# Investigating (inter)organisational data governance design in maintenance networks: developing a research methodology and crafting data collection methods

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# Investigating (inter)organisational data governance design in maintenance networks: developing a research methodology and crafting data collection methods

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**Abstract**

With information technologies becoming available on a growing scale, capturing large amounts of building information is becoming cheaper and economically viable. This is creating new challenges for real estate management organisations. Producing digital assets is one thing, managing them and knowing how to use them is another. The information management tasks and responsibilities of real estate management organisations therefore are becoming challenging and complex at the same time. Not in the least by the fact that in many situations, maintenance activities are outsourced to contractors and sub-contractors, creating maintenance networks. While building register information may be produced in the first place to fulfil the building owner's needs, this research assumes building registers could also contribute to innovation in the greater maintenance network if the right form of data governance can be implemented. This paper, which is part of a larger research project, presents a research approach for investigating such governance designs for building registers. The approach is based on a qualitative research approach because it aims to address the stakeholders interests adequately and produce findings that are meaningful to all stakeholders for improving data governance in professional practice. Within a multiple case study methodology, an embedded case study design is presented that may provide a useful guide for researchers in this field. The proposed methodology will be used to conduct four in depth case studies. The intended outcome of this research is a theoretical framework that integrates data governance design factors with network innovation effects. It can be used to guide the design of (inter)organisational data governance programmes in maintenance networks.

**Keywords:** maintenance networks, data governance, case studies, embedded cases

## 1. Introduction

In recent decades, corrective maintenance as well as preventive maintenance, renovations and fit-out projects have been outsourced by building owners on a large scale. Through sub-contracting practices, building maintenance is often carried out by a network of autonomous contractors, sub-contractors and service providers that can be viewed as loosely coupled systems (Dubois & Gadde, 2001). In order to plan and execute maintenance activities, these stakeholders rely on information from the building register. A building register contains information about a building and the components out of which it is constructed (Talamo & Bonanomi, 2016). It is the one and only source of reliable information on the building and the elements and systems that are part of it. However, keeping the building register up-to-date throughout a buildings life cycle and sharing building register information with stakeholders in the maintenance network is a challenge (Miettinen & Paavola, 2014; Becerik-Gerber, Jazizadeh, Li, & Calis, 2012; Volk, Stengel, & Schultmann, 2014).

Environmental pressures form a driver for innovation in construction networks (e.g. Bossink, 2002). Within maintenance networks, sustainability innovations can lead to the use of new products (e.g. materials, building components), processes (e.g. new application methods) or services (e.g. reverse logistics, recycling related services). However, the nature of building maintenance networks seems to hamper innovation (Dubois & Gadde, 2001). Häkkinen & Belloni (2011) argue that this is not caused by a lack of information, technologies or sustainability assessment methods, but by the fact that stakeholders find it difficult to adopt new ways of working and collaborating. Building register information can potentially play an enabling role in the supply chains for building components for reuse and recycling (e.g. Carra & Magdani, 2017; Iung & Levrat, 2014; Ellen Macarthur Foundation, 2016). Building register information in combination with data analytics can be used to develop new services for smart and sustainable maintenance. However, the value that individual firms assign to building register information may depend on a firm's position and role within the network. There appears to be a need for data governance designs that addresses the interests of all stakeholders and enables the sharing of data (Johannes, Voordijk, & Adriaanse, 2016).

This research explores new ways of collaborating with the building register, focussing on the data governance of the building register. Talamo & Bonanomi (2016) introduce the idea of a 'command centre' as an organisational entity responsible for managing information flows between maintenance supplier and the facility management organisation. In another way, Bosch, Volker, & Koutamanis (2015) also propose an organisational entity for managing information flows. They discuss the 'central data authority' that should operate as a centralized agency for all information supplying maintenance contractors. Both Talamo & Bonanomi (2016) and Bosch et al. (2015) suggest that responsibilities for data governance should be centralized in some way. However, they do not discuss how data governance responsibilities could be allocated or shared among firms and what the relevant factors are that guide these design decisions.

From the brief explanation of the research problem above, the main research question can be formulated as:

*Through what factors can (inter)organisational data governance design of building registers contribute to sustainability innovations in maintenance networks?*

By writing 'inter' between brackets, this research assumes that inter- as well as intraorganisational aspects of data governance could emerge. This question disaggregates into logical sub-questions. The sub questions and their justifications are as follows.

*RQ1: What is the role of building register data for sustainability innovations in maintenance networks?*

Building register information in combination with data analytics can play an enabling role in the development of new services for smart and sustainable maintenance. However, the value that individual firms assign to building register information may depend on a firm's position and role within the network. From the perspectives of the stakeholders within the maintenance network, this research question explores the role of building register information for sustainability innovations in maintenance networks.

*RQ2: What are the effects of (inter)organisational data governance design of building registers on sustainability innovations in maintenance networks?*

Khatri & Brown (2010) define data governance as the allocation of responsibilities for decision making about definition, production, use and retention of data. A data governance design in which decision-making responsibilities are centralized asymmetrically (e.g. within the building owner's organisation) could unwittingly restrict data-reuse and innovation within in the network. When on the other hand, certain decision-making responsibilities are shared to a certain extent among network partners, this could lead to other outcomes.

*RQ3: What factors determine (inter)organisational data governance design for building registers?*

While data governance design has been investigated in corporate settings to some extent (e.g. Khatri & Brown, 2010; Tallon, Ramirez, & Short, 2013; Wende, 2007), research on the allocation of data governance accountabilities and decision rights within building maintenance networks is scarce. This research question aims to identify the factors that determine the allocation of accountabilities and responsibilities. These could be related to ownership of the building or to stakeholder interests, stakeholder goals and power relationships within the network.

*RQ4: How can (inter)organisational data governance of building registers be designed to contribute to sustainability innovations in maintenance networks?*

If the effects of data governance design on sustainability innovations are known, data governance can be designed in a way to stimulate innovation. The findings of the first three sub questions can be used to design (inter)organisational data governance that is tailored to specific ownership situations and maintenance network configurations.

The aim of this research is to generate insights into the design factors for interorganisational data governance of building registers. The intended outcome of this research is a framework that integrates governance design factors with maintenance network innovation and that can guide the design of interorganisational data governance programmes aimed at data sharing and sustainable innovation. As will be discussed in section 2 of this paper, Eisenhardt's approach for theory building (1989) will be adopted for this purpose. The remainder of this paper is structured according to the eight steps of this approach. In section two, Eisenhardt's approach is discussed and the a-priori theoretical constructs are presented together with the research questions (Step 1). The case selection strategy (Step 2) is also described in this section. Section three describes the interview guides that are used along with other data collection methods (Step 3), while section four deals with respondent sampling procedures and data analysis (Steps 4 and 5). While this research is work in progress, steps 6, 7 and 8 will only be touched briefly in this section. The measures for ensuring the reliability and validity of this research are discussed in section five. The last section finally, presents some reflections and conclusions about the presented research methodology and gives a brief account of the current status and the prospects of the research.

## 2. Research design: a multiple embedded case study design

Data governance design of building registers cannot be investigated in isolation from its business context. The researcher cannot manipulate the process by which accountabilities and responsibilities for data governance are allocated and then analyse the effects on sustainable innovation in the network. Data governance is a contemporary phenomenon which is actually taking place as stakeholders try to understand it. As discussed by Yin (2014), Cavaye (1996) and Darke, Shanks, & Broadbent (1998), case studies are very well suited to study contemporary phenomena in their real-life context. Action research, where the researcher intervenes in an organisation, can also be an adequate strategy. However, because theory development is the aim of this research and not the implementation of data governance, this research project uses case studies.

The use of case study research as a means for theory development has been discussed in the literature by Eisenhardt (1989, 1991) and Eisenhardt & Graebner (2007). Eisenhardt (1989) has developed a roadmap for executing theory building research with multiple cases (Table 1).

The first step in Eisenhardt's approach ('Getting started') involves the formulating of a research question and the identification of a-priori theoretical constructs. The research questions for this research have been formulated in the first section of this paper. The a-priori theoretical constructs and the sub research questions are shown in Figure 1. In this research, three important theoretical constructs are

'Building ownership', '(Inter)organisational data governance design of building registers' and 'Sustainability innovations in maintenance networks'. The a-priori understanding of these theoretical constructs comes from the literature. However, it is important as the research proceeds, to keep an open mind towards the data, patterns in the data and what is happening in the case (Eisenhardt, 1989), while none of the a-priori constructs is guaranteed a place in the final theory to be developed.

| | Step | Activity | Reason |
|---|---|---|---|
| 1 | Getting started | Definition of research question<br>Possibly a-priori constructs<br>Neither theory nor hypothesis | Focuses efforts<br>Provides better grounding of construct measures<br>Retains theoretical flexibility |
| 2 | Selecting cases | Specified population<br>Theoretical, not random, sampling | Constrains extraneous variation and sharpens external validity<br>Focuses efforts on theoretically useful cases (those that replicate or extend theory by filling conceptual categories) |
| 3 | Crafting instruments and protocols | Multiple data collection methods<br>Qualitative and quantitative data combined<br>Multiple investigators | Strengthens grounding of theory by triangulation of evidence<br>Synergistic view of evidence<br>Fosters divergent perspectives and strengthens grounding |
| 4 | Entering the field | Overlap data collection and analysis, including field notes<br>Flexible and opportunistic data collection methods | Speeds analysis and reveals helpful adjustments to data collection<br>Allows investigators to take advantage of emergent themes and unique case features |
| 5 | Analysing data | Within-case analysis<br>Cross-case pattern search using divergent techniques | Gains familiarity with data and preliminary theory generation<br>Forces investigators to look beyond initial impressions and see evidence thru multiple lenses |
| 6 | Shaping hypotheses | Iterative tabulation of evidence for each construct<br>Replication, not sampling, logic across cases<br>Search evidence for 'why' behind relationships | Sharpens construct definition, validity and measurability<br>Confirms, extends, and sharpens theory |
| 7 | Unfolding literature | Comparison with conflicting literature<br>Comparison with similar literature | Builds internal validity, raises theoretical level, sharpens construct definitions<br>Sharpens generalizability, improves construct definition, and raises theoretical level |
| 8 | Reaching closure | Theoretical saturation when possible | Ends process when marginal improvement becomes small |

Table 1. Process of building theory from case study research (Eisenhardt, 1989)

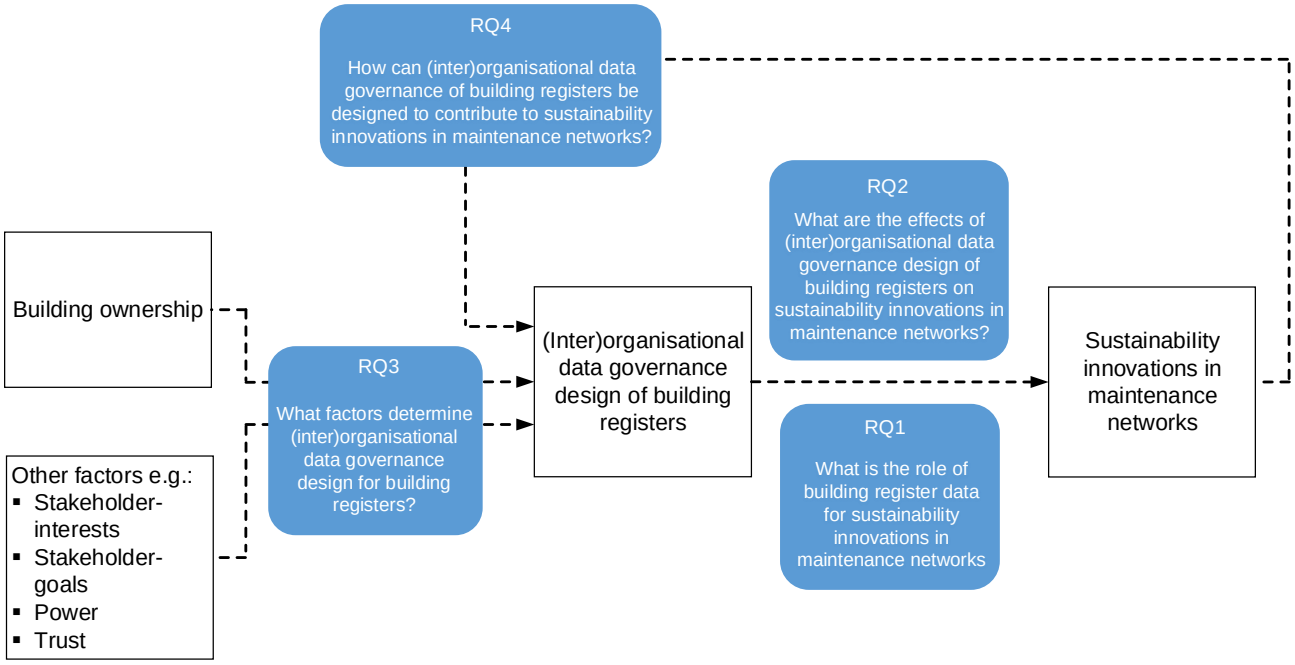


Figure 1. A-priori theoretical constructs

In the second step in Eisenhardt's approach ('Selecting cases'), cases are strategically selected. One of the strengths of the inductive approach suggested by Eisenhardt is that it enables generating of novel theories in new topic area's (Eisenhardt, 1989). It allows for the use of multiple cases that are theoretically sampled, meaning that cases are strategically selected based on their appropriateness in clarifying or extending relationships and logic among constructs (Eisenhardt & Graebner, 2007). Compared to single-case studies, multiple case studies provide a stronger base for theory building (Yin, 2014). The theory can be more robust because the propositions originate from varied empirical evidence (Eisenhardt, 1991). In this research, cases are selected for the purpose of illuminating relationships between dimensions of 'Building ownership', '(Inter)organisational data governance design of building registers' and 'Sustainability innovation in maintenance networks'. Eisenhardt & Graebner (2007) propose "polar types" as an important theoretical sampling approach. This however requires an in-depth knowledge and familiarity with each case which cannot always be realised. We cannot always know before the start of the study, whether a maintenance network is high or low performing on sustainable innovation.

Seawright & Gerring (2008) discuss seven case selection techniques for small-N research, each of which facilitates a different strategy for within-case analysis. According to Seawright & Gerring (2008) case selection has two objectives: the identification of a representative sample and useful variation on the dimensions of theoretical interest. In this research, the primary dimension of theoretical interest is building ownership. It may be expected that in maintenance networks governed by occupier-owner organisations, allocation of decision rights may proceed according to other mechanisms than in maintenance networks governed by investor-owner organisations while interests and goals of both type of owner organisations may be different.

While some design factors for (inter)organisational governance may be related to the owner organisation, other factors may be related to a specific maintenance network. Therefore, the research design makes use of embedded cases as described by Yin (2014). When using embedded cases, two units of analysis are identified on two levels: on the level of the overall case (in this research: the owner organisation) and on the level of the embedded case (in this research: the maintenance network). The level of the owner organisation provides the context for the analysis of the maintenance network. The former is a higher-level unit compared to the latter. Within one owner organisation, several maintenance networks can be in operation at the same time, independent from each other. Figure 2 shows how four planned cases are positioned in relation to the primary dimension of theoretical interest. Two types of owner organisations are distinguished: occupier-owner organisations and investor-owner organisations.

For both type of owner organisations, two maintenance networks will be selected, according to the demarcation of maintenance responsibilities for building components. An embedded case study design allows the research to examine specific phenomena in operational detail (Yin, 2014). One of the weaknesses of embedded designs according to Yin (2014) occurs when there is too much focus on analysing the subunits without analysis on the higher level of analysis. In this research however, the analysis on the level of owner organisation will support the making of inferences drawn from the two investigated maintenance networks through cross-case analyses (discussed in section four of this paper).

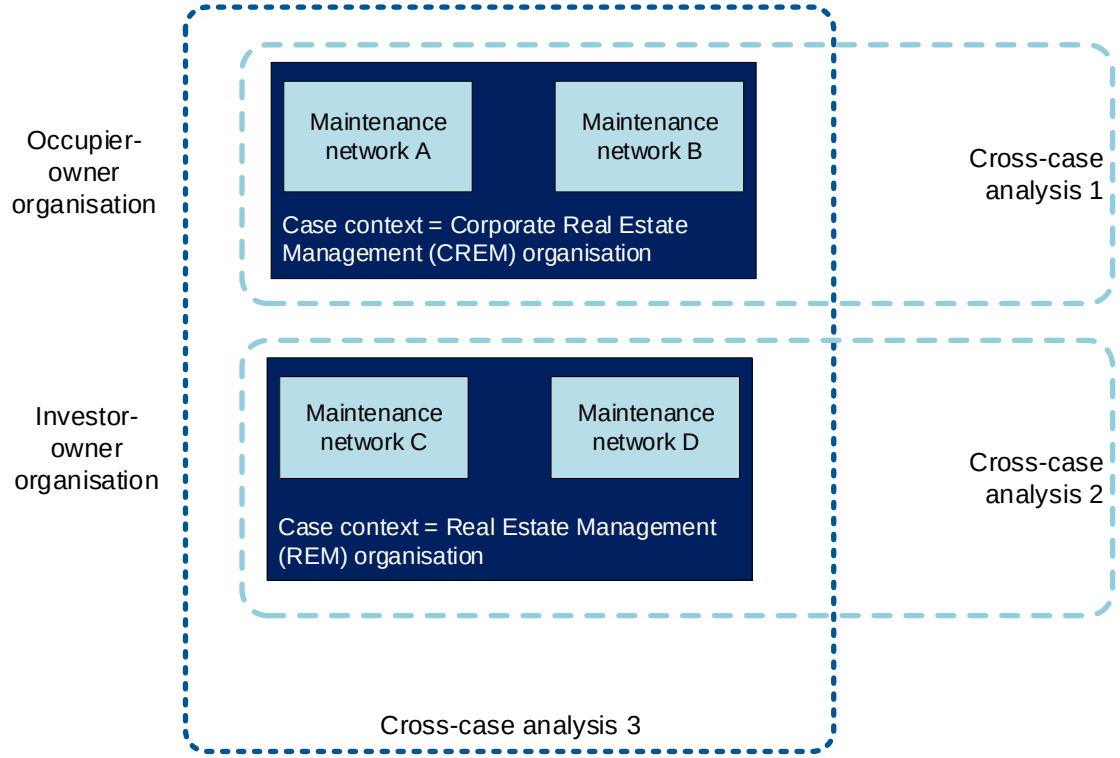


Figure 2. Sampling plan for (embedded) case selection

## 3. Data collection methods and design of research instruments

The third step of Eisenhardt's (1989) approach ('Crafting instruments and protocols') deals with choosing data collection methods and designing research instruments. In this research the two main data collection methods are interviews and documentation. The theory to be developed should incorporate the interests, views and behaviours of different stakeholders on both the level of the owner organisation and the level of the maintenance network. In order to build a theory that addresses the perceptions, attitudes and meanings of stakeholders on the data governance of the building register, interviews will be an important data collection method. The second source of evidence is case-specific documentation. Table 2 shows the type of documents that will be used for corroborating the evidence found in the interview data and field notes of the researcher.

Related to interviews as a means of eliciting data from individual respondents, Fontana & Fry (1994) distinguish structured from unstructured interviews. Their discussion of unstructured interviews seems for a great deal related to ethnographic research practices. In this research, a semi-structured format is used as described by Bryman (2014). This format allows fairly specific topics to be covered, but the interviewees are relatively free and unrestricted in their responses. It facilitates a conversational interview with the possibilities to explore a number of topics in rich detail. Although interview guides are used in following a consistent line of inquiry, the actual stream of questioning will likely to be fluid. Probes and prompts will be used to ask for additional explanation and to check the veracity of statements. Two

interview guides are developed, aimed at different respondent groups. They are informed by literature and discussed below.

| Owner organisation level |
| --- |
| Formal study and evaluation reports on the (C)REM organisation and the building register<br>Internal notes and memoranda related to the (C)REM organisation and the building register<br>Case related public news clippings related to the (C)REM organisation and the building register |
| Maintenance network level |
| Contract documents maintenance contractors<br>Agenda's and minutes monthly contract administrator's meetings<br>Agenda's and minutes quarterly contract managers meetings<br>Agenda's and minutes yearly contract managers meetings<br>Maintenance policy plans |

Table 2. Case documentation on both levels of analysis

*Interview guide for managers (Interview guide A)*

This interview guide facilitates the conversation on the constructs 'building ownership' and 'data governance design in maintenance networks' as well as the relations between them. The aim is to look into the different dimensions in which ownership rights are exercised and how these dimensions are related to the design of data governance. The motives for organisations to acquire the ownership of buildings can be diverse. On the one hand, building ownership can be obtained with the purpose of generating a return on investment. On the other hand, building ownership can be obtained primarily for non-financial reasons to facilitate a business process, to accommodate an organisation or a policy or to accommodate an urban development process. Depending on the motives of building owners, ownership rights can be exercised in different ways. Bon (1994) and Haynes, Nunnington, & Eccles (2017) distinguish three dimensions in which ownership can be exercised: the financial asset dimension, the operational asset dimension and the physical asset dimension. The financial asset dimension of building ownership relates to the economic value of buildings as represented on an organisations accounts balance sheet. The operational asset dimension of building ownership relates to the business use and the business value that a building, facility or the space in a building represents for the owner. The physical asset dimension relates to the building as a material artefact. It relates to the provision of land and a physical construction in which business operations can be performed. The interview guide allows for in depth conversations on all the case study questions identified. It will be used for semi-structured interviews with managers and professionals of (corporate) real estate departments and facility management departments. Besides topics on building ownership, the interview guide will contain topics that explore the nature of the maintenance network. Topics about the (inter)organisational data governance of the building register will also be included.

*Interview guide for maintenance staff (Interview guide B)*

Building register users in the context of this research are individuals, in their day-to-day work involved in the planning executing and supervising building maintenance in the case under investigation. They can be employed by a (corporate) real estate management department, a property management agency, a facility management department, a maintenance (sub)contractor or a supplier. The interview guide for building register users facilitates the conversation on sustainable maintenance practices, their data requirements, drivers and barriers for data sharing, and (inter)organisational data governance.

## 4. Data collection protocol, selection of respondents and data analysis

When entering the field (approach Eisenhardt (1989), step 4 (Table 1)), individual face-to-face interviews will be held with respondents in different roles from different stakeholders involved: client (or building owner), maintenance contractor and manufacturer. The organisational context in which this research examines data governance forms the narrative environment in which the respondents are interviewed. Narrative environments feed personal accounts of individuals that are part of the environment (Gubrium & Holstein, 2014). The individual accounts of respondents about data

governance are informed by the social forces and cultural frameworks that they encounter. Both intra- and inter-organisational dimensions of these social forces and cultural frameworks can be identified.

On the level of the embedded cases, within the maintenance networks, autonomous businesses (maintenance department (of client system), main-contractor and sub-contractor) are contractually connected on the one hand, but also subject to different social and cultural frameworks on the other hand. So, there is reason to believe that these differences will inform and shape the experiences of individuals with data governance of the building register. Therefore, this research will select respondents from main-contractors as well as sub-contractors. On the level of the owner organisation, within the organisation, the experiences of individuals with data governance of the building register will be informed and shaped by the different roles that have to be fulfilled within separate business units, teams and corporate departments.

In order to make sure that the interview data gives an accurate account of the respondent's voice on the research topic, this research defines the subject positions behind the respondents, which can be difficult if respondents can adopt different positions or when they are not aware of the different positions involved. Shifts in subject positions of respondents is often ignored in interview research (Gubrium & Holstein, 2014) and can lead to problems with generalisation. Facility management organisations for example, can vary from very small teams to large multi-department organisations. In small teams, one individual can be responsible for several tasks whereas in large facility management organisations, those tasks would be given to separate individuals. A title or job description does not always provide the right information about the subject position a respondent will adopt. In order to compare the interview results of different cases and to enable cross-case analysis of interview results, specific subject positions within the units of analysis are identified (Table 3). On the level of the maintenance network, building register user respondents (e.g. site handy man, facility location operator, maintenance planner, maintenance engineer, maintenance mechanic) will be sampled from all network stakeholders.

The fifth step of Eisenhardt's approach (Table 1: 'Analysing data') deals with analysing the collected data from the cases. In this research, the expected number of interviews needed for each maintenance network will lie between 12 and 22. The expected number of interviews on the level of the owner organisation is 7. From the case informants through snowballing suitable interview participants will be identified and contacted. In recruiting the participants for the interviews, the stakeholder organisations will be asked for assistance. All interviews will be recorded, transcribed and send to the interviewees for comments. The data collected in the interviews will be analysed using NVivo. A thematic analysis of transcript data will be conducted to identify important themes, using a hierarchical data coding process. In this way, key constructs and variables for the theory to develop will be identified. In analysing data, the analysis is not only directed to the individual case but also to the cross-examination of cases as discussed below.

| Level of analysis | Subject positions | Research Instrument | Number of respondents per case |
|---|---|---|---|
| Owner organisation | Investor | Interview guide A | 1 |
| | Corporate Real Estate Management | Interview guide A | 1 |
| | Real Estate Management | Interview guide A | 1 |
| | Property management | Interview guide A | 1 |
| | Facility management | Interview guide A | 1 |
| | Maintenance management | Interview guide A | 1 |
| | Corporate Data Governance | Interview guide A | 1 |
| Maintenance network | Contract management (client) | Interview guide A | 2 |
| | Contract management (contractor) | Interview guide A | 1-2 |
| | Contract management (sub-contractor) | Interview guide A | 2-4 |
| | Building register users | Interview guide B | 5-10 |

Table 3. Data collection protocol

*Cross-case analysis 1: occupier-owner organisation (as shown in Figure 2)*

In the case selected on occupier-ownership, the context for the maintenance networks is provided by the occupier-owner organisation. Occupier-owner organisations own buildings for their own business use. In the real estate literature, this context is referred to as Corporate Real Estate Management (CREM) (Dewulf, Krumm, & De Jonge, 2000). As Yin (2014) discusses, questions can be asked to find patterns across multiple cases. The purpose of cross-case analysis 1 is to find patterns in the investigated data governance designs for both maintenance networks that can be traced back to occupier-ownership. The major question (related to main research question RQ3) that will be used to guide cross-case analysis 1 is:

- What characteristics of occupier-owner organisations are relevant for designing (inter)organisational data governance of building registers?

*Cross-case analysis 2: investor-owner organisation (as shown in Figure 2)*

In the case selected on investor-ownership, the context for the maintenance networks is provided by the real estate management organisation that invests in real estate with the purpose of generating income from it (Dewulf, Krumm, & De Jonge, 2000). The purpose of cross-case analysis 2 is to find patterns in the investigated data governance designs for both maintenance networks that can be traced back to investor-ownership. The major question (related to main research question RQ3) that will be used to guide cross-case analysis 2 is:

- What characteristics of investor-owner organisations are relevant for designing (inter)organisational data governance of building registers?

*Cross-case analysis 3 (as shown in Figure 2)*

This analysis is aimed at interpreting the findings of cases from the primary theoretical perspective: ownership. The case study results will be interpreted using different theories (e.g. stewardship theory, agency theory, property rights theory) to answer the following questions (related to main research question RQ4):

- What design factors for (inter)organisational data governance of the building register are caused by occupier-ownership characteristics?
- What design factors for (inter)organisational data governance of the building register are caused by investor-ownership characteristics?

During the sixth step ('Shaping hypotheses') of the 8-step-roadmap of Eisenhardt (1989), the focus is on finding evidence for causal relations between the theoretical constructs that have emerged from data analysis. Hypotheses about causal relations between data governance design factors and their effects on sustainability innovations in maintenance networks will be formulated. In step seven ('Enfolding literature') the hypotheses about the emerging theory will be compared with other research on inter and intraorganisational data governance in networks. Other research both with conflicting and similar findings will be used to deepen the insights on the generalisability and limitations of the emerging theoretical framework. On reaching closure (Step 8), Eisenhardt (1989) argues that ideally, the number of cases is determined by the point of theoretical saturation (when incremental learning from adding cases has dropped to a minimum level). In practice however, the number of cases is often determined by pragmatic considerations about available time and money. In this research, it is expected that four strategically selected cases will generate enough evidence for grounding the theory.

## 5. Validity and reliability

Threats to validity and reliability of research arise when constructs are interpreted in different ways by the researcher and the respondents (Runeson & Host, 2007). Therefore, the validity and reliability threats will be discussed with the proposed countermeasures. As Yin (2014) argues, the quality of case study research is established by four tests that will be discussed below.

*Construct validity*

Construct validity refers to the identification of the correct operational variables for the concepts being studied (Yin, 2014; Gibbert, Ruigrok, & Wicki, 2008). This research studies building ownership, data governance, sustainability innovations and their relationships. In order to enhance construct validity, a combination of tactics is used. First, data triangulation is used to collect data from several sources. Data will be collected from documents, interviews with (senior) managers from different stakeholders

and from users of the building register. Second, the research instruments (the interview guides are discussed in section 4) will be tested on a representative group of professionals. Third, draft versions of case study reports will be discussed with participants and key informants on both levels of analysis within the cases.

*Internal validity*

Internal validity refers to the way causal relations are examined. Internal validity in particular is important in experimental and quasi-experimental research that aims to investigate causal relationships between a dependent and independent variable (Yin, 2014; Gibbert et al., 2008). As Yin (2014) argues, for case study research in general, internal validity refers to making inferences about situations or events that cannot be observed directly. In this research several tactics are used in meeting internal validity. First, by data triangulation, multiple sources of evidence collected on two levels of analysis (owner organisation and maintenance network) will be combined to reduce the risks of making incorrect inferences. Second, theory triangulation will be adopted when interpreting the interview data from different theoretical perspectives to support pattern matching and explanation building.

*External validity*

External validity relates to the way case study findings can be generalised beyond the specific case that generated the findings. It is based on the idea that a theory should be able to account for phenomena in other settings than the setting that was used to develop it (e.g. Yin, 2014; Gibbert et al., 2008). Through its multiple case design, this research establishes external validity through replication logic. By making use of multiple cases (two cases based on occupier-ownership and two on investor-ownership) that are expected to deliver similar results literal replication is realized. Conclusions that are common to both cases within the same type of owner organisation (occupier-ownership / investor-ownership) can be generalised to a larger group of similar contracted maintenance networks for that type of owner organisation. Theoretical replication is realized by selecting two groups of embedded cases that are expected to deliver contrasting results for anticipatable reasons related to differences in ownership.

*Reliability*

Reliability deals with minimizing errors and biases in conducting research (Yin, 2014). A research is reliable when subsequent researchers would arrive at the same findings and insights if they would conduct the research along the same steps (Yin, 2014; Denzin & Lincoln, 1994; Gibbert et al., 2008). In this research a case study protocol is used in which all the research instruments, procedures, data analysis methods are documented. Furthermore, a case study data base will be used to store all field notes, case-documents and interview transcripts.

## 6. Conclusion

Case study research is proposed as an appropriate methodology for research into (inter)organisational data governance design in maintenance networks. It is particularly suited to investigate processes through which accountabilities and responsibilities for data governance are allocated in real life contexts. The concept of embedded cases is used to distinguish two levels of analysis: the level of the owner organisation and the level of the maintenance network. Depending on the size and scope of the owner organisation and the real estate portfolio, within one owner organisation several maintenance networks can be in operation at the same time independent from each other. The research design of a multiple embedded case study design in this paper is used for theory building purposes. A theoretical framework will be developed that integrates governance design factors with maintenance network innovation characteristics. Following the 8-step-roadmap developed by Eisenhardt, the research has currently arrived at the fourth step: entering the field. The first two maintenance networks, of the same occupier-owner organisation are under investigation. Based on the findings and field experiences, if necessary, adjustments will be made to the interview guides and document analysis procedures. Even so, if necessary, data collection methods will be added. The aim is to investigate two other maintenance networks within one investor-owner organisation over the course of the next 18 months.

**References**


Becerik-Gerber, B., Jazizadeh, F., Li, N., & Calis, G. (2012). Application areas and data requirements for BIM-enabled facilities management. *Journal of Construction Engineering and Management, 138* (3), 431-442. doi: http://dx.doi.org/10.1061/(ASCE)CO.1943-7862.0000433

Bon, R. (1994). Ten principles of corporate real estate management. *Facilities, 12*(5), 9-10. doi:10.1108/02632779410057584

Bosch, A., Volker, L., & Koutamanis, A. (2015). BIM in the operations stage: Bottlenecks and implications for owners. *Built Environment Project and Asset Management, 5*(3), 331-343. doi:10.1108/BEPAM-03-2014-0017

Bossink, B. A. (2004). Managing drivers of innovation in construction networks. *Journal of Construction Engineering and Management, 130*(3), 337-345. doi:10.1061/(ASCE)0733-9364(2004)130:3(337)

Bryman, A. (2012). *Social research methods* (4th ed.). Oxford: Oxford University Press.

Carra, G., & Magdani, N. (2017). *Circular business models for the built environment*. Amsterdam: Arup & BAM.

Cavaye, A. L. M. (1996). Case study research: A multi-faceted research approach for IS. *Information Systems Journal, 6*(3), 227-242. Retrieved from http://dx.doi.org/10.1111/j.1365-2575.1996.tb00015.x

Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal, 8*(4), 273-289. Retrieved from http://dx.doi.org/10.1046/j.1365-2575.1998.00040.x

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research.* Los Angeles: Sage publications, inc.

Dewulf, G. P. M. R., Krumm, P. J. M. M., & De Jonge, H. (2000). *Successful corporate real estate strategies*. Nieuwegein: Arko Publishers.

Dubois, A., & Gadde, L. (2002). The construction industry as a loosely coupled system: Implications for productivity and innovation. *Construction Management and Economics, 20*(7), 621-631. doi:10.1080/01446190210163543

Ellen Macarthur Foundation. (2016). *Intelligent assets; unlocking the circular economy potential.* (Appendix: selected case studies). Cowes, Isle of Wight: Ellen Macarthur Foundation.

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review, 14*(4), 532-550. 10.2307/258557 Retrieved from http://www.jstor.org/stable/258557

Eisenhardt, K. M. (1991). Better stories and better constructs: The case for rigor and comparative logic. *The Academy of Management Review, 16*(3), 620-627. 10.2307/258921 Retrieved from http://www.jstor.org/stable/258921

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25-32. 10.5465/AMJ.2007.24160888 Retrieved from http://amj.aom.org/content/50/1/25.abstract

Fontana, A., & Frey, J. H. (1994). Interviewing; the art of science. In N. Y. L. Denzin (Ed.), *The handbook of qualitative research* (pp. 361-376). Thousand Oaks: Sage Publications.

Gibbert, M., Ruigrok, W., & Wicki, B. (2008). What passes as a rigorous case study? *Strategic Management Journal, 29*(13), 1465-1474. doi:10.1002/smj.722

Gubrium, J. F., & Holstein, J. A. (2012). Narrative practice and the transformation of interview subjectivity. In J. F. Gubrium, J. A. Holstein, A. B. Marvasti & K. D. McKinney (Eds.), *The SAGE handbook of interview research: The complexity of the craft* (2nd ed., pp. 27-44). Thousand Oaks, California: SAGE Publications, Inc. doi:10.4135/9781452218403

Häkkinen, T., & Belloni, K. (2011). Barriers and drivers for sustainable building. *Building Research & Information, 39*(3), 239-255. doi:10.1080/09613218.2011.561948

Haynes, B., Nunnington, N., & Eccles, T. (2017). *Corporate real estate asset management: Strategy and implementation* (Second ed.). New York: Routledge.

Iung, B., & Levrat, E. (2014). Advanced maintenance services for promoting sustainability. *Procedia CIRP, 22*(0), 15-22. doi:http://dx.doi.org/10.1016/j.procir.2014.07.018

Johannes, K., Voordijk, J. T., & Adriaanse, A. M. (2016). The use of BIM for deconstruction and reuse: Literature review and future needs. In J. Bakker, D. M. Frangopol & K. v. Breugel (Eds.), *Life-cycle of engineering systems: Emphasis on sustainable civil infrastructure* (pp. 624-631). London: Taylor & Francis Group.

Khatri, V., & Brown, C. V. (2010). Designing data governance. *Communications of the ACM, 53*(1), 148-152. doi:10.1145/1629175.1629210

Miettinen, R., & Paavola, S. (2014). Beyond the BIM utopia: Approaches to the development and implementation of building information modeling. *Automation in Construction, 43*(0), 84-91. doi: http://dx.doi.org/10.1016/j.autcon.2014.03.009

Runeson, P., & Höst, M. (2008). Guidelines for conducting and reporting case study research in software engineering. *Empirical Software Engineering, 14*(2), 131-164. doi:10.1007/s10664-008-9102-8

Seawright, J., & Gerring, J. (2008) Case selection techniques in case study research: A menu of qualitative and quantitative options. *Political Research Quarterly, 61*(2), 294-308. Retrieved from https://doi.org/10.1177/1065912907313077

Talamo, C., & Bonanomi, M. (2016). *Knowledge management and information tools for building maintenance and facility management*. Heidelberg: Springer.

Tallon, P. P., Ramirez, R. V., & Short, J. E. (2013). The information artifact in IT governance: Toward a theory of information governance. *Journal of Management Information Systems, 30*(3), 141-178. doi:10.2753/MIS0742-1222300306

Volk, R., Stengel, J., & Schultmann, F. (2014). Building information modeling (BIM) for existing buildings — literature review and future needs. *Automation in Construction, 38*(0), 109-127. doi:http://dx.doi.org/10.1016/j.autcon.2013.10.023

Wende, K. (2007). A model for data governance - organising accountabilities for data quality management. Paper presented at the *Proceedings of 18th Australasian Conference on Information Systems,* Mark Toleman, Aileen Cater-Steel and David Roberts. 417-425. Retrieved from https://www.alexandria.unisg.ch/67284/

Yin, R. K. (2014). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.