented in the QCA R package using the prime implicants' matrices from both solutions, combining them according to the directional expectations to filter those that are ultimately responsible with the intermediate solutions (Dusa, 2019).

The logical minimisation of the truth table entails standard analysis, which produces conservative, intermediate and parsimonious solutions, as previously mentioned, through different strategies for handling logical remainders and considering the directional expectations. Some scholars have proposed, however, that standard analysis does not guard against a significant pitfall: creating solution terms based upon untenable assumptions (Schneider and Wagemman, 2012). Schneider and Wagemman (2012) propose conducting enhanced standard analysis, which consists of barring untenable assumptions from inclusion in any solution term, which is described next. Indeed, as suggested by Kahwati and Kane (2019), before moving to final analysis of the sufficient conditions and interpretation of the findings,

an evaluation of initial analysis findings (model analytics) should be conducted, including interpretation of the standard solution parameters of fit, evaluating the assumptions made in the logical minimisation process, identifying model ambiguity (if present), conducting the enhanced minimisation process, interpreting the enhanced solution parameters of fit, and assessing the robustness of the findings.

5.6.3.1 Interpreting standard solution parameters of fit

To produce the simplest solutions, the algorithm logically minimises truth-table roles with an outcome value of 1, and for the intermediate solutions it minimises some, or all, logical remainder rows by considering the directional expectations. There might be multiple ways of minimising the truth table when generating conservative, intermediate or parsimonious solutions. It is a property of the logical minimisation process used. The algorithm provides all variations of the solution that fit the data, and decisions should be made regarding what to consider, analysing either consistency/coverage values of each solution or individual terms.

Table 5.19 and Table 5.20 display sufficient causal paths for decoupling from the 'what' and the 'how' considering the intermediate solution and the standard analysis, that is, before barring untenable assumptions from being part of the model. As can be observed for decoupling from both the 'what' and the 'how, there are two logically valid ways of minimising the truth table.

Table 5.19 – Intermediate solution for causal configurations of decoupling from the 'what'

		Coverage			
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**	**M1**	**M2**
~reg_rules • ~norm_rules • cog_rules	0.970	0.305	0.286	-	-
~reg_rules • cog_rules • ~strategic	1.000	0.211	0.192	-	-
reg_rules • norm_rules • ~capacity	0.957	0.103	0.052	-	-
reg_rules • ~capacity • cog_rules	0.955	0.099	0.000	-	
~norm_rules • ~capacity • cog_rules	1.000	0.047	0.000		-
M1	0.979	0.648			
M2	0.979	0.648			

Table 5.20 – Intermediate solution for causal configurations of decoupling from the 'how'

		Coverage			
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**	**M1**	**M2**
~norm_rules • cog_rules	0.905	0.770	0.425	-	-
norm_rules • capacity • ~cog_rules	1.000	0.161	0.057	-	-
~reg_rules • cog_rules	0.923	0.414	0.000	-	
~reg_rules • norm_rules • capacity	1.000	0.172	0.000		-
M1	0.926	1.000			
M2	0.926	1.000			

The concept of consistency is also extended to interpreting solutions. The solution consistency is the degree to which membership in the overall solution is a subset of membership in the outcome (Ragin, 2008). For decoupling from the 'what', for example, this is the degree to which the four configurations of each model, together, are linked to the decoupling outcome. The solution consistency of 0.979 for both models in decoupling from the 'what' solution, and 0.926 for both models for decoupling from the 'how' solution, indicate that the solutions would be consistent in explaining the outcomes, as the consistency is above the recommended threshold of 0.8. In other words, it indicates the overall strength of the sufficiency claim. The consistency of each configuration is also above the threshold, indicating strong sufficiency of each individual solution.

Coverage is the other parameter of fit that should be considered in the context of interpretation of the intermediate causal recipe. It is used to identify how much of the outcome can be explained by the combination of conditions identified in the solution (Kahwati and Kane, 2019). A solution with high coverage identifies sufficient combinations of condition that are found in nearly all cases in the outcome set. The coverage of the overall solution for both models in decoupling from the 'how' has more empirical relevance than the overall solution for both models in decoupling from the 'what'. However, both overall solutions have high consistency and coverage in general terms and are robust set-theoretic findings that can be interpreted with high confidence.

In contrast to overall solution coverage, solution terms have two types of coverage: raw coverage and unique coverage. The raw coverage solution term is the portion of cases that are in both the outcome set and the solution term set (Kahwati and Kane, 2019). The different coverage of the solution terms confirms equifinality. For example, the raw coverage of the first configuration (0.305) for decoupling from the 'what' means that 30.5% of the outcome and

empirical strength can be attributed to this individual configuration. In other words, this solution term set is the one with the higher proportion of cases in the outcome set. Similarly, decoupling from the 'how' is most explained by configuration 1 in Table 5.20.

The previously mentioned assessment of raw coverage can be complemented with assessment of each combination's 'unique' coverage; in other words, it is possible to partition coverage in set-theoretic analysis in the same way as the partitioning of explained variation in multiple regression (Ragin, 2008). The unique coverage refers to a measure of distinctiveness and to the proportion of memberships in the outcome explained only by that single configuration (Ragin, 2006). For decoupling from the 'what', the coverage is uniquely explained by the first three configurations for both models in Table 5.19, whereas the two alternative terms for each model share similarities with other terms. For decoupling from the 'how', the first configuration has high unique raw coverage (0.425), meaning this term can uniquely explain most of the outcome in the solution. The other term has low unique raw coverage, indicating that the configuration has similarities rather than providing different pathways to the respective outcome.

However, as previously mentioned, this first standard analysis might contain some pitfalls that should be reviewed. The previously presented model was then re-analysed, as described next.

5.6.3.2 Evaluating assumptions

Evaluation of the assumptions made during the logical minimisation process is necessary, as the algorithm-driven process of logical minimisation could result in untenable simplifying assumptions on logical remainder rows (Kahwati and Kane, 2019). As previously described, for minimisation of the truth table to occur, each row needs an outcome value assigned that is based on the consistency, but for rows that are logical remainders there is no consistency and, therefore, no assigned outcome value. The algorithm must then assume the outcome value of the row to be either 1 or 0. If assuming the outcome value of 1 allows the algorithm to logically minimise the row, then the row is a simplifying assumption and the algorithm assigns the value of 1. If assuming 1 does not lead to logical minimisation of the row, then the row is not a simplifying assumption and outcome 0 is assigned, meaning the algorithm does not use the row in the minimisation process. Although simplifying assumptions result in a more parsimonious solution, some simplifying assumptions are untenable and might fail in two categories: implausible or incoherent. The assumptions should then be reviewed.

Implausible assumptions are assumptions made on logical remainder rows that could not reasonably exist. Some rows may not have any cases because it is not within the realm of possibility. For example, it would be unlikely that a holistic implementation would happen (i.e. non-decoupling) without strategic alignment and capacity. Thus, simplifying assumptions made using rows with this combination would not be plausible and thus are untenable. However, this step should be performed only for the outcome in question (i.e. decoupling), and not for its complement (non-decoupling); therefore, any combination of conditions for the decoupling outcome is possible or plausible, and no truth-table rows needed to be removed.

Incoherent assumptions are assumptions that have some logical inconsistency with findings from other parts of the analysis, and two types of incoherent assumption might occur (Kahwati and Kane, 2019). The first type are assumptions that might contradict a finding of necessity when combinations of condition are necessary for the outcome, but then there are solution terms where the complements of the conditions are also necessary for the outcome, contradicting the earlier finding of necessity. This incoherent finding occurs if the algorithm makes simplifying assumptions on logical remainder rows that include the complement of the combination of necessary conditions. By reviewing the simplifying assumptions, it was possible to identify that the algorithm used assumptions with the complement in the logical minimisation process, and these rows were then removed, as indicated in bold in Table 5.21 and Table 5.22

Table 5.22. As presented before, some disjunction or substitutable necessary conditions were identified for both types of outcome. Rows representing the complement of the combination of conditions leading to decoupling from the 'what', and rows representing the complement of the combination of conditions leading to decoupling from the 'how', were excluded, as they would be inconsistent with the findings from the identified disjunctions.

Table 5.21 – Parsimonious solution simplifying assumptions for decoupling from the 'what'

	Regulative rules	**Normative rules**	**Capacity**	**Cognitive rules**	**Strategic alignment**
1	0	0	0	0	0
2	0	0	0	0	1
3	0	0	0	1	0
4	0	0	0	1	1
5	0	0	1	0	0
6	0	0	1	0	1
9	0	1	0	0	0
10	0	1	0	0	1

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
11	0	1	0	1	0
12	0	1	0	1	1
13	0	1	1	0	0
17	**1**	**0**	**0**	**0**	**0**
18	1	0	0	0	1
21	1	0	1	0	0
23	1	0	1	1	0
25	1	1	0	0	0
27	1	1	0	1	0
29	**1**	**1**	**1**	**0**	**0**
31	**1**	**1**	**1**	**1**	**0**
Complement	**reg_rules*norm_rules*capacity + reg_rules*norm_rules*cog_rules + norm_rules*capacity*strategic**				

Table 5.22 – Parsimonious solution simplifying assumptions for decoupling from the 'how'

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
1	0	0	0	0	0
2	0	0	0	0	1
4	0	0	0	1	1
5	0	0	1	0	0
6	0	0	1	0	1
7	0	0	1	1	0
9	0	1	0	0	0
10	0	1	0	0	1
11	**0**	**1**	**0**	**1**	**0**
12	**0**	**1**	**0**	**1**	**1**
13	0	1	1	0	0
15	**0**	**1**	**1**	**1**	**0**
17	1	0	0	0	0
18	1	0	0	0	1
19	1	0	0	1	0
20	1	0	0	1	1
21	1	0	1	0	0
22	1	0	1	0	1
23	1	0	1	1	0
29	**1**	**1**	**1**	**0**	**0**
Complement	**reg_rules*norm_rules + norm_rules*cog_rules**				

A second type of incoherent assumption occurs when the algorithm uses the same simplifying assumption for minimising the truth table for both the outcome and the outcome's complement (Kahwati and Kane, 2019), which might lead to a logically inconsistent finding suggesting that the same combination of conditions is sufficient for both the outcome and its complement. To assess whether this type of assumption was present, solutions for the outcome complement were generated and a verification was performed to see whether the algorithm used the same simplifying assumptions in the analyses for the outcome and the outcome complement. If the same logical remainder row was used as a simplifying assumption for both analyses, then it was decided which analysis the row should be used for, or to omit the row from use in either analysis. Table 5.23 and Table 5.24 show solutions for the outcome and the outcome complement for decoupling from the 'what', and Table 5.25 and Table 5.26 for decoupling from the 'how'. In the case of the outcome decoupling from the 'what', row 31 appears in the analysis of the outcome and the outcome complement. A decision was made to include the simplifying assumption for the outcome, as a lack of strategic alignment would not lead to non-decoupling. For decoupling from the 'how', the decision was taken to include the simplifying assumptions (rows 17 to 20) for the outcome, as a lack of capacity would result in decoupling.

Table 5.23 – Parsimonious solution simplifying assumptions for decoupling from the 'what'

	Regulative rules	**Normative rules**	**Capacity**	**Cognitive rules**	**Strategic alignment**
1	0	0	0	0	0
2	0	0	0	0	1
3	0	0	0	1	0
4	0	0	0	1	1
5	0	0	1	0	0
6	0	0	1	0	1
9	0	1	0	0	0
10	0	1	0	0	1
11	0	1	0	1	0
12	0	1	0	1	1
13	0	1	1	0	0
17	1	0	0	0	0
18	1	0	0	0	1
21	1	0	1	0	0
23	1	0	1	1	0

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
25	1	1	0	0	0
27	1	1	0	1	0
29	1	1	1	0	0
31	**1**	**1**	**1**	**1**	**0**

Table 5.24 – Parsimonious solution simplifying assumptions for non-decoupling from the 'what'

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
31	**1**	**1**	**1**	**1**	**0**

Table 5.25 – Parsimonious solution simplifying assumptions for decoupling from the 'how'

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
1	0	0	0	0	0
2	0	0	0	0	1
4	0	0	0	1	1
5	0	0	1	0	0
6	0	0	1	0	1
7	0	0	1	1	0
9	0	1	0	0	0
10	0	1	0	0	1
11	0	1	0	1	0
12	0	1	0	1	1
13	0	1	1	0	0
15	0	1	1	1	0
17	**1**	**0**	**0**	**0**	**0**
18	**1**	**0**	**0**	**0**	**1**
19	**1**	**0**	**0**	**1**	**0**
20	**1**	**0**	**0**	**1**	**1**
21	1	0	1	0	0
22	1	0	1	0	1
23	1	0	1	1	0
29	1	1	1	0	0

Table 5.26 – Parsimonious solution simplifying assumptions for non-decoupling from the 'how'

	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment
17	**1**	**0**	**0**	**0**	**0**
18	**1**	**0**	**0**	**0**	**1**
19	**1**	**0**	**0**	**1**	**0**
20	**1**	**0**	**0**	**1**	**1**
25	1	1	0	0	0
27	1	1	0	1	0
31	1	1	1	1	0

Once the assumptions had been evaluated and the untenable assumptions removed, the next step entailed conducting the enhanced analysis.

5.6.3.3 Enhanced analysis

After evaluating the assumptions in the previous step and making the decisions, the enhanced parsimonious solution was generated for the two types of decoupling, as shown in Table 5.27 and Table 5.28. As can be observed for decoupling from the 'what', there are two logically valid ways of minimising the truth table. The two possibilities are similar and differ by one solution term. When faced with model ambiguity, no criteria for selecting which model to interpret exists (Kahwati and Kane, 2019). The literature suggests choosing the model that maximises consistency or coverage (Kahwati and Kane, 2019). However, both models have similar coverage and consistency, so it was not possible to reach any conclusion based on this aspect.

Table 5.27 – Enhanced parsimonious solution, decoupling from the 'what'

		Coverage			
Enhanced parsimonious causal recipe	**Consistency**	**Raw**	**Unique**	**M1**	**M2**
~reg_rules • ~norm_rules	0.970	0.305	0.286	-	-
~reg_rules • ~strategic	1.000	0.211	0.192	-	-
~capacity • strategic	0.967	0.136	0.113	-	-
~norm_rules • ~capacity	1.000	0.047	0.000	-	
~norm_rules • ~strategic	1.000	0.042	0.000		-
M1	**0.979**	**0.657**			
M2	0.979	0.657			

Table 5.28 – Enhanced parsimonious solution, decoupling from the 'how'

		Coverage	
Enhanced parsimonious causal recipe	**Consistency**	**Raw**	**Unique**
~norm_rules	0.905	0.770	0.483
~reg_rules • capacity • strategic	0.930	0.460	0.069
capacity • ~cog_rules • strategic	1.000	0.161	0.057
Solution	0.926	1.000	

The next step considered which simplifying assumptions were included in each model. When analysing the simplifying assumptions, model 1 seems to be more appropriate because it uses fewer simplifying assumptions (15 in M2 vs 13 in M1), meaning the model would be based more on empirical evidence and less on counterfactuals. Additionally, the model 1 term ~norm_rules • ~capacity has slightly higher raw coverage (0.047 vs 0.042). Therefore, model 1 is used as the enhanced parsimonious solution.

As previously mentioned, the intermediate solutions are derived based on the comparison between the conservative and the parsimonious solutions. The conservative solutions are shown in Table 5.29 and Table 5.30.

Table 5.29 – Conservative solution, decoupling from the 'what'

		Coverage	
Conservative causal recipe	**Consistency**	**Raw**	**Unique**
~reg_rules • ~norm_rules • capacity • cog_rules	0.970	0.305	0.286
reg_rules • ~norm_rules • ~capacity • cog_rules	1.000	0.047	0.047
reg_rules • norm_rules • ~capacity • strategic	0.957	0.103	0.103
~reg_rules • capacity • cog_rules • ~strategic	1.000	0.211	0.192
Solution	0.979	0.648	

Table 5.30 – Conservative solution, decoupling from the 'how'

		Coverage			
Conservative causal recipe	**Consistency**	**Raw**	**Unique**	**M1**	**M2**
~norm_rules • capacity • cog_rules • strategic	0.899	0.713	0.425	-	-
norm_rules • capacity • ~cog_rules • strategic	1.000	0.161	0.057	-	-
~reg_rules • ~norm_rules • ~capacity • cog_rules • ~strategic	1.000	0.057	0.057	-	-
~reg_rules • norm_rules • capacity • strategic	1.000	0.172	0.000	-	
~reg_rules • capacity • cog_rules • strategic	0.912	0.356	0.000		-
M1	0.926	1.000			
M2	**0.926**	**1.000**			

As can be observed in Table 5.30, for decoupling from the 'how', two models were identified, with the same overall consistency and coverage. The models have the same coverage, but the second alternative term (~reg_rules • capacity • cog_rules • strategic) has higher coverage. Therefore, the second model was chosen because it includes a solution term with more empirical relevance.

Creation of the intermediate solution term is based on barring all difficult counterfactuals from the simplifying assumptions and allowing only easy counterfactuals to be included (Schneider and Wagemman, 2012). The software judges each individual simplifying assumption. The judgement involves considerations that simultaneously take into account (Schneider and Wagemann, 2012): i) which conjunctions appear to be sufficient for the outcome (expressed in the conservative solution), ii) which single conditions are available for any intermediate solution (as expressed in the most parsimonious solution), and iii) which expectations based on theory exist for single conditions (as expressed in the directional expectations).

Taking the example of decoupling from the 'how', the first term ~norm_rules from the parsimonious solution must be present in any intermediate solution, because the parsimonious solution is a superset of the intermediate solution. This conjunction is a superset of the solution terms ~norm_rules • capacity • cog_rules • strategic and ~reg_rules • ~norm_rules • ~capacity • cog_rules • ~strategic in the conservative solutions. Next, it is necessary to check which conditions can be dropped considering the directional expectations. As previously discussed, those conditions are capacity and strategic alignment, since, based on the previous literature on organisational decoupling, the expectation is that a lack of capacity or strategic alignment would lead to decoupling from policy, and in this case decoupling from the 'what' and the 'how'. What this means in practice is that if there is empirical evidence that decoupling happens with capacity and strategic alignment, it is safe to assume that a lack of strategic alignment or capacity will also lead to decoupling because strategic alignment and capacity are necessary for non-decoupling to happen. In the first analysed term (~norm_rules • capacity • cog_rules • strategic), both 'strategic alignment' and 'capacity' conditions can be dropped because if ~norm_rules • capacity • cog_rules • strategic is sufficient for the outcome, then ~norm_rules • ~capacity • cog_rules • ~strategic is also likely to be sufficient.

Next, it is necessary to find a remainder that differs from the empirical evidence from this solution term by ~strategic alignment and ~capacity. Looking at the simplifying assumptions (Table 5.31), row 19 has in common the term ~norm_rules with the conservative term ~norm_rules • capacity • cog_rules • strategic, but it lacks capacity and strategic alignment, which is what we are looking for. Next, this remainder will only be included if there is empirical evidence that differs by only ~strategic and ~capacity. Looking at the truth table (Table 5.16), the second row (reg_rules • ~norm_rules • capacity • cog_rules • strategic) is sufficient for the outcome and differs by only the conditions capacity and strategic alignment of the remainder 19 (reg_rules • ~norm_rules • ~capacity • cog_rules • ~strategic). In other words, the observed evidence shows that reg_rules • ~norm_rules • capacity • cog_rules • strategic is sufficient to decoupling, and because of the directional expectations – that a lack of strategic alignment and capacity also leads to decoupling – the remainder reg_rules • ~norm_rules • ~capacity • ~ cog_rules • ~strategic is included as a counterfactual. Because this remainder is in line with both empirical evidence and the directional expectations, it is said to be an easy counterfactual. After dropping the condition capacity and strategic alignment, the conservative term ~norm_rules • capacity • cog_rules • strategic becomes the intermediate term ~norm_rules • cog_rules, as shown in Table 5.32.

Table 5.31 – Simplifying assumptions for decoupling from the 'how'

Row #	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	Type
1	0	0	0	0	0	Hard
2	0	0	0	0	1	Hard
4	**0**	**0**	**0**	**1**	**1**	**Easy**
5	0	0	1	0	0	Hard
6	0	0	1	0	1	Hard
7	**0**	**0**	**1**	**1**	**0**	**Easy**
17	1	0	0	0	0	Hard
18	1	0	0	0	1	Hard
19	**1**	**0**	**0**	**1**	**0**	**Easy**
20	**1**	**0**	**0**	**1**	**1**	**Easy**
21	1	0	1	0	0	Hard
22	1	0	1	0	1	Hard
23	**1**	**0**	**1**	**1**	**0**	**Easy**

Table 5.32 – Intermediate enhanced solution, decoupling from the 'how'

		Coverage	
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**
~norm_rules • cog_rules	0.905	0.770	0.483
norm_rules • capacity • ~cog_rules • strategic	1.000	0.161	0.057
~reg_rules • capacity • cog_rules • strategic	0.912	0.356	0.000
Solution	0.926	1.000	

The same procedure is repeated for each conservative and parsimonious term, and subsequently for decoupling from the 'what'. Table 5.33 shows the simplifying assumptions for decoupling from the 'what', and Table 5.34 shows the intermediate enhanced solution for decoupling from the 'what'.

Table 5.33 – Simplifying assumptions for decoupling from the 'what'

Row #	Regulative rules	Normative rules	Capacity	Cognitive rules	Strategic alignment	Type
1	0	0	0	0	0	Hard
2	0	0	0	0	1	Hard
3	**0**	**0**	**0**	**1**	**0**	**Easy**
4	**0**	**0**	**0**	**1**	**1**	**Easy**
5	0	0	1	0	0	Hard
6	0	0	1	0	1	Hard
9	0	1	0	0	0	Hard
10	0	1	0	0	1	Hard
11	**0**	**1**	**0**	**1**	**0**	**Easy**
12	0	1	0	1	1	Hard
13	0	1	1	0	0	Hard
17	1	0	0	0	0	Hard
18	1	0	0	0	1	Hard
21	1	0	1	0	0	Hard
23	1	0	1	1	0	Hard

Table 5.34 – Intermediate enhanced solution, decoupling from the 'what'

		Coverage	
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**
~reg_rules • ~norm_rules • cog_rules	0.970	0.305	0.286
~reg_rules • cog_rules • ~strategic	1.000	0.211	0.192
~norm_rules • ~capacity • cog_rules	1.000	0.047	0.047
reg_rules • norm_rules • ~capacity • strategic	0.957	0.103	0.103
Solution	0.979	0.648	

Analysis of the parameters of fit (consistency and coverage) for the intermediate enhanced solution should be repeated.

5.6.3.4 Interpreting enhanced solution parameters of fit

As previously mentioned, the solution consistency represents the degree to which all configurations in combination are linked to the decoupling outcome. The solution consistency of 0.97 for decoupling from the 'what', and 0.92 for decoupling from the 'how' (above the

threshold of 0.8), indicate that the solutions are consistent in explaining the outcomes. The consistency of each configuration is also above the threshold, indicating strong sufficiency of each individual solution.

Again, the coverage of the overall solution for decoupling from the 'how' (1.00) has more empirical relevance than the overall solution for decoupling from the 'what' (0.648). Although the empirical relevance of the solution for decoupling from the 'what' is slightly below the recommended threshold of 0.75, both solutions identified sufficient combinations of condition that are found in the majority of cases in the outcome set, explaining the majority of cases with the two types of outcome. The different raw coverage of the solution terms for both cases confirms equifinality. For decoupling from the 'what', the raw coverage indicates the empirical strength that can be attributed to individual configurations, which means that 30.5% of the outcome is explained by configuration 1, for example. Similarly, decoupling from the 'how' is most explained by configuration 1 in Table 5.32.

For decoupling from the 'what', the unique coverage is almost equal to the raw coverage, indicating that these configurations are almost unique in explaining the outcome. For decoupling from the 'how', the unique coverage values indicate that the outcome is not uniquely covered by solution term 3 and is uniquely covered by solution terms 1 and 2, mostly by 1.

For decoupling from the 'what', the resulting intermediate standard solution yielded two models, whereas the resulting intermediate enhanced solution yielded only one. The solutions share two configurations with the same terms and consistency/coverage values, namely, ~reg_rules • ~norm_rules • cog_rules and ~reg_rules • cog_rules • ~strategic. They also have a similar term, which has the same consistency/coverage values and only differs by a single term within a configuration (reg_rules • norm_rules • ~capacity in the standard solution vs reg_rules • norm_rules • ~capacity • strategic in the enhanced solution). Finally, the standard solution has two alternative terms for each model, reg_rules • ~capacity • cog_rules and ~norm_rules • ~capacity • cog_rules, with the latter also being present in the enhanced solution. Although the standard solution yielded two alternative models, both are simpler than the enhanced solution. This happens because those solutions include untenable configurations, showing that a more parsimonious model does not necessarily translate into a better solution.

For decoupling from the 'how', the resulting intermediate solutions have the same consistency and coverage values and differ only by conditions included in each solution term. The models have the same consistency and coverage values because each solution term has the same cases for both the standard and enhanced models. The standard intermediate solution

yields a simpler solution only because it includes untenable configurations, showing that a more parsimonious model does not necessarily result in a better solution.

The robustness of the intermediate enhanced solution was further checked, as described next.

5.6.3.5 Assessing robustness

Assessing robustness consists of checking whether the findings substantively change in response to small changes in input; in other words, it is the same as a sensitive analysis (Kahwati and Kane, 2019). The literature suggests three robustness tests: i) adding or excluding cases; ii) changing calibration points, and iii) changing the consistency threshold used (Kahwati and Kane, 2019). The robustness test considered consisted of changing the consistency threshold used. Adding or excluding cases were not contemplated because this type of analysis usually considers borderline cases with respect to whether they should be included, which is not the case in this study. Excluding cases was not considered here, as the sample is large, and adding or reducing a small number of clauses would not make a huge difference. Second, the goal was to include all clauses and recommended processes as part of the two analysed standards, which was considered initially, so removing these cases now would not be aligned with the goal of being inclusive in terms of considering implementation of as many cases as possible. Changing the calibration points is a specific test for fuzzy-set, not crisp-set, QCA. Thus, the sensitive analysis focused on changing the consistency threshold, composed of using a lower threshold of 0.75 set within the software to determine which truth-table rows are used in the logical minimisation process, and afterwards a higher threshold of 0.9.

For decoupling from the 'what', using a lower threshold of 0.75 would result in a higher solution coverage, as more rows were included in the minimisation (and 20 new cases) and a slightly lower consistency, as shown in Table 5.35. The first and second rows of Table 5.34 were further minimised and condensed into the solution term ~reg_rules • cog_rules. For decoupling from the 'how', the use of a threshold of 0.75 would not impact the solution, as it would not result in the inclusion of additional rows and cases.

Table 5.35 – Intermediate enhanced solution with a threshold of 0.75, decoupling from the 'what'

		Coverage	
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**
~reg_rules • cog_rules	0.947	0.592	0.592
~norm_rules • ~capacity • cog_rules	1.000	0.047	0.047
reg_rules • norm_rules • ~capacity • strategic	0.957	0.103	0.103
Solution	0.952	0.742	

The use of a higher threshold of 0.9 would not impact the solution for decoupling from the 'what', as it would not result in the inclusion of additional rows and cases. For decoupling from the 'how', it would result in a slightly higher consistency and lower coverage, compared with the full coverage for the threshold of 0.8, as shown in Table 5.36. The use of a higher threshold leads to a more complex solution, with four terms instead of the three terms of the 0.80-threshold solution. This happens because the first term of the 0.80-threshold solution becomes the first and third term of the 0.90-threshold solution.

Table 5.36 – Intermediate enhanced solution with a threshold of 0.90, decoupling from the 'how'

		Coverage	
Intermediate causal recipe	**Consistency**	**Raw**	**Unique**
reg_rules • ~norm_rules • cog_rules	0.902	0.425	0.425
~reg_rules • norm_rules • capacity • strategic	1.000	0.172	0.069
~norm_rules • ~capacity • cog_rules • ~strategic	1.000	0.057	0.057
norm_rules • capacity • ~cog_rules • strategic	1.000	0.161	0.057
Solution	0.939	0.713	

In summary, for the 0.90-threshold solution, there would be no impact on the solution for decoupling from the 'what', and small changes for the consistency of decoupling from the 'how', but more significant changes for the coverage. In addition, the 0.90-threshold solution

for decoupling from the 'how' is a more complex solution with an additional term. A threshold of 0.75 would not impact the solution for decoupling from the 'how' and would lead to small changes in the parameters of fit for decoupling from the 'what'. These results indicate that the threshold of 0.8, in alignment with previous studies, is appropriate, leading to robust results with a balance between consistency and coverage.

Analysis of the model analytics previously described established the validity of the results reported. The results of the analysis can then be interpreted further.

5.6.4 Configurations sufficient for decoupling from the 'what'

As previously mentioned, the enhanced intermediate solution was considered for interpretation of the configurations sufficient for decoupling, and the results of the minimisation procedure are reported in Table 5.37. The results use the notation for solution tables introduced by Ragin and Fiss (2008), in which black circles (●) indicate the presence of a condition, and circles with a cross-out (⊗) indicate its absence. Blank spaces represent a 'don't care' situation in which the causal condition may be either present or absent. Large circles in this notation imply core conditions, and small circles refer to peripheral conditions (Fiss, 2011). Core conditions are present in both parsimonious and intermediate solutions and demonstrate a strong causal relationship with the outcome (Fiss, 2011). Peripheral conditions are present only in the intermediate solution and demonstrate a weak causal relationship with the outcome (Fiss, 2011). This perspective of the results was considered because it provides a more in-depth understanding of how configuration elements are connected to outcomes (Fiss, 2011).

There are four solution terms in the intermediate solution, suggesting an equifinal mechanism when it comes to underlying conditions of decoupling from the 'what'. This is not surprising, given that implementation of coercive pressure at project level is complex and given the range of organisational and industry aspects that are involved and shape work in projects. The solution terms in Table 5.37 characterise first-order equifinality; that is, the equifinal types exhibit different core characteristics (Fiss, 2011).

Table 5.37 – Configurations sufficient for decoupling from the 'what'

	Solutions			
Configuration	**1**	**2**	**3**	**4**
Normative rules	⊗		⊗	●
Regulative rules	⊗	⊗		●
Cognitive rules	●	●	●	
Capacity			⊗	⊗
Strategic alignment		⊗		●
Consistency	0.970	1.000	1.000	1.000
Raw coverage	0.305	0.211	0.047	0.103
Unique coverage	0.286	0.192	0.047	0.103
Overall solution consistency	0.979			
Overall solution coverage	0.648			

The first solution term covers the majority of cases and indicates that a lack of reconfiguration of normative and regulative rules, even if cognitive elements are reconfigured (i.e. even if project members are not following their past models of reality and previous guidance within their bodies of knowledge at industry level), would lead to non-implementation of some standards, its clauses or a violation of clauses and respective processes. It is indeed anticipated that non-reconfiguration of two of the three categories of rules would mean the majority of old structures guiding new actions, for example, old procedures, governance systems, which would result in decoupling.

For example, following the old governance systems in projects and reward and cost structures might lead to incomplete pursuit of new processes that would require new actions, but the cost structures would follow the previous pattern, because it would only represent a new task for some stakeholders, such as lead contractors, and the cost structure for them would be the same, which might lead them not to implement all processes in full. This solution term also suggests that even if there is capacity to implement the new processes (e.g. skills, resources), and the client organisation and project stakeholders are willing to implement them,

if existing procedures, governance systems at the client organisation, cost and reward structures at project level, among other things, are not reconfigured, implementation of 'what' has been imposed by the policy framework might not occur fully. This term reveals that both normative and regulative rules are the core conditions leading to decoupling from the 'what', meaning both conditions are equally causally relevant.

The second term suggests that if there is a lack of reconfiguration of regulative rules and a lack of will because of a lack of alignment of the imposed structure with the organisation's strategic objectives, decoupling from what is imposed by the policy framework may occur, even if the cognitive rules are reconfigured. It does not matter if the normative rules are reconfigured and if there is capacity. The previous term suggested that if both regulative and normative rules are not reconfigured, it does not matter if there is willingness to implement or not, because implementation would not occur holistically. The second term suggests that, if there is no willingness to implement and the regulative rules are not reconfigured, it does not matter whether the normative rules are reconfigured. In other words, these two terms suggest that, in most situations where decoupling occurs, there was a lack of reconfiguration of regulative rules (i.e. governance systems and reward and cost structures) as part of the combination of conditions leading to it.

The third solution term suggests that, if the normative rules are not reconfigured and there is no capacity, decoupling from what is imposed will occur, even if the cognitive rules are reconfigured, and independent of whether the regulative rules are reconfigured and there is willingness to implement. This is expected, because implementation of a policy framework may involve new processes and roles as part of these processes, as in the case of the analysed policy framework, and if the existing roles are not reconfigured and there are no new skills or resources in place, it is likely that the imposed processes will not be totally implemented.

The last term, on the other hand, suggests that decoupling from what is recommended by the policy framework will occur when there is no capacity to implement it, even if there is strong alignment and in the presence of all other conditions; that is, there is awareness to reconfigure the rules or they are not conflicting. This is the only situation where there is no lack of reconfiguration of at least one of the rules of the system. A lack of reconfiguration of either regulative and/or normative rules is present in most cases. A surprising finding from three of the equifinal types is that, although a lack of reconfiguration of one of the categories of rules would, indeed, be necessary for decoupling, it might not be sufficient – decoupling from what has been proposed only happens when more than one of the types of institution

stabilising the system is not reconfigured, or when one category of rules is not reconfigured, accompanied by a lack of capacity or willingness to implement.

In summary, the findings confirm that non-complete implementation results mostly from a combination of multiple factors that seem to be equally relevant in predicting the occurrence of decoupling.

5.6.5 Configurations sufficient for decoupling from the 'how'

For decoupling from the 'how', three solution terms were found to be part of the equifinal mechanism (Table 5.38), characterising first-order equifinality with equal causal influence. Solution 1 covers the majority of cases.

Table 5.38 – Configurations sufficient for decoupling from the 'how'

	Solutions		
Configuration	**1**	**2**	**3**
Normative rules	⊗	●	
Regulative rules			⊗
Cognitive rules	●	⊗	●
Capacity		●	●
Strategic alignment		●	●
Consistency	0.905	1.000	0.912
Raw coverage	0.770	0.161	0.356
Unique coverage	0.483	0.057	0.000
Overall solution consistency	0.915		
Overall solution coverage	1.000		

The three solutions indicate that, when there is a lack of reconfiguration of one type of rule, decoupling from the 'how' or non-holistic implementation of the imposed structure's meaning will occur, even if there is capacity and willingness to implement the imposed pressure. Solution 1 indicates that a lack of reconfiguration of role expectations, codes of

conduct, authority system and procedures would lead to implementation of the 'letter' but not the 'meaning' of the imposed structure. This is independent of having other conditions in place. It is indeed expected that if expectations regarding roles are maintained, or existing procedures not updated, as discussed in Chapter 4, superficial implementation will occur. The findings showed that a re-enactment of existing roles, instead of a reconfiguration of these roles when executing the new practices, was a major causal condition of decoupling from the 'how' of the imposed structure.

Similarly, solution 2 suggests that when scripts of action from bodies of knowledge and models of reality are not reconfigured, symbolic implementation will probably occur. Chapter 4 showed that a lack of reconfiguration of cultural–cognitive frames was related to symbolic implementation. This solution term, however, covers the minority of cases. Solution 3 suggests that, even if there is capacity and willingness to implement a new policy framework, but there is a lack of reconfiguration of governance systems and reward and cost structures in place, which are typical of, for example, some delivery approaches, holistic implementation might not occur.

In summary, the results suggest that non-reconfiguration of any of the existing institutional rules will lead to non-holistic implementation, meaning that when project team members are implementing new practices but are bounded by old structures, it is very likely that implementation will follow previous ways of working and not occur as envisaged by policy. This may also result in non-achievement of the envisaged outcomes, as the processes, despite being implemented, are not implemented in the expected way. This may also explain why some projects/client organisations have reported not seeing the benefits of BIM level 2: although they have implemented the 'letter' of the mandate, there are old structures shaping implementation, and the meaning of the imposed structure is not completely implemented.

5.7 Summary and final remarks of the chapter

The findings reported in this chapter characterised a project-level decoupling phenomenon. The results revealed that projects may respond in four different ways to institutional pressure, illustrating a hybrid response, and there are common underlying conditions for such responses. Analysis of the differences in implementation revealed that the same underlying conditions, when combined in different ways, may lead to different types of response or two variances of a decoupling phenomenon. The analysis showed that project-level decoupling is underlined by

causal complexity, and the application of QCA enabled a more fine-grained analysis through the logic of set theory.

The analysis revealed first-order equifinality for both types of decoupling. It also showed that a lack of reconfiguration of normative and/or regulative rules is related to non-complete implementation. Also, non-reconfiguration of one of the three categories of rules will certainly lead to decoupling from the 'how'. Both analyses show that there are different paths to decoupling, and even when there is strategic alignment and capacity to implement pressure, if there is no agency to reconfigure the existing rules, holistic implementation and change will not occur. The findings and conceptualisation of decoupling at project level extend the existing literature in different ways, as discussed in the next chapter.

Chapter 6 – Discussion

6.1 Chapter introduction

This chapter establishes the significance of the key findings and relates them to the different literature streams underpinning the research questions. It starts by discussing the results in the context of organisational responses to environmental pressures and decoupling. The findings expand the decoupling literature in terms of both conceptualisations of the decoupling phenomenon and the conditions underlying its occurrence. Additionally, by applying institutional theory as a theoretical lens, this research also contributes to the project management and construction management literature and calls for more research examining the link between projects and institutions. The contributions to the built environment literature are then presented; this also includes practical insights to policy-making. Finally, the chapter outlines how the findings enhance the BIM literature itself. It concludes with a summary of the contributions to both theory and practice.

6.2 Contributions to organisational theory literature

A range of institutional studies have demonstrated that organisations vary in their responses to institutional pressure. Decades of research on decoupling have enabled a thorough understanding of how organisations manage to adopt formal rules ceremonially while keeping their practices unaffected (Bromley and Powell, 2012). The findings of this research, however, elaborate further on dimensions of decoupling that have recently been revisited in the literature.

As discussed in Chapter 2, scholars have posited that there are two main forms of decoupling (Bromley and Powell, 2012): policy–practice decoupling and means–end decoupling. Most of the management research has focused on the symbolic adoption of policies (policy–practice decoupling) or the gap between formal procedures and actual practice. However, Bromley and Powell (2012) highlight another common form of decoupling, at means–ends level, in which policies are adopted but implementation is symbolic. In such cases, formal structures have real organisational consequences, work activities are altered, and policies are implemented and evaluated; nonetheless, scant evidence exists showing that these activities are linked to outcomes (Bromley and Powell, 2012). The envisaged outcomes are not achieved in a situation of means-end decoupling because the adopted practices might be inappropriate (Wijen, 2014). Means–end decoupling also occurs when organisations adopt new

ends that are not directly related to core goals and when the link between enactment of those practices and an organisation's core goals is unclear (Wijen, 2014).

The findings here suggest that non-achievement of the envisioned outcomes might also occur when there is coupling between the means and the ends, and when practices are actually implemented (i.e. existing ways of work are altered). The failure to achieve the outcomes is not because of a lack of implementation of new practices and a change to existing ones. As previously discussed, the failure to achieve the envisaged goals also occurs because of a lack of implementation of the 'hows' of the imposed structure or its meaning. This means that, although the new structure and respective practices are implemented, implementation does not occur holistically. Thus, as discussed in Chapter 5, when adopting a practice-based perspective (Jarzabkowski et al., 2016), the concept of policy–practice decoupling could be extended to consider not only the adoption and implementation of practices, or their content (the 'what'), but it could also be more nuanced in consideration of 'how' the practices should be implemented (Jarzabkowski et al., 2016). Most of the existing research on policy–practice decoupling has conceptualised its occurrence as an either/or proposition, in relation to whether organisations adopt it completely (in terms of the content) or not, and whether organisational practices change or not; it has also proposed that the achievement of outcomes is related to full implementation in terms of implementation of this content (Bromley and Powell, 2012). However, as posited by practice scholars (Jarzabkowski et al., 2016), analysis of performance cannot be attributed merely to the adoption or non-adoption of practices without considering how these practices are transformed when put into action. Thus, the findings suggest that in the conceptualisation of policy–practice decoupling and when considering outcome achievement, it is appropriate to explore how organisations implement new practices in terms of implementation of their underlying meaning as well, rather than simply predicting whether organisations adopt the imposed practices at all and whether the working practices or daily routines are altered. In establishing the 'what' and 'how' of decoupling as separate, it is possible to propose the conceptualisation of the decoupling phenomenon into a more nuanced one; this conceptualisation considers decoupling from implementing the content of the practices (the 'what') or decoupling from implementing the underlying 'hows' or meaning of practices. This proposal of a more fine-grained conceptualisation represents the first contribution of this research.

Second, the findings are in alignment with recent studies (e.g. Li, 2017) expanding the initial insight of decoupling proposed by Meyer and Rowan (1977), that decoupling occurs as a gap between adoption and implementation. The results indicate that implementation might

not be holistic because of a prior decoupling that occurs at the level of the imposed structure itself (i.e. a decoupling between the 'saying' and the 'meaning' at the level of the standards). This subsequently leads to a decoupling from the 'how' of the imposed structure at the level of implementation. Thus, the findings reveal a mechanism through which decoupling occurs; implementation might not be translated into its meaning because there is a gap between what the imposed structure suggests and what it is intended to mean. What the standards suggest does not sufficiently articulate what the standards mean; in this case, the project team members might not implement the real meaning, leading to a decoupling between what they do and what it was expected their actions would originally mean by doing it. Actors implement what the structure suggests but not necessarily what it means by its saying. The lack of reconfiguration of existing rules, which, as previously identified, led to decoupling from the 'how', might occur because it is not explicit by the imposed structure in saying that this reconfiguration should occur, although it is what the imposed structure implicitly meant, influencing the awareness and, subsequently, ability to respond to the institutional pressure. Previous research has suggested that decoupling might occur because the pressure is not always very clear, and sometimes conflicting, leading organisations to vary in their interpretations (Battard et al., 2017). This research adds to this argument and posits that awareness might be compromised.

A lack of reconfiguration of the existing institutional rules, however, might also occur because actors did not enact such reconfigurations when it was expected or required from them. This might result from other intentional or unintentional reasons besides them not being aware that reconfiguration should occur, because the new imposed structure is not explicit about it, or because there might be a prior decoupling at the level of the imposed structures. Detailed explanations for a lack of reconfiguration of the diverse institutionalised rules, however, were not covered by this research, which sought to identify the underlying reasons for responses employed by projects and identified that a lack of reconfiguration of existing rules is a cause of non-holistic implementation, which is related to a lack of awareness and/or conflicting rules. However, it did not investigate all mechanisms or scope conditions related to this. Nevertheless, the findings resulted in the identification that the imposed structure itself might play a role in this.

By illustrating the role of the imposed structure and highlighting a prior decoupling that might occur at the level of the imposed structure itself, the findings also contribute to institutional theory and decoupling literature by stressing the role of the imposed rules on the mechanisms leading to decoupling. As noted by Suchman and Edelman (1996), while institutional theory is quite subtle in the treatment of organisations' rules or structure-

following, there is a lack of similar subtlety in the treatment of the rules themselves. The underlying assumption is that rules are explicit, authoritative and coercive. The findings demonstrate that the formal structure itself might not be framed in a manner that induces awareness and the actions necessary to completely implement it. Thus, the results also indicate that decoupling at the level of adoption and implementation may be related to decoupling on another level.

Third, by uncovering the role played by the imposed structure, the findings are also consistent with recent research challenging the perception that variation in the implementation of new organisational practices is a purposeful adaptation by those implementing them, or that decoupling is always intentional because of a perceived misalignment between the imposed structure and the organisation (Gondo and Amis, 2013). The existing assumption is that if actors accept the need to implement new practices or imposed structures, implementation should occur non-problematically (Gondo and Amis, 2013). Gondo and Amis (2013) argue that much behaviour in organisations occurs with minimal conscious reflection on its continued appropriateness, and the continued passive use of established activities within organisations explains why there is variation in the implementation of accepted practices. The results observed across projects confirmed that even when the imposed structure and respective practices are accepted and conceived of as beneficial, implementation might not fully occur. This lack of full implementation, wherein decoupling from the 'what' and the 'how' is not necessarily intentional, is consistent with Gondo and Ami's (2013) findings. As previously discussed, there are established structures and taken-for-granted patterns that must be reconfigured; this reconfiguration might be within the responsibility of the implementers who should take action to reconfigure it. However, these actors might not realise that such reconfigurations of existing structures need to occur. In the case that the imposed structure is unclear about its meaning regarding its saying, implementers may not realise that existing structures should be reconfigured. Thus, the findings align with Gondo and Ami's (2013) conclusions that decoupling is not always intentional; it might also occur unintentionally because of a lack of action and awareness of the changes that need to occur.

Fourth, intentionally or unintentionally, there is a traditional understanding in decoupling studies of decoupling in organisations as a whole; studies posit that organisations either couple or decouple (in different forms) their activities from policy and institutional pressure, and decoupling is mostly analysed at organisational level (Meyer and Rowan, 1977; Kern et al., 2018). The results in the context of projects reveal that multiple responses can be employed simultaneously in the course of implementation of a new structure comprising a range of

practices; it might not be either decoupling or coupling from the policy framework but both, and it is not either purely intentional (calculated deception) or unintentional enactment. Total decoupling or total coupling in relation to the policy mandate were not observed. At inter-organisational level, in which the phenomenon had not previously been explored, multiple responses were observed, and the causes producing those responses were also multiple and involved multiple levels (i.e. there were reasons related to the organisational context of those involved in the projects, such as the client; there were also reasons involving the industry context, such as an existing shared understanding). This finding also extends existing research, as previous studies primarily focused on exploring individual causes of decoupling, and the findings presented here reveal that decoupling may actually present characteristics of conjunction and equifinality, namely, complex causality. While previous studies have unveiled a range of firm-level variables or environmental circumstances to explain the conditions underlying manifestation of the phenomenon, the findings suggest that those conditions might occur not in isolation but in combination. As argued by Battard et al. (2017), although previous studies provide fruitful information by focusing on various elements, these elements are typically considered separately, which may lead to a partial explanation.

This is also consistent with Crilly et al.'s (2012) assertion that a robust explanation of decoupling must account for how both the internal organisation and external environment interact in shaping organisational responses to external pressures. Crilly et al.'s (2012) argument is that the consideration of exclusively firm-level variables is more relevant when single actors direct firms' responses. In the case of projects, although the client plays a significant role in the delivery and activities enacted, delivery is coordinated by multiple actors whose actions are shaped by a diverse institutional environment; therefore, the multi-level perspective, which accounts for both the organisational contexts of actors involved and the industry context, is appropriate to explain the responses employed by projects. This resulted in causal recipes of organisational and industry aspects that, in combination, shape the responses developed by projects, and which cannot be effectively explained by single factors at any isolated level of analysis.

In terms of the identified underlying conditions, recent research has revealed that a reconfiguration of organisations' multiple 'spaces', involving physical spaces (the infrastructure and equipment, formal rules and role structure within the organisation), mental spaces (the shared meaning and sense that members make of their organisation and field) and social spaces (the sense of belonging and how identity is constructed in relation to practices) is necessary in coupling with institutional pressures (Battard et al., 2017). The identified

underlying reasons align with these findings, which posit that multiple 'rules' should be reconfigured to avoid decoupling, and extend the argument by contending that the reconfiguration of spaces involves multiple levels. Additionally, the causal recipes reveal that there are multiple paths and combinations of these rules, in association with the willingness and other scoping conditions of the ability, that are likely to induce the two variances of decoupling. The paths also reveal that a lack of reconfiguration of some rules is more likely to be associated with decoupling.

In short, the findings presented previously enhance our understanding of organisational responses to institutional pressure along two main dimensions, which are the focus of institutional studies: the types of response, and the causes leading to such responses.

6.3 Contributions to the project management and construction management literature

The findings extend project management and construction management literature along two lines. First, they shed light on aspects of the relationship between projects' internal processes and the environment. Second, the findings reveal characteristics of projects' responses to institutional pressure that help to conceptualise a decoupling phenomenon at inter-organisational level.

The research questions investigated in this study contribute directly to recent calls in project management literature to investigate the institutional pressure that is applied in projects and the responses that projects develop to cope with these requirements (Soderlund and Sydow, 2019). Despite some research addressing institutional aspects of projects having emerged, project management scholars continue to acknowledge that projects have mostly been treated as 'black boxes' (Soderlund and Sydow, 2019). As posited by Winch and Sanchez (2020), even the emerging studies elucidating how projects can shape institutions have not focused in-depth on understanding interactions with the institutions in which projects are embedded. The findings presented in the previous chapters show that the process of change and institutionalisation of new structures imposed by the environment is a process of structuration, influenced by existing structures from multiple contexts in which projects are embedded. The results demonstrate that combinations of multi-level institutionalised rules and organisation-level variables shape how projects respond to exogenous pressures. The results thereby reveal institutional factors related to changes in work practices in projects (Bresnen, 2016). The

findings demonstrate that implementation of new practices at ground level varies and relies on the agency of project members.

Moreover, a central and general aspect in institutional analysis concerns how organisations respond to institutional pressure (Kraatz and Block, 2008; Soderlund and Sydow, 2019). The findings reveal characteristics of decoupling at inter-organisational level, taking into account the characteristics of projects that reflect how this form of organising responds to environmental pressure. Because projects are embedded in multiple contexts, and work is influenced by these contexts, the underlying causes of the employed responses arise from these multiple contexts and are also multiple; a combination of these multiple conditions influences the responses adopted. The implementation of new practices requires reconfiguration of multi-level structures. Organisational-level variables also involve multiple organisational contexts. The findings also reveal more than one pathway to a given outcome. How projects respond to environmental pressure can then be characterised as underlined by causal complexity. By revealing such characteristics of decoupling at inter-organisational level, the findings also contribute to existing institutional studies on decoupling and illustrate that the phenomenon may actually occur under circumstances of causal complexity, which is also scarcely reported in organisational theory literature.

6.4 Contributions to the built environment policy literature

The findings extend existing research concerning built environment policy along two dimensions: the gaps between policy design and implementation, and the conditions of policy success and failure, or the achievement of the policy's objectives.

Scholars have acknowledged that a rationalist view is predominant in policy-making, which involves treating policy design and subsequent implementation in an absolutist manner by setting standards and prescribing mandated courses of action (Rasmussen et al., 2017). The findings have demonstrated that agency in projects mediates the impact of coercive pressures such as mandates, corroborating the views that policy discourses, its assumptions and the prescriptions that follow it are generally perceived as readily accepted by a multitude of stakeholders and easily implemented (Smiley et al., 2014), when in fact they are not, necessitating a more critical examination. The range of responses to a policy mandate that projects might employ shows that the focus thus far on the linear process of policy design, implementation and evaluation has come at the expense of understanding post-adoption

variation. The presence of new practices implemented across the sector as a result of a policy mandate can mask considerable diversity in enactment, as broad diffusion may generate broader variety at ground level. The observed diversity of responses thus suggests that consideration must be given to implementers and the context of implementation, and to how implementation has occurred, when determining whether the policy has achieved the envisaged outcomes.

As discussed in Chapter 2, the current methods of minimising the gaps between policy design and implementation discussed in the literature include the co-design of policy in open and transparent forums, including the stakeholder's community and members with an experiential understanding of how things are (Foxell and Cooper, 2015; Schweber et al., 2015; Warwick, 2015). Foxell and Cooper (2015) propose that this approach could also benefit from being combined with a risk-based assessment of the odds of policy success in the face of poor conception, underpowered implementation and politics.

The findings expand the research into the gaps between policy design and implementation due to poor conception. The results suggest that poor conception might occur not only as a consequence of a lack of participation in the design process of those involved in implementing the policy, but also when the context of implementation, and the interaction of policy with this implementation context, is not considered by institutional designers during policy design, and/or this consideration is not translated into comprehensive guidance. In other words, when there is no consideration of how the imposed structure part of the policy would interact within the existing context, the imposed structure might not be developed in such a manner that it would raise awareness and result in policy implementation in the way envisaged by policy-makers, involving changes to existing structures. This finding is in alignment with previous research highlighting that the existing socio-technical system conditions influence the implementation of policies and should be considered in policy formulation, but this interaction is often implicit or taken for granted (Pan and Ning, 2015).

The findings uncovered that some of the processes prescribed by the imposed structure were not comprehensively prescriptive (i.e. as previously described, there was a decoupling between the 'meaning' and the 'saying' at the level of the imposed structure), they did not induce the awareness and change necessary to completely implement the imposed structure, or they even indirectly encouraged reproduction of existing structures. An example includes the prescriptions regarding the definition of information requirements (according to clause 5.1.5 PAS 1192-2:2013):

Employers are strongly advised to assign the role of project-delivery manager to one or more individuals as early as possible to develop those requirements. Under the CIC BIM protocol (2013) the employer is obliged to appoint a party to undertake the role of information manager.

This prescription recommends that the information requirements, part of the information model that will be one of the deliverables at the end of the project, are defined by delivery managers, who can be third parties. The standards do not specify that this process of defining requirements should also include new stakeholders or the new 'clients' of the information models (i.e. the users of information models), although that is an implicit aspect of this new process. This led projects to the definition of information requirements without the proper input of all information-users, in a similar manner to how it has always been done for other requirements (i.e. defined by third parties). Thus, poor conceptions of policy may also occur when the context of implementation and how activities are currently performed are not carefully considered in the development of new structures and/or the prescriptions that follow it. This consideration would lead to a better understanding of what should change, in comparison to how enactment currently takes place, leading to development of policy in a way that such change would occur. As previously mentioned, Foxell and Cooper (2015) suggest that during built environment policy design, it is necessary to understand the probability and extent of success, and the results suggest that this understanding can be enhanced if there is consideration of how the imposed structure would interact with existing structures.

While deinstitutionalisation – the process by which the legitimacy of institutionalised practices is eroded – might take time, given the strength of existing structures in the sector, the data revealed that it might be even slower if the technical prescriptions that follow the institutional pressure are not sufficiently comprehensive to drive awareness and the actions that should be taken by project stakeholders to enact new processes without framing old structures, or the actions they should pursue to reconfigure existing structures. Structures persist to the extent that actors are able to continuously reproduce them (Scott, 2014), and the data uncovered the role of the imposed structure; sometimes, the imposed structure might reinforce existing institutions rather than promoting change. This occurred, for example, regarding prescriptions of the analysed standards in terms of the assignment of roles, not necessarily inducing a required change of existing role expectations. Thus, the findings draw attention to a phenomenon of decoupling from policy and a lack of understanding of the envisaged outcomes as also resulting from the interaction between the imposed structure and the context for implementation, and the need to consider this interplay. Previous research has noted that while

standards are known to facilitate technological and processual convergence, it remains unexplored how they truly affect trajectories (Kim et al., 2017). The findings indicate that standards might also hinder convergence by leading to variance in enactment if they clearly do not induce a reconfiguration of existing institutions or unintentionally reinforce them.

Regarding performance, the success and failure of built environment policy have been highlighted mostly from the perspective of policy design. For example, some authors (Janda and Topouzi, 2015) stress the importance of framing in both defining and delivering successful outcomes; they posit that built environment policy is always regarded as a 'hero' and that changing to a 'learning' mode is necessary for recognising realistic limits to policy objectives; doing so could result in reducing the rate and extent of performance failure in the sector. As previously mentioned, most existing research has focused on how policy problems are framed, as opposed to how policy is used (Simmons, 2015). The findings suggest that how policy is used should be accounted for when analysing performance and transformation.

The results suggest that implementers are not passive receptors of imposed policy, and implementation cannot be assumed to be a straightforward process; it cannot be assumed that the main issue is policy design and that if design is successful and widespread adoption occurs, the outcomes will be achieved at the pace envisaged by policy-makers. The findings illustrate that decoupling may occur when implementing a new policy as a result of a willingness and ability to implement. Decoupling might occur either intentionally or unintentionally. Implementers may choose to implement a new policy merely to comply with requirements and as 'window dressing'. The imposed structure may also not be consistent with implementers' objectives, and implementation might not occur holistically in terms of what has been proposed by the policy. This suggests that mechanisms, such as monitoring, to ensure that implementation occurs as envisaged, should also be considered in the policy process. More emphasis should be placed on the stage 'putting solutions into effect' in the 'policy cycle' (Foxell and Cooper, 2015).

The findings also suggest that when there is a lack of capacity, implementation may not occur as expected. On other occasions, implementation might not be holistic because of a lack of reconfiguration of existing structures. As previously mentioned, there might be a gap in the prescriptions themselves, and because of a lack of comprehensive prescription, implementers might not realise the actions that should be pursued to change existing structures. The lack of reconfiguration might also occur for other reasons. This all suggests that implementation is more complex than assumed and that the envisaged goals might not be achieved because of implementation that does not occur as envisaged.

Thus, implementation is not a straightforward process, and not all implementers of a built environment policy will implement policy in the same manner and the expected way. Variance at ground level exists, and this variance might impact the pace of isomorphism and the achievement of the envisaged outcomes by policy-makers. The BIM level 2 policy mandate, as part of the 2011 UK government's construction strategy, was intended to help reduce the cost of public-sector assets by up to 20% by 2016. This would be achieved by addressing the problem of information that is inaccurate, incomplete and ambiguous, which results in unnecessary additional capital delivery costs amounting to 20–25%. However, the results have highlighted that implementation is not occurring holistically, as has also been revealed in the case of the analysed public-sector project. Consequently, the envisaged outcomes have not been achieved at the pace anticipated.

Therefore, when accounting for performance success and failure in built environment policy aiming to transform the construction sector and improve overall performance, it is necessary to consider implementation and how it has occurred, as well as the real state of isomorphism in the sector. Diffusion of a policy does not equal legitimation of practices, and successful implementation and performance cannot be evaluated merely based on the increased adoption of a policy across the sector, as has been assumed, for example, in some BIM-related research.

6.5 Contributions to the BIM literature

The technological merits of BIM are still perceived as being central to industry transformation. As mentioned in Chapter 2, scholars have acknowledged that it remains necessary to analyse the diverse implications of BIM policy approaches (Aksenova et al., 2019). Literature on BIM adoption and implementation has acknowledged that coercive pressures such as mandates contribute to widespread adoption and diffusion of BIM (Cao et al., 2014; Ahmed and Kassem, 2018), but studies looking at how implementation actually occurs under the influence of such pressures are still limited. There is a shared assumption that the BIM discourse and prescriptions that follow it are readily accepted by a multitude of stakeholders (Smiley et al., 2014). However, the findings of this research show that implementation of an imposed structure from a coercive pressure is not a straightforward process, in alignment with recent research challenging the perceptions of BIM enactment as a linear process (Dainty et al., 2017).

The findings indicate that BIM implementation may diverge at ground level and offer a more granular conceptualisation of 'how' implementation may unfold, extending previous

research that mostly focuses on either adoption or implementation, without exploring 'how' implementation occurs, or which conceptualise implementation and its extension in terms of maturity of uses. Although previous research has posited that BIM is characterised by hybrid practice, and has explored this hybridisation at organisational level and the generating factors of hybrid environments (Davies et al., 2017), it is not clear how such hybridisation occurs in terms of its modes, when implementing processes, especially concerning the project context.

By revealing that implementation of new processes rarely occurs as assumed by BIM policy-makers, and revealing different ways that implementation of a coercive pressure may occur, the findings also provide novel insights into why the proclaimed benefits of BIM have not always been realised. As highlighted by Dowsett and Harty (2019), despite an increase in the adoption of BIM throughout the construction industry, important links between implementation and benefits realisation have not yet been explored. BIM benefits are an extensively researched area, but most existing studies adopt a technocentric perspective and do not consider the wider socio-organisational context or how these might be reconfigured to achieve the outcomes (Dowsett and Harty, 2019). The results suggest that non-realisation of the intended benefits can be an outcome of 'symbolic' adoption or non-holistic implementation of the imposed structure; it could also result from 'symbolic' implementation or decoupling from the 'how' of the imposed structure. It thus shows that it is not just a matter of reconfiguring practices or adopting new practices, but also 'how' these practices should be enacted.

In terms of underlying conditions of the identified responses, the findings show that both the willingness and ability of projects to respond to external pressure influence the response employed. These two dimensions have been conceptualised in alignment with previous organisational theory literature (Oliver, 1991), and they are related to the multiple contexts in which projects are embedded. The scope of conditions under which projects show willingness to conform to the pressure are bounded by the alignment of the pressure with the client organisation's strategic objectives. In the case of the specific coercive pressure under analysis, implementation is driven by the client's organisation. Previous research has identified that the client organisation mediates the extent of BIM adoption (Cao et al., 2014). Other studies have also posited that maturity and adoption depend on the client (Porwal and Hewage, 2013). Ahmed and Kassem (2018) have identified that adoption is dependent on the level of business interest in BIM innovation. The findings here complement these studies by showing that, under coercive pressure, the client organisation or its interest in BIM will affect not only the extent of adoption in terms of BIM use but also how implementation of processes will unfold.

The extent of implementation of processes, however, is not influenced by the client organisation's willingness alone. The findings show that full implementation is also underpinned by the ability to respond to the pressure. The scope of conditions under which projects are able to conform to the institutional pressure is bounded by capacity, conflict and awareness. Capacity involves having the resources, skills and experience necessary to fully comply. The findings revealed that a lack of capacity may lead to either non-implementation and/or violation of the imposed structure as part of the coercive pressure. Previous research has already identified that a lack of skills, experience and resources influence adoption or implementation, and the findings here extend these studies by showing how an imposed structure will be implemented in a condition of a lack of capacity. Moreover, the ability to implement pressure is influenced by the conflicting nature of the imposed structure with aspects of existing structures and awareness of project members of the need to reconfigure existing structures. The findings show that cognitive, regulative and normative structures from multiple contexts in which projects are embedded might not be reconfigured in an episode of change related to implementation of an institutional pressure. This lack of reconfiguration is related to both awareness and conflicting issues. The findings reveal, then, that existing multi-level structures and agency of project members are related to implementation. Previous research has pointed out that structural changes are necessary (e.g. Cavka et al., 2015) for BIM implementation, and some studies have recognised that existing structures influence innovation (e.g. Poirier et al., 2015; Hall et al., 2020); and the findings here elaborate on 'how' implementation unfolds under the influence of multi-level structures and provide a detailed account of the influence of different types of rule based on analysis of real implementation. The results show that even when there is capacity and willingness to implement coercive pressure, if one of the groups of rules is not reconfigured, decoupling from the implicit meaning of the imposed structure might occur. The findings also uncover the role played by the imposed structure itself in the lack of reconfiguration of existing rules, as previously mentioned. This further contributes to calls for more critical analysis of BIM policy mandates (Dainty et al., 2017; Aksenova et al., 2019).

By revealing the combined effect of multiple conditions on how implementation unfolds by employing a configurational approach, this research extends existing BIM literature that identifies factors influencing adoption and implementation based on surveys with practitioners. The correlation-based approaches used by existing studies do not account for conjunctural and equifinal causal relations, which were identified in the first stage of this research as underlying implementation. The dominance of these approaches has resulted in theory on BIM

implementation that is marked by a general linear reality based on conceptions of independent causality. Some studies have posited that, actually, implementation is affected by multiple factors (e.g. Davies et al., 2017), but they have not elaborated on the conjunctural influence.

Finally, the findings reported here suggest that understanding the transformation of the sector must extend beyond studies of diffusion to account for how implementation truly unfolds. While it is relevant to understand the factors related to adoption and diffusion, diffusion in and of itself does not guarantee the legitimation of new practices (Scott, 2014). Previous research has illuminated the causal processes by which BIM diffuses and becomes legitimate and spreads, but the sustained focus on explaining diffusion across members of the sector comes at the expense of understanding post-adoption variation. Widespread adoption of BIM does not necessarily mean that implementation is unfolding as envisaged or that the policy framework is having the intended impact. The results also contribute to the existing body of research on innovation diffusion in construction by showing that many of the factors pointed out in previous research as influencing the diffusion of innovation in terms of adoption (e.g. Harty, 2005) also influence implementation and reveal different modes of how implementation may unfold.

6.6 Summary and final remarks

In summary, this study makes three main contributions to the existing literature: (i) it contributes to a departure from rationalist perspectives on policy design and implementation and provides a framework for projects' responses to institutional pressures; (ii) it identifies factors that, in combination, explain the variety of responses, illustrating that the responses are not always intentional and that the imposed structure plays a role in determining how implementation unfolds; and (iii) it sheds light on modes of inter-organisational responses to institutional pressure (i.e. the two variances of decoupling) and uncovers the characteristics of project-level decoupling. Based on these three main findings, contributions to different streams of literature could be traced, as previously described.

From a practical perspective, the findings reveal how implementation of a mandate may occur, providing insights to built environment policy-makers regarding how policy should be conceived in order that implementation unfolds as envisaged and the expected benefits can be realised. Based on the findings, the main implications and conclusions of this thesis are outlined in the following chapter, along with the limitations and suggestions for further research.

Chapter 7 – Conclusion

7.1 Chapter introduction

The findings of this research contributed to unpacking the black box that follows the adoption of an institutional pressure in the form of project policy. By taking the perspective of the implementers of such pressures, the findings show that compliance is socially constructed in action, and variance emerges. The way that the policy framework has been enacted in practice draws attention to the role played by the imposed structure itself and its prescriptions in shaping practical implementation, in addition to its interaction with existing institutions in the context of implementation as an essential aspect to be considered by institutional designers. The knowledge generated through the investigation of practical implementation of BIM policy can serve as the basis for thinking about policy design in such a way that the implementation that follows will perform as envisaged, as reformers rarely take into account implementers' perspectives or specific aspects of the context of implementation when designing policy.

From a theoretical perspective, the findings contribute to the different streams of literature, as described in Chapter 6. The relevance of these contributions is further elaborated in Section 7.2, followed by a description of its practical significance in Section 7.3, the research limitations in Section 7.4 and, finally, some directions for future work in Section 7.5.

7.2 The theoretical contributions

The results and findings presented in the previous chapters conceptualised a decoupling phenomenon as a response to institutional pressures at inter-organisational level, and elaborated upon its predictors. The main findings along the two previously mentioned dimensions can be summarised as follows.

Projects' hybrid responses to institutional pressures

- The process of implementation of a new structure in projects, imposed by the environment, is a process of structuration and is influenced by existing multi-level structures shaping the work in projects and by the agency of project stakeholders.
- When faced with an institutional pressure imposing a new structure, either coupling and decoupling from the imposed structure might occur simultaneously, as implementation is dependent on multiple parties involved in projects and is shaped by multiple contexts.

- Decoupling from the imposed structure might occur in terms of decoupling either from the content or the 'what' of the imposed structure and its prescriptions, or from the implicit meaning of those prescriptions, namely, the 'how'.
- The conceptualisation of policy–practice decoupling in the organisational theory literature can be extended to a more nuanced one, in light of practice theory, to go further than the conceptualisation of its occurrence when the content of the imposed policy is not implemented to also consider the implementation of its meaning.

The underlying predictors of decoupling

- Decoupling in projects can be characterised as causally complex, underlined by both conjunction and equifinality. Conjunction means that the responses that projects employ result from the interdependence of multiple conditions, which sit within the multiple contexts in which projects are embedded. Equifinality means that multiple combinations of these conditions may lead to the same outcome.
- The willingness and ability of projects to respond to an institutional pressure shape the responses employed.
- The imposed structure itself plays a role in how implementation unfolds; the prescriptive nature of the imposed structure might limit the ability of projects to respond by influencing project stakeholders' awareness of structural changes that might be necessary.
- Decoupling is not necessarily a pre-conceived response; it might also occur unintentionally when actors are unaware of the structural changes necessary to fully implement the institutional pressure's structure.

7.2.1 The building-blocks of the theoretical contribution

According to management theorists, a value-added contribution to theory development constitutes some elements or building-blocks (Whetten, 1989), which are elaborated as follows for the contributions of this thesis.

What and how. A meaningful theoretical contribution should go beyond adding or subtracting factors (*what*) from an existing model to demonstrate how a change of factors affects the accepted relationships between variables (*how*). The findings reported here provide insights leading to a change in the existing conceptualisation of policy–practice decoupling to a more fine-grained one involving both the content of what is being implemented (the 'what') and the meaning (the 'how'). The findings show how different combinations of factors lead to each

outcome. In other words, the findings provide a new view of the decoupling phenomenon. The findings also propose new causal mechanisms on how a set of conditions, previously identified in the BIM literature as independently affecting BIM implementation, combine and lead to a hybrid mode of implementation and decoupling, unpacking 'how' implementation might unfold. The findings, thus, add to the 'what' and 'how' of existing theory within these domains.

Why. A relevant theoretical contribution often challenges the underlying rationale behind existing theory, usually by borrowing a perspective from other fields. The findings showed that a decoupling from the 'how' or the meaning of the imposed structure may also occur. By borrowing from practice theory, this more nuanced conceptualisation of policy–practice decoupling was proposed.

Who, when, where. A theoretical contribution should also go beyond pointing out the limitations in current conceptions of a theory's range of application. Although it has been pointed out that inter-organisational responses have not been addressed by current organisational theory literature, exploring this context contributed to the theory by confirming that what has been raised at intra-organisational level by previous publications in terms of antecedents of decoupling actually occurs simultaneously; decoupling is underlined by conjunction and equifinality. Thus, something new about the theory itself could be learnt as a result of working with it within a different context (i.e. inter-organisational level).

The relevance of the theoretical contributions to managerial decision-making is outlined next.

7.3 Practical relevance

In practical terms, the findings enrich practitioners' understanding of the situation – how the interaction of institutional pressures with projects unfolds – and, consequently, provide practical insights into the design and implementation of such pressures. According to the taxonomy of forms of practical relevance in management science proposed by Nicolai and Seidl (2010), the findings can be conceptualised as providing conceptual relevance to practice in the following ways.

Linguistic constructs. The findings conceptualise policy–practice decoupling as decoupling from the content or the 'what', and decoupling from the meaning or the 'how'. This conceptualisation provides institutional designers with a new way of thinking about the implications of designed policy when it is implemented, offering insights for policy design in such a way that decoupling can be minimised. By knowing that these two forms of decoupling

might happen, institutional designers need to develop policy in such a way that its prescriptions lead to the awareness necessary to reconfigure existing structures, and thus implementation occurs holistically.

Uncovering contingencies. The findings suggest an alternative for minimising the gap between built environment policy design and implementation. The findings call attention to considering the context in which policy will be implemented and the interactions of the imposed structure with this context and existing structures during the conception process, besides integrating those involved in implementing the policy into the policy design process.

Uncovering causal relationships. The results lead practitioners to become aware of causal relationships not previously discussed. The findings reveal the influence of new variables (i.e. existing structures) on how implementation unfolds. The findings suggest that practitioners might not realise the benefits even if processes are implemented, as it is a matter of not just implementing the mandate in terms of the suggested processes but also implementation of its meaning. Also, the results suggest multiple equifinal paths that might lead to either symbolic adoption or implementation.

7.4 Limitations

This research is exploratory, and the findings are empirically driven based on the sample of projects analysed. Most of the research so far on BIM adoption and implementation has been based on surveys and practitioners' perceptions, not uncovering how actual implementation unfolds from a project perspective. This research provided a more granular view of the interaction of projects with institutional pressures through in-depth analysis of practical implementation. Nevertheless, all designs and methodological choices inevitably have limitations.

The first limitation relates to generalising from the case-based research approach itself, as even multiple case studies do not allow for statistical generalisation and inferring conclusions about a population. Thus, it cannot be inferred that the same is occurring for all projects in the national context. However, analytical generalisation, which refers to the generalisation from empirical observations to theory, was achieved, as the same type of responses emerged within settings and projects and across them. This indicates that mixed responses might occur independent of the stage of adoption or motivation for adoption, and this might impact the pace of transformation of the sector as a whole and achievement of the results envisaged by policy-makers at the pace envisaged by them.

The second limitation relates to the nature of the sample. Because of time limitations and the need to conduct in-depth and longitudinal analysis, while taking into account the length of projects, a limited number of settings/cases could be considered. Also, assumptions had to be made on occasions when data was not available or it was not possible to obtain it, for example, when data about a previous life-cycle stage was necessary, and one of the project members was no longer available to provide details about it or the team has been disassembled. In that case, more projects in the same setting were considered, so a view on implementation across all stages could be gained. Nevertheless, assumptions about similar enactment had to be made for projects in the same setting when information was not available. An even more comprehensive analysis would need to consider a larger sample of projects and look at implementation longitudinally across all stages of these projects. This would also improve the application of QCA. If a larger sample is considered, there are more possibilities of having more diversity, i.e. more cases with and without the outcome can be included in the QCA analysis, improving the results' robustness.

Time constraints also limited further investigation of why re-enactment of existing structures happened, once it was identified. The analysis identified that reproduction of existing structures is related to decoupling and is broadly related to a lack of awareness, and on other occasions it is related to conflict between the new structure and existing ones, which are both dimensions of the ability of projects to respond to the pressure. A detailed analysis of the reasons leading to a lack of reconfiguration would require further investigation, which was not feasible because of time constraints and given that, when the second-order analysis was completed, some projects had already finished and project teams had been disassembled. These limitations, however, did not compromise the identification of a decoupling phenomenon that might occur when projects are faced with institutional pressure or the identification that project responses are underlined by complex causality. The findings also opened avenues for further research, as outlined next.

7.5 Directions for further research

The findings created opportunities for further investigation on either the interactions of projects with the environment or BIM mandate implementation.

First, further research could address the limitations identified in the previous section and look longitudinally at a larger sample of projects in the analysed context, aiming to extend generalisation across the population and extend the conceptualisation of the ability and

willingness dimensions. As Oliver (1991) pointed out, it is both the willingness and ability of organisations to respond to exogenous pressures that underlie the variegated organisational responses. However, as highlighted by Durand et al. (2019), these two dimensions remain largely untheorised in the organisational theory literature. The findings here identified some scope conditions of these two dimensions, but future research could look at the imposed structure in more detail, aiming to identify precisely which prescriptions are related to a limitation of awareness and conflict with existing structures. Future studies could also look at different international BIM mandates and compare aspects of the policy related to holistic implementation and transformation, not just widespread adoption. These insights would be valuable to improving existing mandates and support other countries in their national efforts and policy development. Further research could also look at implementing the new ISO 19650 standards in projects across countries and identify the interactions of the standards and related mandates with existing structures from different contexts. This could provide feedback for further improvements and adaptations of the imposed structure to each context.

Other research trajectories on BIM implementation or overall transformation of the sector could also expand to look at how the sectoral structures co-evolve over time and explore the pace of institutionalisation of new structures given the influence of different actors. Previous studies have highlighted that innovation in the construction sector can be better understood if it accounts for the dynamic interactions and range of influences of different actors and artefacts (Harty, 2008). Further research could look at the combined influence of actions from multiple stakeholders on the transformation process driven by BIM, which structures are institutionalised, and the pace that old structures are deinstitutionalised or maintained (and why). As already highlighted by some scholars (e.g. Soderlund and Sydow, 2019), it remains necessary to understand which institutions influence the shaping and life of projects and the role of the project network in creating, maintaining and disrupting institutions.

Moreover, further investigation could also look at projects' responses to different types of pressure (not only coercive) and analyse if new responses emerge, or if the extent of the hybrid response and decoupling vary according to the type of pressure. This could provide other insights into the interplay between projects and institutions. Also, this research identified the influence of structures from the multiple contexts in which projects are embedded, including the organisational context of project members, on how implementation unfolds. But given the focus on implementation of a specific pressure, in other words, a BIM mandate, structures and organisational variables related to the client organisation were mostly emphasised. Future research could look at the coordination of multiple embedded contexts and

organisational environments part of projects in shaping responses and conduct more detailed analysis. Further analyses could also look at project responses under conditions of institutional complexity (e.g. in the context of megaprojects) and explore other possible underlying conditions shaping responses. Additional studies could explore inter-institutional projects and fighting institutional forces from multiple fields and the responses strategies to cope with various conflicting institutional pressures and complexities (Soderlund and Sydow, 2019). This thesis has revealed that existing structures might be reproduced in the implementation of new practices and consequently influence the pace of the transformation. This finding would be particularly relevant to explore in the context of megaprojects where multiple and different structures co-exist and together shape the implementation of new practices. It would be relevant to understand which types of structures are reproduced and why. Future research could also compare implementation contexts and explore in which types of contexts the pace of deinstitutionalisation of existing structures might be slower and the reasons for that.

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