

MASTER'S THESIS

Digital Transformation (DT) and The Future of Work in Real Estate: an exploratory case of the Dutch market

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Award date:
2022

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Digitale Transformatie (DT) en de toekomst van werk in vastgoed: een exploratieve casus van de Nederlandse markt

Digital Transformation (DT) and The Future of Work in Real Estate: an exploratory case of the Dutch market

Opleiding:	Open Universiteit, faculteit Betawetenschappen Masteropleiding Business Process Management & IT
Degree programme:	Open University of the Netherlands, Faculty of Science Master of Science Business Process Management & IT
Course:	IM0602 BPMIT Graduation Assignment Preparation IM9806 Business Process Management and IT Graduation Assignment
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Identification number:	
Date:	28 th June, 2022
Thesis supervisor	Rachelle Bosua
Second reader	Vanessa Dirksen
Third assessor	<if applicable>
Version number:	FINAL
Status:	DELIVERY
Wordcount:	14.813

Abstract

Real Estate (RE) is traditionally slow in the adoption of new technologies for a number of reasons. However, the ongoing implementation of digital technologies in property development and management (the so called PropTechs) is digitalising this industry, changing the way it operates. In this research I examine the state of digitalisation of the Dutch RE industry, its drivers and barriers, in order to gain an understanding about how digital technologies add value to the future of work of RE professionals. With a qualitative approach I conduct an empirical study composed of multiple case studies, focused on four of the largest Dutch RE developers, active in the residential sales market, besides three developers active in commercial and hospitality properties, and one of the Big Four accounting companies involved in Digital Transformation (DT), as complementary data sources. The main findings of this research can be summarized as: (i) the ongoing digitalisation of the Dutch RE has accelerated and optimized the work, made it more interesting for employees, and added a number of jobs, (ii) virtual reality, market place, and artificial intelligence are emerging technologies that are changing the customer and employees experience, making it more digital, and have the potential to disintermediate the work of RE agents, (iii) the conservative mindset of C-level leaders is the main barrier that prevents a faster and disruptive DT of the Dutch RE industry.

Key Terms

Digital Transformation, digitalisation, digitisation, Future of Work, PropTech

Summary

Real Estate (RE) has been slow in the adoption of digital technologies due to a number of reasons such as a possible shortage of technologically skilled workers and a prevalence of unstructured data and siloed processes. The assets are large, heterogeneous, fixed in one place, developed in long phases that don't seem to match with the fast pace of digital technology developments. Most importantly, as this research demonstrates, is the conservative mindset of its C-level leaders which undertake digitalisation only to 'stay up to date', with a lack of sense of urgency that is present in more innovative sectors. In The Netherlands this is even more acute due to the alarming disequilibrium between supply and demand: there are too few houses being built every year in relation to the amount of people willing to buy. This fact positions the Dutch RE organisations in a comfort zone where there is little reason to radically innovate or disrupt the industry. As the interviewees say, 'there is [a] market for everyone'.

I start the present research explaining the context of the study, my motivation, and the research gap: the need of understanding Digital Transformation (DT) in specific industries. Then I describe my aim: to analyze the ongoing digitalisation of the RE industry, its drivers and barriers, the digital technologies being used, and then bring an understanding about the impacts in the work of RE professionals and how digitalisation can add value to it, which is my main research question. The approach taken is qualitative and exploratory, using an interpretative research design containing multiple interactions with the objects being studied in order to gain deeper insights about the phenomenon.

In order to build a conceptual model of the research I conducted a literature review centered on digitalisation, Digital Transformation, PropTechs and Future of Work, which gave me a preliminary research knowledge about the subject. After developing a conceptual model I explained the methodology adopted: the inductive approach with an explorative attitude, starting from specific observations (a multi-case study conducted mainly through interviews), document analysis, and then seeking to establish generalizations. Following that I discuss the Validity, Reliability and Ethical aspects of this research.

In the end I expose the main findings, considering them in light of the research questions I aimed to answer, and then elaborate the conclusions: (i) the ongoing digitalisation of the Dutch RE has accelerated and optimized the work, made it more interesting for employees, and added a number of jobs, (ii) virtual reality, market place and artificial intelligence are emerging technologies which are changing the customer and employees experiences, making it more digital, and have the potential to disintermediate the work of RE agents, (iii) the conservative mindset of C-level leaders is the main barrier for a faster and disruptive DT of the Dutch RE industry. To finalize I explain some limitations of this research, such as the lack of including case organisations focused on the residential rental market and SME (small and medium-sized enterprises), besides the non-generalizability to other countries, giving recommendations for further researches and for the practice of RE.

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Keyword Table

Digitalisation	The implementation of digital technologies to optimize existing business processes by allowing a more efficient coordination between processes, and/or by creating additional customer value through enhancing user experiences (Verhoef et al, 2021).
DT (DT)	A major organisational change driven by, built on, or enabled by digital technology, altering how business is conducted (Osmundsen et al, 2018).
Digitisation	The transformation of analogue information into digital information (Gartner Glossary, 2017).
Future of Work (FoW)	New ways of organizing work that are becoming possible (Malone, 2005).
PropTech	Software tools and platforms used by different participants in the RE industry (Baum, 2017).

1. Introduction

1.1. Context of the study

Real Estate (RE), the world's largest asset class (Baum, 2017), is traditionally not the fastest in terms of adopting new digital technologies. The industry is considered a slow-moving sector, marked by a focus on personal connections (Braesemann & Baum, 2020) and a lack of capacity of continued innovation (Baum, 2017). The RE market also does not readily embrace technological change (Baum et al., 2020) and is considered a conservative industry with only gradual evolution (Battisti et al., 2019). Thus, it is no surprise that the industry is lagging behind the digital technology curve by approximately five years (Ullah et al., 2018).

The reasons for this conservatism are multifold. According to Klee (2021), the good economic situation of RE and a possible shortage of skilled workers, prevent the DT of the RE industry. In The Netherlands this seems to be even more acute due to the alarming disequilibrium between supply and demand: i.e., there are too few houses built every year in relation to the amount of people willing to buy. This fact puts the Dutch RE organisations in a comfort zone where there is little reason to radically innovate.

The asset-based nature of RE, composed by large heterogeneous assets traded in private markets (Baum et al. 2020) and its space-related materiality (Braesemann & Baum, 2020) are also to blame. It is also said that there is a temporal mismatch between RE and digital technology developments: a high pace of DT and a long-term development of RE projects (Nowik, 2018). According to Conway (2018), the prevalence of unstructured data in RE is a hinderance to speed up the adoption of new technologies, but also the RE industry is marked by siloed processes.

Another big barrier to RE technology adoption can be identified as a lack of technical literacy within the industry (the skill set issue), and the lack of interest in these skills during the recruitment process (Baum et al., 2020). This fact corroborates with Deloitte's report (2021) revealing that job openings in RE mainly focus on traditional skills and very little on advanced data analytics, confirming the conservatism of the industry and challenging the notion that there is a shortage of tech-savvy workers as mentioned by Klee (2021). This fact is interesting as it reveals that the problem is complex and not yet well-understood.

The so-called PropTechs, software tools and platforms used by different participants in the RE industry (Baum, 2017), are said to be changing this situation and possibly leading to a disruption of this market (Lecomte, 2016). Although PropTech is defined by the implementation of technologies in RE (Baum 2017; Braesemann & Baum, 2020; Baum et al., 2020; Siniak et al., 2020), in practice the term has been used to qualify a technology organisation providing digital tools for RE developers, property owners and investors. Because of the rise in venture capital investments in these PropTechs the RE industry is said to be currently undergoing a transformation that might, at some point, affect all its activities (Battisti 2019).

1.2. Motivation of the study

The ongoing transformation of the Dutch RE through digital technologies, however slow, is digitalising the industry and impacting the way work gets done. However, the extent of this impact

and its characteristics have not yet been researched. Since major public and private owners are now committing large sums of capital for new technology integration (Worzala et al., 2020) it is supposed that the implementation of these technologies will grow and increasingly impact the future of work in RE.

DT can deliver a number of opportunities to organisations, e.g., improving operational processes, creating new business models, enhancing customer and employee experiences (Berman, 2012 in Morakanyany et al., 2017) and hence transform the way organisations operate, create value and change the experience of all stakeholders involved (Morakanyany et al., 2017). Thus, it seems only logical that the RE sector cannot ignore DT altogether.

Nevertheless, technology adoption in RE faces some challenges, such as the need to change management style, mindset and culture (Worzala et al. 2020). Major consultancy firms indicate the importance of leadership, a flat and agile organisational structure, the communication of a sense of urgency, and a culture open to innovation, as in the end digitalisation is about people (Accenture, 2017). None of these characteristics, common to IT companies and start-ups, are part of the conservative RE environment.

Covid-19 work from home and now hybrid-work, seem to have accelerated the speed of digitalisation of the work environment, creating a need of having all workflow online so that people can collaborate remotely. On the other hand, the pandemic has also showed the fragility of organisations which have a low level of digital maturity (Fletcher & Griffiths, 2020; Wade & Shan, 2020). These issues are yet to be explored in the RE industry.

1.3. Research gap

There is a need of understanding DT in specific industries (Morakanyane et al., 2017) and even more so in RE, a slow-tech industry. The rise of PropTechs¹ demonstrates that the sector is possibly going through a disruptive process (Lecomte, 2016) with the use of AI tools as the most visible and challenging project (Schuetzler et al., 2021). However, while the digital technologies used for RE and the investments in PropTechs have already received quite some attention from researchers, the literature is scant on how digitalisation of the RE industry is affecting the way work gets done, and more importantly, how can it add value to the future of work.

The fact that RE is such a huge asset class and at the same time slow-moving makes it an intriguing situation that deserves more attention, as a traditional business neglected from digital topics is usually a particularly interesting issue to focus on (Klee, 2012).

1.4. Aim and Scope

The aim of this research is to analyze the ongoing DT of the Dutch RE industry, its drivers and barriers, and then bring an understanding about its impacts in the work of professionals and how digitalisation can add value to it. These impacts can be felt in different work methods (using digital tools, agile methods, among others) and in particular the emergence of new job roles using specific sets of advanced analytical skills (Verhoef et al., 2021). New roles can be realised by new hires,

¹ A common term used by professionals to qualify organisations offering technology services in RE

through training of existing employees or via automation achieved by machines, sometimes leading to a substitution of human work.

There are a number of categorizations of PropTechs. In this research I use the segmentation defined by MIPIM property forum of 2017 (item 2.2 section iii), one of the world's leading RE events (Baum, 2017), to scope this study on the value add of specific digital technologies on the future of work of the RE industry.

1.5. Research Questions

Considering the growth in use of digital technologies, the slow pace of digitalisation in the RE market, and changes in the future of work in the RE industry, the *MAIN RQ1* of this study is:

RQ1:

How can Digital Transformation (DT) add value in the future of work (FoW) of the RE industry, a traditionally slow adopter of technologies?

With the following two sub research questions:

SUB, RQ2:

How are digital technologies used in RE (PropTechs) impacting the work of this industry? and

SUB, RQ3:

What are the main barriers for the implementation of digital technologies in the Dutch RE industry?

1.6. Research Approach and Outcomes

To conduct this research a qualitative exploratory research method was chosen, using an interpretative research design that contained multiple interactions with the objects being studied in order to gain deeper insights into the phenomenon, attitudes, motivations and behaviors (Saunders et al., 2019). This exploratory approach deemed relevant for adding new organisations, that are active in the non-residential market, to contribute to a better understanding of the situation being explored. This method collected and analyzed empirical data and then developed explanations, arriving at conclusions that can be used to formulate theories or conduct further quantitative studies.

As outcomes I aimed at discovering if the Dutch RE sector is undergoing a DT, which digital technologies were being adopted, what were the drivers and barriers, and what is their value add for the future of work.

1.7. Overview of the Thesis

Chapter 2 starts with the literature review method and covers key academic literature on DT in RE and the future of work. It also presents a conceptual model of the research and the theory relevant for it: the theory of disruption. Chapter 3 concentrates on the methodology and the research design, selection criteria for participating case organisations and participants, data collection instrument and analysis techniques used, finishing with a reflection on validity, reliability and ethical aspects.

Chapter 4 presents the research findings based on a thematic analysis of the findings, explains the adjustments needed in the inclusion and exclusion of case participants, while Chapter 5 discuss the findings in light of the research questions, resulting in five propositions. Chapter 6 presents the conclusion, limitations and recommendations for future research and for the practice.

2. Literature Review

This chapter concentrates on the literature review method (section 2.1) and the major themes that emerged from the literature analysis (section 2.2).

2.1. Literature Review Method

In order to conduct a systematic literature review, a scholarly literature research was conducted to retrieve credible journal outlets, rated 32 or higher in Google Scholar. Here I used the four phases of the literature analysis approach (Gass et al., 2015, in Morakanyany et al., 2017):

Phase 1: Searching process: using Google Scholar and the JAIS (Journal of the Association for Information Systems), I first concentrated on key articles about DT. Further searches were conducted in the Journal of Strategic Information Systems, IEEE, SAGE, Oxford Academic Journals, Cambridge University Press and Emerald to find RE articles related to DT. Forbes and the websites of the largest consulting companies (Deloitte, PwC, Accenture, McKinsey and KPMG) were also used to identify latest trends in digitalisation and the future of work.

The keyword combinations first used were, *DT, DT AND strategy, DT AND innovation, digitalisation*. Secondly, I looked at the relation of DT with the future of work, thus keywords used were: *DT AND future of work, future of work, and future workplace*. In the end, I searched using the *terms DT AND RE, DT AND future of work AND RE, RE AND AI, RE AND blockchain*. After finding the concept of PropTechs in some articles, it was also used as a search word in combination with the former search terms.

Articles found on DT in specific fields such as health, public sector, education, manufacturing, specific case companies in other sectors, etc. and related to specific countries were excluded – with the exception of the Piazzolo & Dogan (2020) with its figures about the German RE market, the only empirical study found about digitalisation and the future of work in RE. Articles regarding specific parts of DT, e.g., detailing business models, and strategy formulation, were also excluded, and instead I concentrated on the twelve most cited papers that were available through Open University's database, to fit the time frame of this research. Articles referring to construction were not included as I decided to focus on RE development activities referring to investment, brokerage, management and valuation (i.e., activities realised before and after the property was built, thus skipping construction robotization and other themes).

Phase 2: Screening process: to narrow down the research, the following conditions were used: the articles had to be in English, published from 2014 onwards, should have been cited more than 30 times, and contained the search keywords in their titles or abstract.

Phase 3: Clustering process: three thematic areas were found and the articles were grouped into:

- i) DT in the RE industry,
- ii) DT in RE and the FoW, and
- iii) Value-add potential of digital technologies in the FoW in RE.

Phase 4: Analysis Process: the thematic analysis was used to synthesize articles to create a body of literature using the constructs, which were then structured in a Conceptual Model (item 2.3).

2.2. Literature Background

A review of the RE literature identified three major themes described in the sections that follow:

i) DT in the RE industry

Digitalisation is defined as the implementation of digital technologies to optimize existing business processes by allowing more efficient coordination between them, and/or by creating new customer value by enhancing users experiences (Verhoef et al, 2021). Digitalisation is intertwined with the concept of DT, a major organisational change driven by, built on, or enabled by digital technology, altering how business is conducted (Osmundsen et al, 2018). Digitalisation is also defined as the leveraging of digital technology, being an enabler of DT (Osmundsen et al. 2018). According to Verhoef et al. (2021) these concepts are parts of a transformation which has three phases: digitisation, digitalisation and DT – where digitisation is simply the encoding of analog information into digital format.

The benefits of digitalisation include increased productivity and value creation, new forms of interactions with customers and a variety of innovations (Matt et al., 2015). Digitalisation is said to be a prerequisite to stay up to date in an environment where consumers are expecting a digital experience (Nowik, 2018). Conversely, DT is as a process where digital technologies create disruptions, triggering strategic responses from organisations (Vial, 2019). According to Van Tonder et al. (2020) DT requires organisations to make changes in their business models, business process, strategy and collaborate with the entire ecosystem that in turn will allow them to be more innovative, in terms of new product and services.

PropTechs:

The use of digital technologies in RE include technologies such as home matching tools, drones, virtual reality, building information modelling (BIM), data analytics tools, AI (AI), Internet of Things (IoT) and blockchain/smart contracts, crowdfunding, FinTechs related to RE, smart cities, smart homes and shared economy (Siniak et al, 2020).

Data Analytics as the core:

Data analytics and related technologies are considered the core of PropTechs as they are receiving the most investments and have been turning the RE sector into a data-driven market (Braesemann & Baum, 2020; Worzala et al., 2020). The industry is said to be at a turning point in embracing technology and has entered a state of experimentation, adoption and investment as new technologies and applications continue to emerge. Analytics can encompass Machine Learning, a subset of AI, which allows a machine to automatically learn from past data without programming explicitly.

Drivers of DT and other elements:

The most important drivers to DT are digital technologies coupled by culture, strategy and digitally savvy human capital (Morakanyane, 2017). Hence, organisations need to become flexible and agile, reduce costs, and increase quality by investing on digital solutions (Demirkan et al., 2016). This includes building the skills required by changes in technology, bringing in outside expertise to help with transformations besides building skills with employee training. Leadership commitment to DT is another key factor to be noted (Demirkan et al., 2016).

ii) DT in RE and The Future of Work

The impact of digitalisation on the future of work in RE are far from certain since the potential scope of automation has expanded beyond routine work. According to recent estimates 47 percent of US jobs are susceptible to automation, and while digital technologies are expected to offer millions of jobs – such as designing, creating and repairing robots, besides jobs in the burgeoning digital industries and through new business models – these have not yet been created (Demirkan et al., 2016). This rate of 47 percent is coincidentally the same found for the German RE sector (Piazolo & Dogan, 2019).

There is no evidence suggesting that digitalisation has reduced overall demand for jobs as technologically stagnant sectors of the economy continue to create vast employment opportunities. However, as the potential scope of automation is expanding, many sectors that have been technologically stagnant (such as RE) are likely to digitalise in the future. Another interesting figure is that 42 percent of OECD workers are employed in firms which have introduced new technologies and have changed work routines or skill requirements (Berger & Frey, 2016). To work on these new jobs, people must improve their skill sets and mindsets (Demirkan et al., 2016).

Humans working alongside Machines:

It is predicted that machines won't do everything: people will work alongside them, and to be productive the new automation age will require a number of human skills: from technological expertise to social and emotional capabilities. Because the skills set will continue to change, there is a need of being flexible and adaptable, with constant training and learning how to learn (McKinsey, 2017). Technology is a powerful enabler, however, it's not the driving force, those making decisions are human beings, people who understand technology, developing and making use of them (Accenture, 2017). Some authors affirm that digitalisation is more about having the right mindset and new skill sets embedded in data science (DeLisle et al., 2019) than about the technologies themselves.

Overcoming organisational barriers that hinder transformation:

Organisations must implement structural changes and overcome barriers that hinder their transformation efforts (Vial, 2019) in order to digitalise and remain competitive. A clear digital strategy is needed, supported by leaders who foster a digital culture where risk taking is the norm. Employees across all age groups want to work for businesses that are committed to digital progress, therefore there is a need to attract and retain the best talent, although maturing organisations tend to provide training for their workforce (Kane et al., 2015).

Digital technologies impacting RE work:

In the RE industry new technologies are rapidly changing how investors, tenants and managers use, invest and finance property, thus changing the way work is conducted. Digital technologies impact the future of work in RE in different ways. In the case of AI/Machine Learning, traditional working methods seem to continue while new algorithm techniques are being run in parallel (Conway, 2020; Rossini, 2000), whereas in the case of Blockchain technology, there is an understanding that it could replace the traditional governance mechanisms, such as automatic financial reviews, automatic verification, approval of transactions, and execution of payments, obviating intermediary roles such as insurance brokers (Lumineau, 2021), therefore blockchain is said to be a job killer (Tapscott and Tapscott, 2016, in Baum, 2017). In the case of sales activities, even though 90% of home sales being originated via online portals and online agents are grabbing a portion of the market, causing a reduction in the need of face-to-face RE agents, consumers still seem to want to work with a human agent in order to reduce the chances of a potentially costly mistake (DelPrete, 2018, in Baum, 2020).

The impacts of digitalisation on the future of work in RE are expected to be mixed: on the one hand, widespread dislocation of workers by multinational organisations, but on the other, a proliferation of PropTechs that offer new, flexible ways of working, education, and specialized skills (Siniak et al. 2020). Technologies that relieve the staff of repetitive and mundane work mean that time can be spent doing meaningful work, like evaluating business models or developing new service lines (Baum et al., 2020), adding value to the future of work.

iii) Value-add potential of digital technologies in the future of work in RE

From the literature review there are many categorizations of technologies applied to RE. In this research I start from the segmentation defined by MIPIM property forum of 2017, one of the world’s leading RE events: **data analytics (DA)**, **virtual reality (VR)**, **smart buildings and IoT**, **market place**, construction technologies (ConTechs), crowdfunding and smart cities (Baum, 2017), but to tighten the focus on the RE development process I excluded ConTechs (the technologies relating to the construction phase of RE, such as robots and 3D printers), crowdfunding (online collectively sourced RE investment, not practiced by the case organisations operating in the Netherlands) and smart city (as the focus here is on RE developers and not on governmental organisations) but added **BIM** (building information modeling, the technology most cited during the interviews realised for this research), **AI** (important to separate it here from data analytics and include its subset **machine learning**) and **blockchain** technology (considered by Baum a potential breakthrough that could completely restructure the way business is conducted in RE). In the following image it’s possible to see the currently most used technologies and their combinations. After that I explain the technologies and their value add to organisations and their employees.

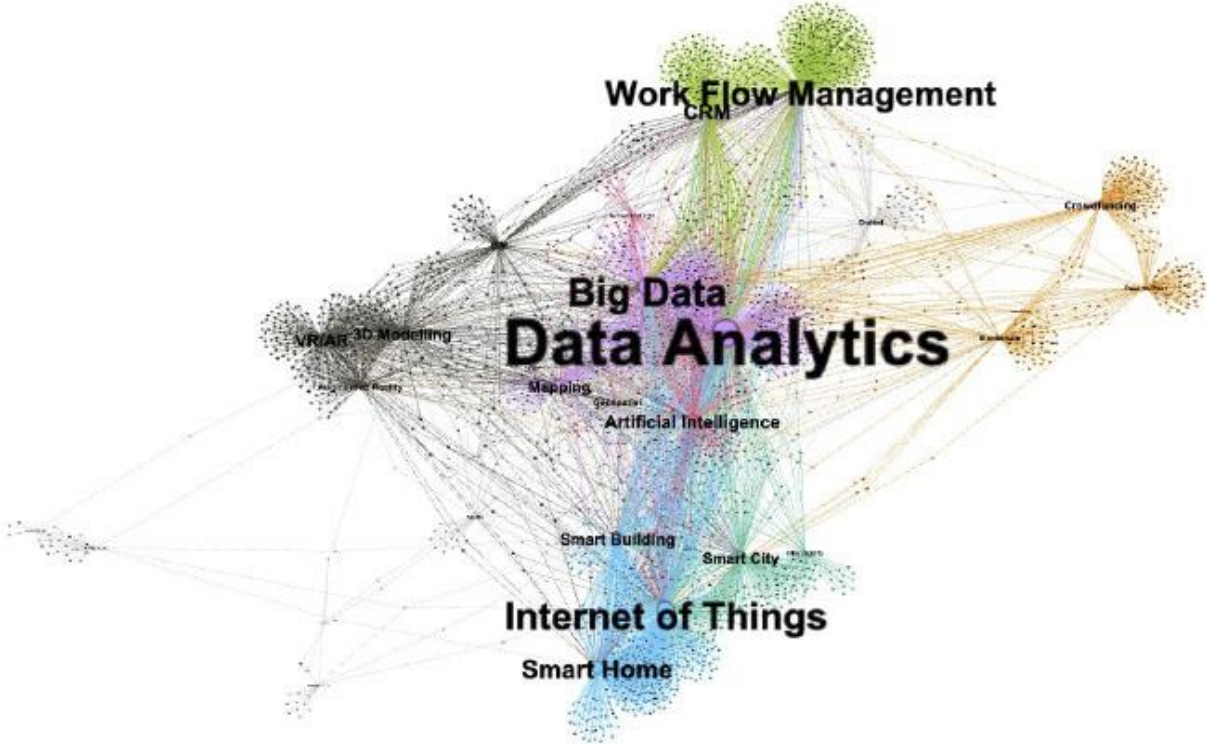


Figure 1: property technology bi-partite network demonstrates the technologies combinations that are used by the PropTech firms, demonstrating that Data Analytics is at its core. Source: Braesemann & Baum, 2020.

1- Data Analytics (DA): the cluster of data analytics technologies is at the core of the network of property technologies (Figure 1). Data, when aggregated by digital tools and techniques (software such as PowerBI or Tableau, languages such as Python) can be analyzed to draw conclusions and forecasts, being called 'actionable data'. When algorithms are used to perform predictive and prescriptive analytics, it falls in the Machine Learning category (a subset of AI, see below). Value add: enables organisations to know better the consumer and where to improve the business. In an increasingly globalized and competitive market there is a growing pressure to make the most profitable use of every property (Braesemann & Baum, 2020), thus data analytics is crucial to make work more precise and avoid human mistakes.

2- Virtual Reality (VR): is an advanced, human-computer interface that simulates a real environment where participants can move around, as a virtual world. Although being around for nearly twenty years it hasn't yet taken off, mostly because of its cost and platform specificity. Value add: allows consumers to experience the finished project before construction completion, in some cases providing them a number of choices, delivering a more engaging and fun experience. Enables customers to understand a product in just a few minutes (Wei, 2020) and reduces the need of RE agents to physically move to show existing properties.

3- Internet of Things (IoT) & Smart Buildings: property management software and buildings using sensors to collect data composing IoT devices. Solutions include home security, home automation, water and energy management (Baum, 2017). It allows ubiquitous, unbounded connectivity of different types of objects and devices anywhere (Vermesan et al., 2011 in Caron et al., 2015). Value add: efficient property management is much needed by landlords but it also provides a better consumer experience for tenants, gaining access to data relating to space use efficiency, security, energy and water consumption, sustainability, maintenance costs, among others.

4- Market Place (MP): online platforms for buying and selling properties, containing online agents, digital payment operations, disintermediating existing information providers. It's a RE e-commerce, a type of RE FinTech focused on online property transactions (Baum, 2017). Value add: enables online shopping but also a better consumer experience by giving access to a wide variety of choices, without needing to move to the RE sales shop. Since a lot of information is available online it diminishes the need of repetitive human interaction with consumers.

5- Building Information Modeling (BIM): is a process supported by various tools, technologies and contracts, involving the generation and management of 3-dimensional representations of physical and functional characteristics of buildings and places. Value add: enables an optimized and accelerated project development process where different stakeholders are seamlessly integrated in the chain. BIM enables virtual construction of a building in 3D, increasing speed, efficiency and reducing waste (Hardin & McCool, 2015). According to some, it makes work more interesting and meaningful when parties are integrated.

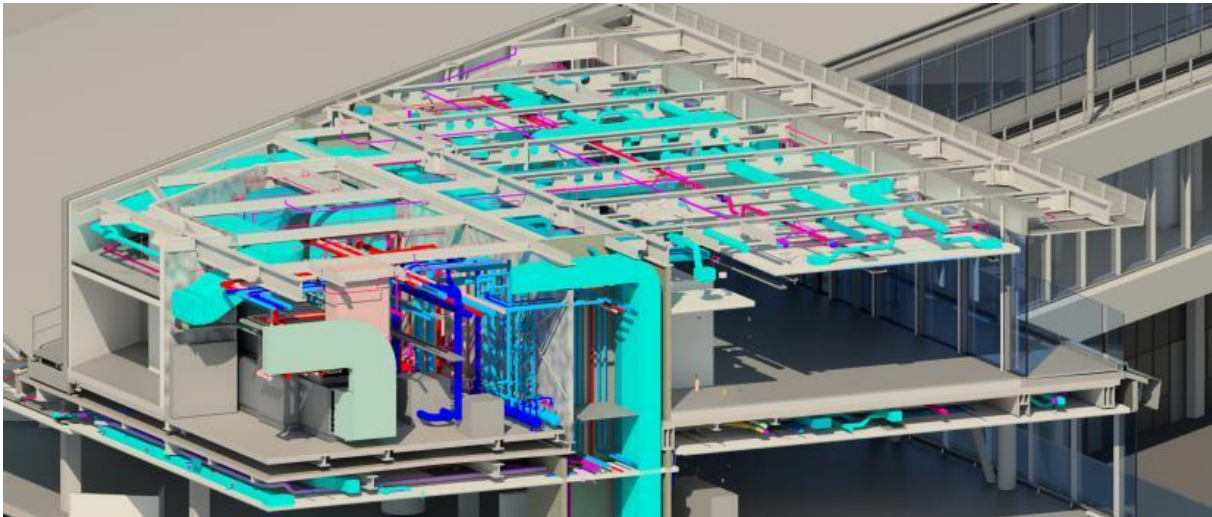


Figure 2: an image from BIM – building information modelling. Source: www.deerns.com

6- AI & Machine Learning: AI is a technology that enables a machine to simulate human behavior. Machine Learning is a subset of AI which allows a machine to automatically learn from past data without programming explicitly. In this research I found two main uses of AI in RE: in the realization of feasibility studies (Spacemaker software) and in the development of chatbots, although not yet implemented in any of the case organisations. ML in RE is mostly used to analyze and predict consumer purchase, but also for valuation of property.

Value-add: AI enables liberation from repetitive tasks so people can focus on more creative work while ML enables a faster and more intelligent decisions based on descriptive, predictive and prescriptive analytics.

7- Blockchain: a distributed ledger technology that can provide a shared, secure, transparent and trusted database that can be used in a number of ways in RE such as for collaborations in project management, land registry, tokenization of assets, crowdfunding, smart contracts (enabling automation of movement of funds and agreements), carbon footprint tracking (for sustainability certification) and the use of cryptocurrency in purchasing of property (FIBREE Industry Report Blockchain RE, 2021).

Value add: establishing trust-based interactions through cryptography enabled by smart coding, thereby enabling the transfer of governance from centralized institutions to distributed networks of peer-to-peer collaboration (Baum, 2017) possibly provoking the disintermediation of middlemen.

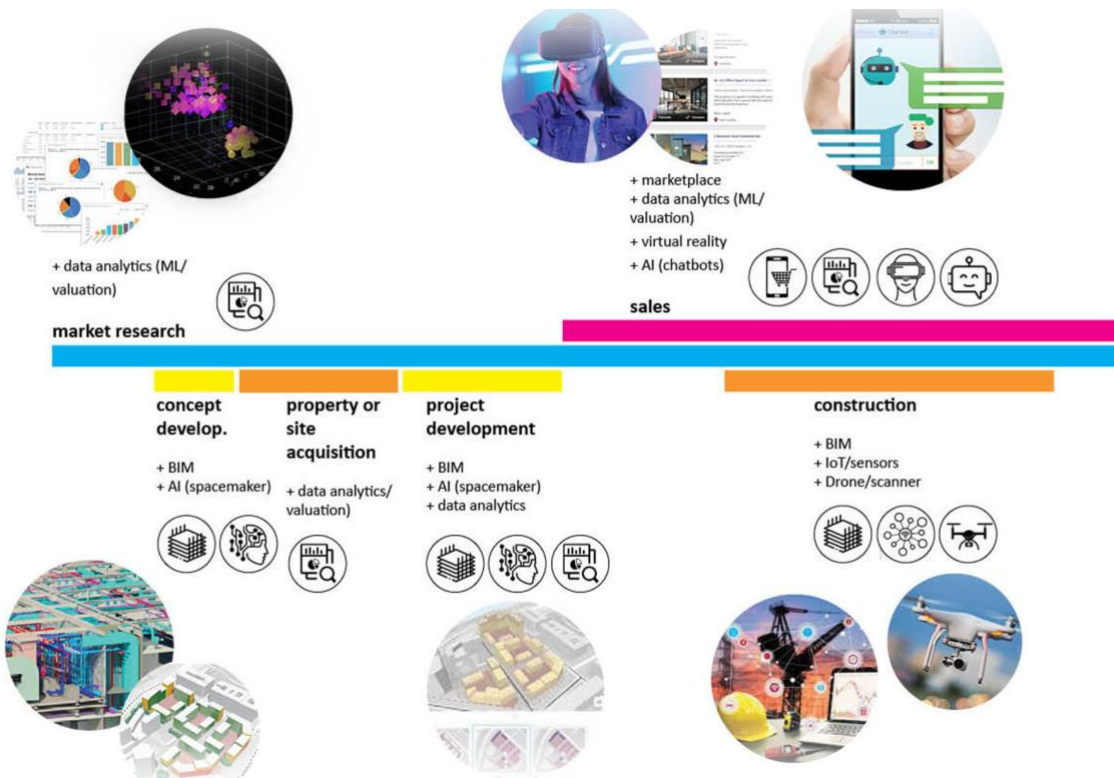


Figure 3: schematic timeline of RE development, indicating digital technologies used on each phase, according to data collected from some interviewees. Source: from the author.

2.3. Conceptual Model of the Research

Here I present the conceptual model of the research showing how the main literature concepts link to the research questions. The research gap is the lack of sufficient research in DT in the specific industry of RE, which is defined in the literature as 'slow in tech adoption', linking to the RQ3 (what are the barriers?). This slowness relates to the two main literature fields of research: DT in RE, linking to RQ2 (how technologies are being implemented?) and the Future of Work in RE, linking to RQ1 (how DT can add value to the FoW of this industry?).

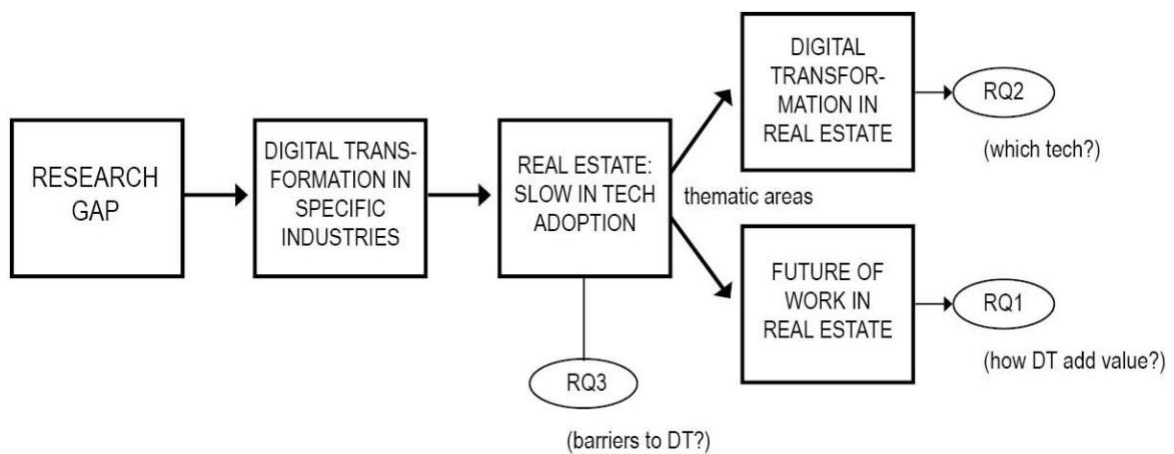


Figure 4: Conceptual Model of the research.

2.4. Theory Relevant for This Study

An important theory for this research is the **theory of disruption**, as developed by three scholars: Joseph Schumpeter (1942), in the concept of creative destruction; Clayton Christensen's disruptive innovation (1997); and the recent elaboration by Kilkki et al. (2018). For Schumpeter, creative destruction is the process of industrial mutation that continuously revolutionizes the economic structures, destroying the old one and creating new ones. A similar process, but in the company level, was described by Christensen and called 'disruptive innovation': a process whereby a smaller company with fewer resources is able to challenge established businesses: new entrants begin by successfully targeting the overlooked, low-demanding segments, but as the existing firms tend not to respond seriously (as they don't perceive it as a threat), the new entrants move upmarket, disrupting the industry (Christensen et al., 2015). According to Kilkki et al. (2018) these existing firms are said to be disrupted when they must redesign their strategy to survive a change in the environment.

How the theory will be used in this research:

In this research I use the theory of disruption in relation to DT. Contrary to digitalisation, DT is a major organisational change which alters how a business is conducted (Osmundsen et al, 2018). DT implies a business model innovation (Van Tonder et al. 2020) and provokes a disruption of the market, triggering strategic responses from other organisations (Vial, 2019).

In the case of the Dutch RE market, its economic stability and state-led characteristics generate a lack of sense of urgency to innovate and digitalise. This is understood as a probable reason underlying the conservative mindset of the C-level leaders, perceiving no threat of disruption on the horizon. This mindset act as a barrier to their organisations' DTs, as digitalisation efforts are undertaken to 'stay up-to-date' only, thus not so radical as in other industries, having a negative effect in the future of work. Without a disruptive mindset, DT is adding value to the FoW but not as much as it could.

3. Methodology

In this section, the methodology of the research is presented. The objective of this chapter is to explain how I answered the main research question: *How can Digital Transformation (DT) add value in the future of work of the RE industry, a traditionally slow adopter of technologies?* The sub research questions dive into particular aspects of this main question (see item 1.4).

There are two main research approaches to reasoning: deduction and induction. In deduction, data collection is used to evaluate hypothesis related to existing theories while in induction data collection is used to explore a phenomenon, identify themes and patterns, and create a conceptual framework. A third approach would be abduction, moving back and forth combining deduction and induction (Saunders et al., 2016), which could be done after the data collection phase is completed.

Usually, qualitative research follows an inductive approach, examining data which are narratives, while quantitative research follows a deductive approach, examining numerical data. Quantitative research generally adopts a deductive approach, starting from generalizations it searches if these apply to specific instances, while qualitative research generally adopts an inductive approach, starting from specific observations and then seeking to establish generalizations (Hyde, 2000). Qualitative research focuses on a contextual understanding in order to understand behaviors, values and beliefs (Bryman and Bell, 2011, in Azungah, 2018).

The qualitative method here starts with a structured literature review of recent articles published in respected journals regarding the subject's 'DT', 'RE' and 'future of work' (as presented in chapter 2) and then empirical research follows, investigating a contemporary phenomenon in-depth and within its real-life context (Yin, 2009). This will be realised by means of interviews with RE experts and an analysis of the case companies' websites and apps, forming a multiple case study.

In order to research the impact of DT in the RE industry an explorative attitude was needed, since the theme is new, broad, complex, and has not been sufficiently researched yet: there is literature published about the technologies applied to RE and the growing investments in PropTechs, but scant empirical research regarding its impacts in the future of work, nor in specific regional markets, such as the Dutch RE case. In the next sections I dive into the design of the research, case selection and the data collection.

3.1. Research Method

The qualitative method chosen uses an exploratory interpretive research design containing multiple interactions with participants and objects being studied in order to gain deeper insights about the phenomenon being studied. Using multiple cases, data was collected through semi-structured interviews, to drill down into the research theme and gather rich data about the perceptions of RE market experts (Saunders et al. 2016). Semi-structured interviews are ideal for an explorative study, allowing the formulation of new questions whenever needed (Yin, 2009). Instead of one in-depth case study, the option using four cases allows for comparing and triangulating the results, besides improving reliability.

Doing observations of participating company activities was not a feasible data collection method as it was difficult to do face-to-face meetings during the pandemic. However, one organisation did invite me to visit their office and we conducted the interview in their meeting room. This seemed no better

than online interviews since not much could be observed there. As extra information I analyzed the case organisations' websites and apps, trying to understand how consumers or potential investors interact with the company. I also used the social media platform LinkedIn to lookup people's roles and case organisations' job vacancies, to gain a better understanding of where they are heading in terms of skill sets.

I also took part in a PropTech event where a number of RE companies showcased what they have been doing. There I watched a presentation by a main residential organisation focused on the Dutch rental market, a sector which was unfortunately not included in this research, but their work in terms of digitalisation gave me a better understanding of trends in the industry.

I conducted in total sixteen interviews: twelve with the four main participating organisations (largest developers in the Dutch residential sales market) and added four extra interviews with digitalisation managers or employees from organisations active in the non-residential rental market (commercial and hospitality), to gain a better picture of the research problem. The interviews took around 30 to 45 minutes each. Sometimes, due to busy agendas, interviews took 30 minutes with extra questions sent by e-mail. When proceeding to the final response to research questions, new questions that arose were again asked to participants.

The interviews were conducted online via Zoom or Teams software and recorded for further in-depth analysis, taking into consideration privacy issues (to be deleted after this thesis is accepted). The data collected from the organisations were analyzed and used to further develop the conceptual model elaborated from the literature study (see item 2.3). In the next section I dive into the case selection and afterwards demonstrate the data analysis.

3.2. Case Selection

In this section I present the selection of the organisations and the criteria used, composed by two items:

- 1- The main case organisations are four of the largest Dutch RE companies active in the development of RE projects, in all phases – from site acquisition and concept development to sales, construction and property management. This allowed me to have a holistic view of how different technologies were being implemented in the RE lifecycle. I chose the largest organisations since those were the ones with sufficient resources and possibly the digital capabilities required to undertake DT efforts. The current ranking of the Dutch RE developers is presented below.
- 2- The complementary organisations are: one is the largest international RE developer and property management organisation who specializes in Commercial RE (CRE) and is active in the Netherlands, two large Dutch hospitality organisations (currently expanding internationally), and one of the Big Four accounting organisations active in DT were also selected (see figure 5 for more detail).

Top 20 grootste woningontwikkelaars

Verkochte nieuwbouwkavels

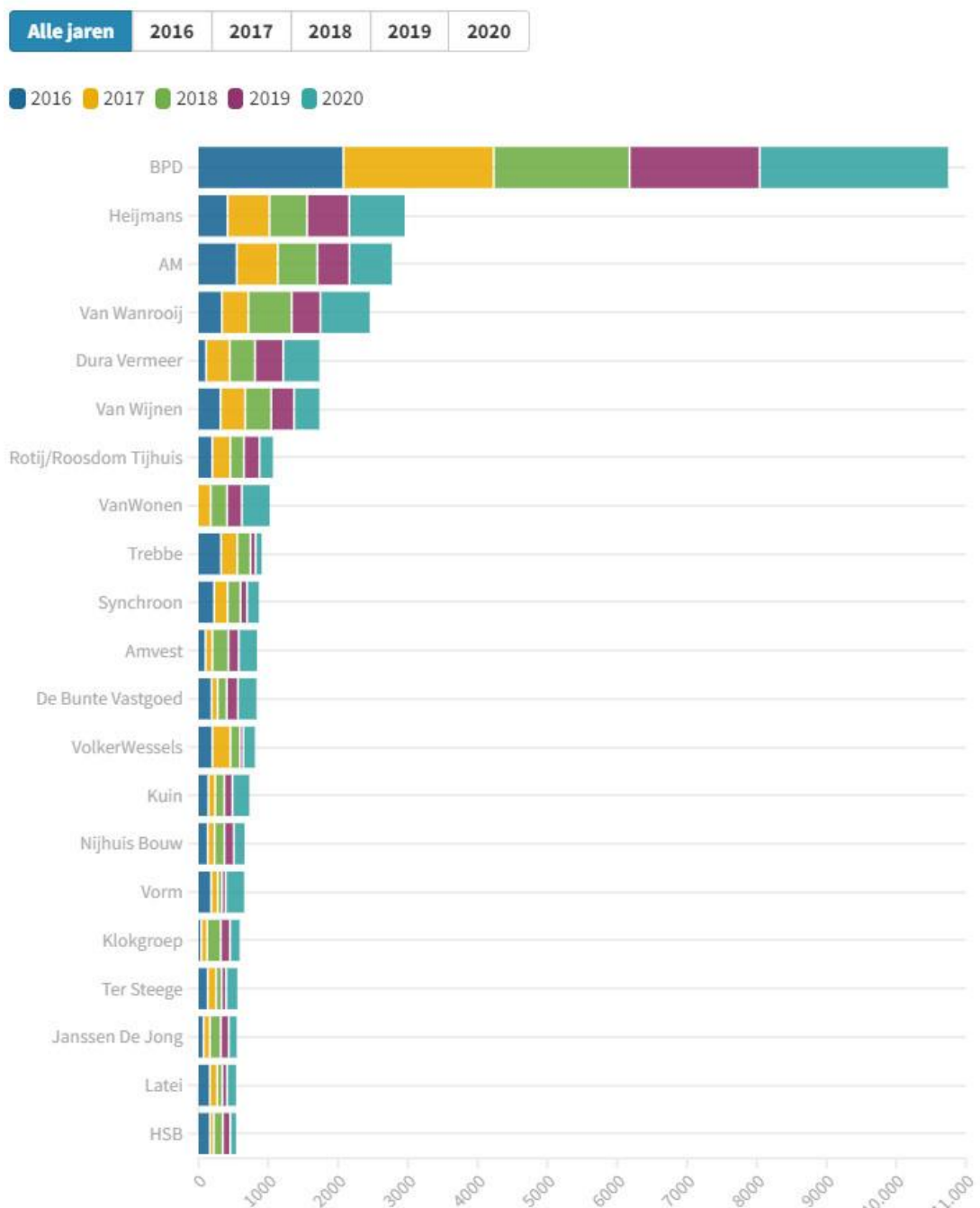


Figure 5: The largest Dutch RE developers. Source: www.cobouw.nl

- Then I searched the social media professional network LinkedIn for people working in these organisations responsible for DT or digitalisation. When nobody appeared, I also searched on Google the company name, DT, digitalisation or the Dutch words “digitalisering” or “digitalisatie”, and some results appeared in their websites, relating to people in charge of digitalisation.

This **criterion for choosing** the participating organisations was to have at least one manager responsible for DT or digitalisation in their job description. This was proof of the company's efforts to digitalise. Many companies have this theme on their websites but when there is no corresponding role-it can be merely seen as a way of promoting their brand images.

i) Case study description

The multiple case study here is focused on four large RE developers focused on residential property sales, currently undertaking digitalisation efforts. In each organisation three employees were interviewed (see next item Case Study Participants). Here I include some background information about the case organisations (ref. Figure 5):

- **Organisation 1 (ORG_1):** Headquartered in Noord-Brabant and founded mid last century, it is one of the biggest RE developers. It is active in residential RE but also realises infrastructure projects.
- **Organisation 2 (ORG_2):** headquartered in Noord-Holland and founded mid last century, it is one of the biggest RE developers in The Netherlands in terms of building plots delivered. It is focused on the residential RE market.
- **Organisation 3 (ORG_3):** Headquartered in Zuid-Holland and founded more than 100 years ago it is also a very large organisation but not as big as the other three. Initially focused on construction, only recently it became a RE developer active in all phases.
- **Organisation 4 (ORG_4)** Headquartered in Zuid-Holland and founded more than 100 years ago, it is also one of the biggest RE developers in The Netherlands. It is active in residential RE but also office buildings.

ii) Case study participants

Interview participants were three employees from each case organisations holding the following roles: one responsible for DT or digitalisation, one for Data Analytics or Business Intelligence and the third a role in Sales or Marketing. Selection criteria for these roles were:

- *Manager in charge of Digitalisation:* a high-level manager with deep knowledge of digitalization, knowing how far the organisation is in this process. This professional has knowledge of all digital technologies used for RE and is probably aware of their impact in FoW. By including this employee, it was possible to understand how digital technologies add value to the organisation and in FoW.
- *Data Analytics or Business Intelligence Specialist:* including a data specialist was important as this professional has knowledge about the business use of data and can judge the usefulness of analytics for achieving the organisation's business goals. Including this role made it possible to assess if new technologies were integrated in the company's daily work, and to verify if the data collected from higher level managers was actually done by the teams, triangulating the findings.
- *A Sales manager:* this role has most contact with the end consumer and his work can probably be digitalised by means of AI chatbots and VR technology for virtual property visits. By including this employee, it was possible to access the impact of those technologies in his

work and how it adds value, but also if these professionals are receiving training to incorporate the digital capabilities needed.

By including three employees in each of the four main organisations and four employees from non-residential market it was possible to answer the research questions of this research.

	ORGANISATION Name (Pseudonym)	ROLE	EXPERIENCE
RE ORGANISATIONS FOCUSED ON RESIDENTIAL SALES MARKET (MAIN DATA SOURCES)			
1	Organisation 1 (ORG_1)	Manager responsible for DT	Around four years working for this organisation, this professional has background in business development in the infrastructure sector.
2	Organisation 1	Data Analyst / Business Intelligence specialist	This professional is working for a year in this organisation but has three years' experience in data analytics.
3	Organisation 1	Sales manager	This professional works on a number of projects of this organisation, having more than 10 year's experience in the RE market.
4	Organisation 2 (ORG_2)	Manager responsible for Digitalisation	This professional has been working four years in this organisation, has previous experience in e-commerce and recently became Head of Digital.
5	Organisation 2	Data / Business Intelligence specialist	Although only one year in the organisation, this professional has five years' experience in social media and background in RE.
6	Organisation 2	Sales manager	This professional has been working four years in this organisation, has a background in marketing and communications.
7	Organisation 3 (ORG_3)	Manager responsible for Digitalisation	Although working one year in this organisation, this person has worked more than two years in a digitalisation laboratory which is now part of his new current job. His background is in business development.
8	Organisation 3	Data / Business Intelligence specialist	This organisation has no fixed professionals responsible for data or business intelligence, but hires these services from partner companies which I interviewed.
9	Organisation 3	Sales manager	This professional has been working three years in this organisation, and has a background in marketing.
10	Organisation 4 (ORG_4)	Manager responsible for Digitalisation	This person holds a director role in this organisation for almost three years. He was project director for four years and has background in technology management.
11	Organisation 4	Data / Business Intelligence specialist	This professional has been six years in the organisation and had a first role in BIM followed by three years in business intelligence.
12	Organisation 4	Sales manager	This professional has been working two years in this organisation and has a background in marketing and RE sales.
RE ORGANISATIONS FOCUSED ON NON-RESIDENTIAL (COMMERCIAL AND HOSPITALITY) MARKET: COMPLEMENTARY DATA SOURCE, USED AS COMPARISON TO THE RESIDENTIAL SECTOR			
13	Organisation 5 (ORG_5)	Manager responsible for Digital Marketing and sales	This person has been working five years in this position and is responsible for digitalisation and digital strategy. He has a background in marketing and RE sales.
14	Organisation 6 (ORG_6)	Manager responsible for Digitalisation	This professional has been working two years in PropTech strategy, and has a background in start-up investment.
15	Organisation 7	Professional	This professional has been working four years in this position

	(ORG_7)	responsible for Digital Content	and is responsible for digital content, and is knowledgeable about the digital efforts of the company.
16	Organisation 8 (ORG_8)	DT Consultant	This professional has been working two years as a DT consultant, and has a background in Digital Marketing.

Table 2: Case study participants (interviewees).

3.3. Data collection instruments

The **data collection instruments** were:

1. semi-structured interviews (main instrument)
2. analysis of participating organisations' websites, apps and LinkedIn pages with job adds (support instrument)

The main data collection instrument, the semi-structured interviews, are ideal to use in exploratory research because they contain a standard main structure for all interviews across all three organisations but leave room for last minute questions that were made based on the conversational flow. If important information was found in the unplanned questions, the same questions were brought to the other organisations, in order to compare results on specific topics. The following **interview themes** were used to create the interviews questions:

1. the organisation's business models and their approach towards digitalisation or DT.
2. technologies being implemented by the case organisation.
3. technologies not being implemented by the case organisation and why.
4. drivers and barriers to digitalisation or DT.
5. add value of digital technologies and digitalisation on the case organisation's work.

By interviewing three professionals from each four residential RE developer, working in different roles, and four professionals from non-residential developers, it was possible to gain sufficient knowledge about digitalisation underway in the Dutch RE, and a less biased view of the cases-studies. In the end, after the sixteen interviews, it was possible to analyze the results (see item 3.4) and derive conclusions to answer the research questions (see item 4: findings, item 5: discussion, item 6: conclusions). Gaps in the empirical data resulted in new interview questions, and new analyses were made.

3.4. Data analysis method

The data analysis method of the empirical part of the research is based on the grounded theory approach as developed by Glaser and Strauss (1967) and more recently Gioia et al. (2012). Grounded theory is a systematic methodology used for qualitative research, applying an inductive reasoning. Since the interviews and their analysis should be proceeding together, the understanding is that interviews can change during the progression of the research (Gioia et al., 2012).

From the semi-structured interviews data was analyzed through coding in three steps, as proposed by Corbin and Strauss (1990):

1. Open Coding: where raw data is broken down and events/actions/interactions are compared with others, given conceptual labels, which are then grouped in categories, which will become the basis for sampling.

2. Axial Coding: where categories are related to sub-categories and vice versa, and their relationships tested against data. Further development of categories takes place.

3. Selective Coding: the process by which all categories are interpreted and unified around a core category, which represents the central phenomenon of the study, the main analytical idea.

In the end I built an inductive model that is grounded in the data, a data structure (figure 6), capturing the informants' experiences in theoretical terms. This grounded theory model shows the relationships among the emerging concepts that describe the phenomenon (Gioia et al., 2012).

3.5. Validity and Reliability Ethical aspects of the study

The study drew on validity, reliability and ethical aspects throughout its course.

Validity:

In order to access the validity of this qualitative research, three types of validity were considered: construct validity, internal validity and external validity. Construct validity refers to the quality of data collected, if it's an accurate reflection of the situation. Internal validity refers to the quality of the reasoning from the data collected to the conclusion. External validity, also called generalizability, refers to the applicability of the findings beyond the environment of study, in this research, being multiple cases who participated in the study (Saunders, 2016).

In order to promote construct validity, it was important in this research to have a well-designed interview protocol (Annex) as data collection instrument with the case organisations, enabling interviewing the right people who are knowledgeable about the issues related to this research. It was also important to triangulate the findings with additional information across all companies, such as inspecting websites, apps and LinkedIn profiles with job posts, besides searching for documents such as digital strategies, if these were online or made available.

To promote internal validity this research established clear causal relationships and addressed rival explanations in order to check if the reasoning proposed is the correct in order to gauge whether the data could be explained and concluded otherwise. Another important measure was to address the researcher's bias, i.e., when the researcher influences the results from the beginning, due to his own acquired understanding and experience in RE. Attempts were made to avoid this at all costs.

To promote external validity this research used multiple case studies. While a case study is an empirical enquiry about a contemporary phenomenon set within its real-world context, a multiple case study approach tries to understand similarities and differences in order to arrive at generalizable conclusions (Yin, 2009a). With the utilization of semi-structured interviews, it was possible to adjust the interview questions for following organisations and in the end to revisit responses from the first and second organisations interviewed, in order to collect the same kind of data.

Reliability:

Reliability is about the extent to which subsequent researchers would arrive at the same conclusions if the research was conducted by them in the same way (Gibbert and Ruigrok, 2010). In this research reliability was promoted by a rigorous elaboration on the methodology steps and types of data to be collected, besides periodical feedback from the university mentor – especially during the formulation of the interviews, coding and interpretation of results – and by sharing the transcript of each interview with each participant for further comments and adjustments. I also sent the coded interviews for the interviewees, so that they got a good understanding about the research and would make time available for some extra questions. But above all, the fact that this is a multiple case study is in itself a crucial measure in ensuring that future similar researches in the Dutch RE market would arrive to similar results, if new research is realised with large organisations as well and if realised in this same year, since DT is on the top of many organisations' agendas and there could be much change in it in the near future.

Addressing bias: my choice for researching the larger Dutch RE organisations is based on the assumption that they have the resources to undertake digitalisation. However, it may also be that DT and a possible disruption of this industry is coming from new, or smaller market players (SME). Therefore, researchers focusing on smaller or middle size companies could arrive at different conclusions. To improve the reliability of this research I looked at some SMEs on LinkedIn but didn't find managers or employees working on digitalisation in those companies in the Netherlands.

Ethical Aspects:

This research was realised according to the Dutch code of conduct of scientific integrity (Algra et al., 2018). There was no employment relationship with any case organisations participating in this research as the researcher had the commitment to analyze the data with objectivity and honesty, thereby avoiding any kind of bias. The researcher was also committed to analyze the data in an ethical way drawing on OU's research integrity guidelines, aiming at presenting the results in an anonymized manner that ensures confidentiality of the participants and the case organisations, their strategies, and business goals.

4. Research Findings

In the last chapters I explained the research methodology adopted, besides the case selection criteria, data collection and aspects relating to the validity, reliability and ethics of this research. In this chapter the main findings are presented as four major themes, each with corresponding sub-themes (highlighted in Fig. 6), that emerged from the data analysis in terms of DT and FoW in RE.

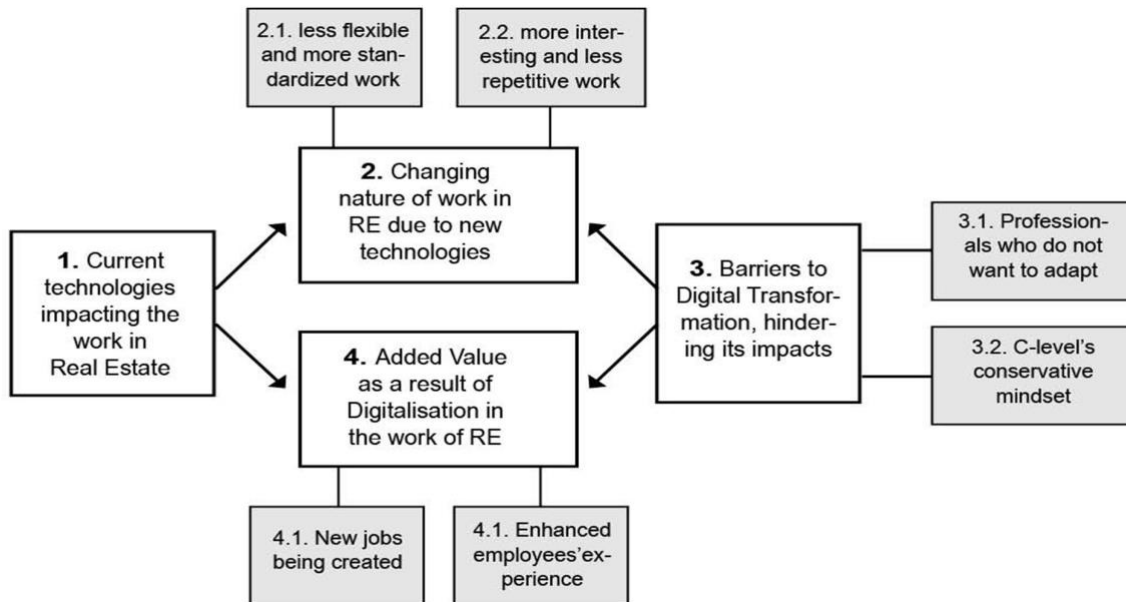


Figure 6: data structure of the research findings themes and sub-themes.

4.1. Theme 1: Current technologies impacting the work in RE

The data analysis revealed to what extent new digital technologies were currently used across different departments of the organisations that participated in the study, as outline in Table 3.

Technology Type	Current use in RE	Evidence
1. Data Analytics (DA)	Use cases: - market research, forecasting demand - predictions of consumer preferences according to their profiles - valuation models to determine the ideal price of each property	DA is growing each year with more organisations creating analytics departments or increasing the existing teams to make sense of more and more data. E.g., <i>Our organisation has hired an entire team of data scientists in the last year to make sense of the data we are collecting and need to be analyzed. (DT manager, ORG_1)</i> <i>We have been experimenting with algorithms (AI/machine learning) in order to make forecasts. (DT manager, ORG_4)</i>
2. Virtual Reality (VR)	Use cases: -virtual visits of existing property -virtual experience of future property being built	There is so far only one of the largest organisations making extensive use of VR. E.g., <i>VR models make sure the customers know better what they are buying. That's important because it's always about buying on paper (not yet built). (DT manager, ORG_4)</i>

		<i>We use VR for upselling. Consumers come to our headquarters and use the VR room to make choices in their future homes such as higher quality kitchen and bathroom options. (DT manager, ORG_4)</i>
3. Internet of Things	Use cases: -sensors to control temperature -sensors to monitor energy use, water use and air quality -sensors for closing sun screens when rays are stronger -sensors for security	There is so far only one of the largest organisations making use of IoT, and not in the residential market. E.g., <i>In our headquarters we have sensors that measure energy and water use, but also sensors that automatically close the sun screens. We use the HQ as a showroom for future clients. (BI specialist, ORG_4)</i> <i>IoT is needed for the smart grids of energy producing homes, but this will require a change in the business model, and the C-level is not capable. (DT manager, ORG_1)</i>
4. Market Place (e-commerce)	Use case: - online platforms for buying, selling, renting homes, sometimes offering consulting services	There is only one of the largest organisations making use of MP. E.g., <i>We are the only developer which were crazy enough to create an entire online shopping experience for RE. We sell for people who never been here. (DT manager, ORG_2)</i>
5. Building Information Modeling (BIM)	Use case: - project development tool using three dimensional representations that integrate different projects and consultants' data inputs	BIM is a ubiquitous digital technology present in all RE developers' work. Some interviewees even use it as a synonym for the digitalisation of the industry. E.g., <i>BIM is already the standard way of working throughout our industry... all companies are doing the same thing when it comes to that. (DT manager, ORG_1)</i> <i>BIM connects all parties in the chain... it accelerates and optimizes our work. (DT manager, ORG_2)</i>
6. Artificial Intelligence (AI)	Use cases: - project development tool for feasibility studies - chatbots	AI is a growing trend in RE. From the four large developers, three are using it to conduct feasibility studies for new projects. Chatbots are being implemented by one developer, to enable continuous customer support. E.g., <i>The trend is on generative design (Spacemaker, an AI software) to conduct feasibility studies... it automatically tests lots of different (building) schemes taking into account restrictions of each location. (DT manager, ORG_4)</i> <i>The upcoming technology, that we are also involved, is parametric design, which is an AI based software from Autodesk... we are also working on a chatbot development to provide a 24/7 consumer experience. (DT manager, ORG_2)</i>
7. Blockchain	Use cases: - smart contracts - project management - land registry	Very little evidence of this was found in the data, but there is currently some experimentation underway, E.g. <i>We have tried one project using blockchain technology, but didn't go well, so we quit... people don't understand blockchain yet. (DT manager, ORG_4)</i>

		<p><i>Smart contract (blockchain based) is the future, not only for buying and selling property, but also between developer and (renting) corporations. It will make all contract management much easier and faster. (DT manager, ORG_7)</i></p>
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Table 3: current Digital technologies in use in RE (Cf. technology list in Figure 1, CH 2)

4.2. Theme 2: The changing nature of work in RE due to new technologies

From the analyzed data it was clear that even though the adoption of digital technologies in the RE industry was relatively slow, there were many changes perceived in the nature of work. In this section two key observations are described as sub-themes.

4.2.1 Less flexible and more standardized work

It was been mentioned by three of the four large developers that digitalisation implies a new way of working where decisions need to be taken in the beginning of the process, and that changes in the project are less welcome during its development (as it's more costly), therefore making the project less flexible. This sub-theme refers specifically to BIM, which is the most prevalent technology in RE, and sometimes equated to digitalisation in the industry's jargon.

The reason for this inflexibility is that in BIM all projects (engineering, architecture and all kinds of consultants) are elaborated in a 3-dimensional way and have a large amount of data attached to it (e.g. types of materials, total sizes needed, costs, among others). Most of the work hours are spent right at the beginning, building this 3D model and attaching all the data. Thus, if one of the parties changes its project in the middle of the process, this implies a lot of re-work for all other designers and consultants, which means extra costs for the client. Some interviewees explained this as follows:

BIM leads to a loss of flexibility during project development. You need to know what you want from the beginning, as it costs more to make changes in the project. (DT manager, ORG_2)

Traditional digitalisation activities use BIM and ERP. New business activities use a 'digital building chain' (OMRT, a parametric AI tool) that connects all the parties involved... needing early decision on structure issues and installations, for instance. (DT manager, ORG_3)

This standardization of the project development process, where decisions need to be taken early on, is a cause of frustration for some previous generation engineers which rather do the work in the old way. However, organisations have been investing in training and coaching teams, to make this a smooth transition. As it seems, they have been succeeding in this effort. As the one manager mentioned:

Digitalisation needs people on board, doing the same thing, and not everybody is doing it right, so they need to adapt to this new way of working. The company needs to guide and support them, and we are doing that. (BI specialist, ORG_4)

4.2.3 A move to more interesting and less repetitive work

It has been mentioned by some DT managers and BI specialists that digitalisation implies a more interesting and efficient way of working, since all parties' work are integrated seamlessly, and work is done with less human error. In this way, professionals can focus on the more creative part of the job, and less on repetitive tasks. In BIM, for example, all drawings relating to views of the different facades, but also cross sections, are done in an automated way, whereas before, in older software, these drawings needed to be made manually one by one. As stated by some employees:

Digitalisation is really important, it adds value to the company and the clients, we work faster, cheaper, and do more interesting work. (BI specialist, ORG_4)

Working digital enables knowledge sharing and makes our work smarter, (with) less mistakes, and much easier. (BI specialist, ORG_2)

When it comes to Data Analytics, AI, IoT, VR and Market Place, the professionals involved showed excitement in working with these new technologies. People who conducted, for example, market research in the past, would be using the telephone and newspapers to collect data about the economy and what was being sold at some moments. Forecasting was done in a rather intuitive manner. Nowadays, DA teams are gathering data from different sources and then advanced analytics is being used to build models and make a number of predictions about the market demand and ideal prices. Software used generates a number of graphs, which are combined into dashboards, giving integrated views of what's happening in the business in different areas, as some participants indicated:

Market research is nowadays done via customer data platform, google analytics, from customers visiting our website (clickstream) and bought datasets, integrating everything, way better than before. (DT manager, ORG_2)

VR models make sure the customers know better what they are buying. That's important because it's always about buying on paper (not yet built) ... we also use it for upselling. (DT manager, ORG_4)

The fact that remote collaboration makes work less time consuming was also mentioned:

Digitalisation leads to optimization and acceleration of work. Remote work also saves time with commuting, making work more efficient and focused on creation. (DT manager, ORG_2)

4.3. Theme 3: Barriers to DT, hindering its impacts

Although delivering many benefits to RE organisations, digitalisation has been difficult for a number of reasons. Through interviews I confirmed that mindset and skill set of employees as the two most relevant barriers to digitalization and DT in the RE. These two issues are further explained here in sub-themes.

4.3.1. Some RE professionals do not readily want to adapt to new ways of digital work

The skill set of employees was found as a barrier for digitalisation, mostly because some employees did not want to adapt to new ways of working. RE organisations have been tackling this issue with a

mix of training, coaching, hiring new people, and partnerships with external companies. This sub-theme was explained by some interviewees:

I would not say that people are not capable or resistant, it's more that they don't see the benefits (of working digital) yet, but that's improving. Digitalisation leads to a loss of flexibility, and not everybody is happy. (DT manager, ORG_2)

Digitalisation is not easy. For young people it is, but older people have more difficulty in adapting to the new ways of working, digitally interconnected. It can be frightening for some, but in the end, everybody wants to progress. (DT manager, ORG_4)

Digitalisation is difficult because some people don't want to adapt, sometimes older engineers, but also younger ones. Dutch people are stubborn. (BI specialist, ORG_4)

Digitalisation is hard because people are afraid of the unknown, afraid of changing to the new tools, as they are not used to think outside of the box and have difficulty to adapt, which sometimes creates frustrations. (DT manager, ORG_7)

However, organisations seem to be tackling this issue successfully. This interviewee stated this quite clearly, showing this is not such a big problem:

Organisations needs to guide and support them (people who have difficult of resistance to adapt), and we are doing that. (BI specialist, ORG_4)

4.3.2. The conservative mindset of C Levels in RE

RE leadership's mindset was found to be conservative, focusing on avoiding risk-taking and being stagnant, in a comfort zone. As there was no sense of urgency in three of the organisations researched (only ORG_3 has it), no major organisational changes were happening yet, only adaptations of existing business models due to adoption of some digital technologies. This was seen as the main barrier for DT and the extra jobs that could be created.

The C-level mindset has a negative effect on the hiring of tech-savvy employees. Although many new jobs were created and quite a lot of training was provided to existing teams, the acquisition of teams and advanced capabilities were not much on the increase – a situation that could have been greater if the C-level roles were willing to digitally transform their organisations.

As mentioned by some interviewees, leadership's traditional mindset provokes a lack of motivation in their work. Two DT managers were unhappy with the fact that they were hired to conduct organisational change but themselves felt their 'hands were tied' as their C-managers had little interest in real DT. This was particularly evident with the lack of new business models that could disrupt the RE market. Coincidentally, during this research, these two DT managers left their organisations to pursue new jobs in software companies. This sub-theme was explained by some interviewees:

Digitalisation is difficult because higher management is conservative and risk averse. RE organisations should become more like tech-companies and take risks even in such a stable market... they need to shift the business model. (DT manager, ORG_1)

The biggest problem is that RE is a traditional industry with a traditional mindset. Most people prefer to work the old ways. For example, even senior managers don't give importance to data quality. (DT manager, ORG_7)

Most of the times it was mentioned that RE was a stable industry where change is of less importance:

We understand that there is no case for change from the outside, no market disruption on the way. DT is our vision, to keep relevant in the marketplace. (DT manager, ORG_2)

There is no competition on the selling side... there is market for everyone, we are not being disrupted... but it's still interesting to invest in technology for upselling and keeping up-to-date. (DT manager, ORG_4)

This situation was different in the non-residential RE companies, where tech-savviness was perceived, an important value-add:

We are a tech-savvy company. We are not like the standard RE company which is a hundred years old and has a backwards mentality. (DT manager, ORG_6)

From the data collected it was visible that the C-levels, besides having a conservative mindset, did not see any disruptors on the horizon. Only one of the four largest organisations did mention about possible disruptors, but they think that it's unlikely to happen:

Google and IKEA are the kind of possible disruptors in the future, as they have a lot of capital and data to leverage... not sure if that would happen... but our organisation is not into trends, such as living-as-a-service and other business models, we are a big company and we stick to what we do. (DT manager, ORG_2)

4.4. Theme 4: Added value result from Digitalisation in RE

Even though the uptake of digital technologies in RE seemed slow, participants spoke about two types of values that were added through digitalisation and the use of digital technologies.

4.4.1. New jobs were being created

Digitalisation added a number of new roles in RE organisations. Examples of these are BIM managers, data analysts, BI specialists, E-commerce software developers, agile project managers, among others. Data Analytics, AI, VR and Market Place (e-commerce) were growing fields where a number of roles are still being created, as found through interviews but also in the organisations' websites and LinkedIn job vacancy posts.

No job losses were seen so far: from the interviews I realised that there was no case of downsizing the RE workforce, which confirms the job creation aspect of digitalisation: while new technologies do replace some tasks, they are creating more work requirements.

Even though there are new roles being implemented, interviewees indicated that data analytics in RE was growing which emphasize the need for new processes to analyze data (and potentially use its outcomes), as remarked by participants:

Our organisation has hired an entire team of data scientists in the last year to make sense of the data we are collecting and need to be analyzed. (DT manager, ORG_1)

Our website (Market Place) has required a number of new employees such as data analysts and software developers to be build, but also to be continuously updated. (DT manager, ORG_2)

Data analytics for example allowed for gaining more insight from data for teamwork and interactions with other stakeholders, as the one BI specialist indicated:

Teams needed to grow and add new knowledge with external people that bring specific knowledge we need. (BI specialists, ORG_4)

New hires were not always young employees, but sometimes came from senior level in other organisations:

New hires, mostly seniors from more digital companies, bring in new digital skills such as software and processes and help us in digitalising as well. (DT manager, ORG_5)

4.4.2. Enhanced employees' experiences, due to a digital consumer experience

The moving of 'shopping experiences' to Market Place platforms, together with the implementation of VR technologies, is creating a digital customer experience that might obliterate the work of RE agents in the near future, since more and more information is available online, with upcoming chatbots that might be giving answers and sending files to new customers, and contracts are starting to be digitally signed.

This means the development of an all-encompassing digital consumer experience, which needs professionals capable of working on it. This theme was cited by some interviewees as follows:

Digital technologies have changed work production in teams, making it easier to share documents... but AI and VR will be the real game changers... repetitive tasks are being automated. (DT manager, ORG_1)

Online marketing and data bring possibilities to reach the customer better, while virtual reality models make sure consumers know what they are buying... we have people working on that. (DT manager, ORG_2)

The drive to technology is to work more efficiently, and the client experience... buyers use VR in our showroom to experience and make choices... our company has the teams with skills needed but also invest in training and make partnerships with software companies. (DT manager, ORG_4)

Customer journey is one of the pillars of our Digital Strategy, and it requires the use of VR to provide a digital experience... therefore the teams need to grow and get trained to add new knowledge. (BI specialist, ORG_4)

This enhanced digital consumer experience might obliterate RE agents' jobs in the future, as mentioned by some interviewees:

I see the work of the RE agent as less and less relevant since there is tendency of elimination of intermediaries in this market, and digital technologies can link prospective buyers directly to selling RE organisations. The agents will remain but in smaller capacity, in a more consultive role. (DT manager, ORG_7)

Probably in the future there will be the possibility of doing everything digital, without an agent, also because new generations rather do everything online. (Market and sales, ORG_5)

In the future I think more will be done online, although sometimes human contact is important, because it's a huge purchase and people have lots of questions, especially older people... so I'm not sure when and how this change will happen. (sales manager, ORG_3)

5. Discussion

In this section I discuss the research findings in relation to the research questions, starting out sub research questions 2 and 3 (sections 5.1 and 5.2) followed by the major research question in Section 5.3.

5.1 SUB, RQ2: How are digital technologies used in RE (PropTechs) impacting the work of this industry?

The following three clusters of digital technologies are currently impacting digitalisation and the FoW in the RE industry:

1. **BIM:** has been optimizing project development and construction of RE property for more than a decade. It provides the ability to virtually construct a building in 3D, increasing speed, efficiency and reducing waste, but it will be only as good as the people who use it (Hardin & McCool, 2015). As found through interviews, BIM requires the collaboration of all parties in the chain, using the same software and ways of working. Decisions need to be taken early on, making the project process less flexible, since making changes has a greater cost. Some employees have found it difficult to adapt to BIM especially older generation engineers who are used to more traditional, less standardized ways of working (see item 4.2.1). However, for some people interviewed it has expedited work, making it more efficient and interesting (item 4.2.3). BIM has created many jobs but this is apparently a finished process, since BIM is nowadays considered a standard information management model in the RE industry.

2. **Data Analytics and AI:** encompassing the work of data analysts, data scientists and business intelligence specialists that analyze market, consumer, economic and demographic data from different sources, this is currently a growing field in RE. As stated by Braesemann & Baum (2020) they make the core of PropTechs as they are receiving the most investments. These technologies enable a more innovative work and data-driven decisions. According to the interviews, Machine Learning algorithms are being applied to DA in order to make predictions about house buyers and how the prices will evolve (see item 3), besides property valuation. AI is also starting to be used in feasibility studies in all four organisations and in ORG_2 in upcoming chatbots. Since not all companies have these teams yet, many jobs will still be created. Although already a core field, there is still a lot of room to grow, as mentioned by Conway (2018). Vacancies are being filled by young new hires and some senior consultants coming from other, more tech-savvy, industries.

3. **Virtual Reality and Market Place:** these two technologies enhance the digital experience for the consumer and therefore also for the employees involved in their development. According to Wei (2020) with VR consumers only need a few minutes to know the whole situation of the property, making the process more relaxed and enjoyable. It also promotes the sale of RE, reducing the marketing cost. Although VR is available in the market for more than twenty years, it has not been much used. One interviewee claimed it's costly and not essential in such a fast-selling high demand market (DT manager, ORG_5). However, one organisation (ORG_4) is quite active with it for upselling (offering higher quality options during the selling process). Market Place, on the other hand, enables organisations to sell online for remote customers in a fast and seamless way. A very important value is that both technologies collect data from consumer preferences, helping organisations to become more consumer centric. As these trends pick up, the hiring of software developers and UX (user experience) specialists will be more and more essential. Work in general is becoming more analytical and innovative, interesting and less repetitive, therefore it is recommended that:

Proposition 1a: *A higher investment in Data Analytics roles may accelerate digital transformation and innovation in the RE industry through improved service delivery, and*

Proposition 1b: *The RE industry needs to broaden their existing scope of using digital technologies (AI, DA, VR and MP) to add more value through more innovative customer services to prevent falling more behind in terms of digitalisation and the FoW.*

5.2 SUB, RQ3: What are the main barriers for the implementation of digital technologies in the Dutch RE and how they prevent the DT of it?

Digitalisation in RE is difficult for a number of reasons. In this research I found that mindset and skill set are the two most relevant barriers to its digitalisation. The skill set is much easier to solve (mostly with training) while the mindset is a much more difficult. As mentioned by DeLisle et al. (2019), digitalisation is more about having the right mindset and new skillsets embedded in data science than about the technologies themselves. The need to change management style, mindset and culture have also been previously identified as the great challenge for the RE industry (Worzala et al. 2020).

Digitalisation needs employee's skills in working with digital tools, but also means a new way of working where, in the case of BIM, project decisions need to be taken right at the beginning, making some participants in the chain not very happy, as they have to abandon the old ways of doing things. There is quite some people who do not want to change and adapt to new technologies, mostly older employees but also younger ones (see 4.2.1), although most companies are providing training. Hence, it's still critical for leaders to recognize people's fears of the unknown and act upon it, emphasizing that DT is an opportunity for everybody (Tabrizi et al., 2019). Emotional capabilities are needed from employees and managers alike, in order to enable a learning and innovative environment (Akgün et al., 2007; Akgün et al., 2009).

For digitalisation to evolve into DT, C-level leaders need to be engaged on it, and have a more innovative and disruptive mindset, in order to create new business models (Von Tonder et al., 2020). This is not yet found in the Dutch RE industry, as interviewees mentioned that their organisations are digitalising only to 'stay up-to-date' (see 4.3.2). This fact confirms the traditional mindset of the industry and explains its slow adoption of new technologies. This slowness is reflected in the speed of job creation: although many new roles are being opened, this process could be faster and more structural, therefore:

Proposition 2a: *Digitalisation requires a tech-savvy mindset from employees to embrace the new innovative digital technologies and work in more innovative ways.*

Mindset is a barrier affecting employees' adoption of digital technologies, as training has been provided by organisations to update their skill set. However, a tech-savvy mindset is also needed from leadership, to promote an innovative culture willing to disrupt the industry, instead of waiting for being disrupted. Therefore, it is concluded that:

Proposition 2b: *DT needs a more disruptive mindset from the C-level leaders, indicating a higher preparedness to take risks that require changes in current business models.*

5.3 MAIN RQ: How can DT add value in the FoW in the RE industry, a traditionally slow adopter of technologies?

Digital technologies can add value in the FoW of RE in a number of ways. According to interviewees, digital technologies can transform the RE industry significantly as they accelerate and optimize work, improve operational processes, make work faster, contribute to less cost, thus representing a more efficient way of working. It also reduces human mistakes and makes work more interesting (see 4.2.3), changing stakeholders experiences in a positive way. These findings confirm the literature background which state that digitalisation improves operational processes and enhances customer and employee experiences (Berman, 2012 in Morakanyany et al., 2017) and as a consequence transform the way organisations operate (Morakanyany et al., 2017), increasing productivity and value creation (Matt et al., 2015). Another important value add of digitalisation is that it has opened many new jobs in the RE industry (item 4.3).

As mentioned in the literature, more use of digital technologies can relieve workers of repetitive and mundane work meaning that more time can be spent on meaningful work, like evaluating business models or developing new service lines (Baum et al., 2020). In RE they liberate people from tiresome tasks such as having to generate a number of different housing development schemes and then calculating their profitability one by one, or having to answer e-mails and phone calls to give the same information that can be given by a chatbot, which are getting progressively better with NPL (natural language processing), although it seems there will still be a point in which human interaction is needed (Conway, 2018). There is no mentioning of diminishing of workforce because of that, although the work of the RE agents might be at risk in the coming years (see 4.4.2) due to the enhancement of the digital consumer experience. With the use of Data Analytics and AI, teams have more data to analyze and base their decisions on. Therefore, digitalisation has increased the analytical potential of firms, generating new work.

Digitalisation also enables a more customer centric form of organisation, inducing business model adaptations, as seen in two organisations (ORG_2 and ORG_4, which are using Market Place and VR), which are generating new value propositions for the customers, which are more digital, enabling companies to grow as they innovate, thus becoming more competitive. Therefore, digitalisation is also confirmed as a prerequisite to stay up to date in an environment where consumers are expecting a digital experience (Nowik, 2018). My findings show that the adoption of a few digital technologies in the Dutch RE has liberated employees from repetitive tasks, allowing them to focus on more creative and innovative work. I have also confirmed with interviewees that digitalisation puts forward new forms of interactions with customers (Matt et al., 2015). It is important that the Dutch RE industry adopt more digital technologies therefore:

Proposition 3: *The adoption of more digital technologies in the Dutch RE may significantly add value to the future of work in this industry, making it more efficient and interesting, and creating a number of new innovative jobs.*

6. Conclusions, Implications, Limitations and Recommendations

The conclusions of this research can be summarized in three statements: (i) the ongoing digitalisation of the Dutch RE has accelerated and optimized the work, made it more interesting for employees, and added a number of jobs, (ii) virtual reality, market place and AI tools are emerging technologies

which are changing the customer and employees experience, making it more digital, and have the potential to disintermediate the work of RE agents, (iii) the conservative mindset of C-level leaders is the main barrier for a faster and more radical DT in the Dutch RE industry.

A rival explanation could be that C-level managers are interested in disrupting the market through DT but are incapable of doing so since they do not possess the capabilities needed for switching existing RE business models. In the scope of this research, we cannot verify their capabilities, although by interviewing their managers responsible to digitalisation there was never any hint of such a scenario. Therefore, it seems plausible to generalize that C-level leaders of the Dutch RE industry do lack a disruptive mindset, instead of business model innovation capabilities.

I have found that digitalisation in the Dutch largest RE organisations is still in a maturing stage. Although it adds value to organisations its implementation is not easy due to a number of barriers, but mainly because of the need of a tech-savvy mindset. Unless the C-level leaders are convinced about the need of DT and start innovating more radically, the door is open for more ambitious disruptors that could shake up the market and force them to adapt to the new reality, just like Airbnb did in the hospitality industry, without owning any physical assets.

6.1 Limitations of this Research

This research was conducted with four of the largest RE developers positioned in the Dutch residential sales market and four large organisations that were added as complementary data sources – three focused on the rental market, one for commercial units and two for hospitality, and one of the Big Four accounting organisations involved in DT. This made it possible to arrive at a broad understanding of digitalisation in the Dutch RE industry and derive valid and reliable conclusions.

However, it was not possible to include an organisation focused on the residential rental market or middle and small size RE developers (SME) to verify if they were more innovative than the large market players, due to the timeframe of this research. In this case I have conducted online research and found none of those having a digitalisation manager, anyone responsible for advanced analytics or any kind of innovation manager. In this way I consider that this multiple case-study research is well generalizable for the Dutch market, bringing a good picture of its current state of digitalisation.

Nevertheless, this research outcomes cannot be generalizable to other countries, as the Dutch urban development is a state-led process, mainly composed by large projects initiated by the municipalities, contributing for the long timeframe of development (around 20 years) and the imbalance between supply and demand which puts the RE developers in a comfortable position where little innovation is needed.

6.2 Recommendations for Future Research

As avenues for research, I recommend future professionals and students to undertake comparative analyses with regards to how DT is being implemented in certain industries but in different countries, as I acknowledge that the Dutch RE is very much state-led and this is one of the causes of the disproportion between supply and demand that ultimately diminishes competitiveness in the RE industry and puts companies in a comfort zone where there is limited innovation and risk taking. It

would be interesting to see other countries, where urbanization is market-led, how digitalisation of RE is evolving. I also recommend future studies to take place within five year's time, when AI, VR and Blockchain technology might have picked up and possibly some job losses might be seen.

6.3. Recommendations for the Practice

During this research I had the opportunity to speak to many inspiring managers in charge of digitalisation but some of them were not entirely satisfied with the speed of change, which affects their motivation. C-level executives need to create a more open culture for innovation, but this is not always happening, as leaders are sticking to traditional ways of thinking and working. Emotional capabilities and flatter organisational structures are also needed to enable collaborative learning in order to speed up innovation in the RE industry.

My recommendation for the two organisations which don't have a Digital Strategy yet, is to develop one as soon as possible. I also recommend that all four case organisations set up an independent start-up to develop RE projects in a more radical and digital way. Being owned by larger organisations, they can benefit from access to capital and personal connections of the parent company, but at the same time being free from the old habits and mindset of the larger company. These start-ups should focus on the rental market, where a number of analytics and IoT technologies can be implemented, and look for opportunity in international markets, as a way of testing ideas in another context, and then bringing back these solutions to test in the Netherlands.

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Annex: Interview Protocol

For every research I started explaining the research, ensured confidentiality, asked for permission for recording and stated that I would send the transcribed interview by e-mail, asking for their final checking. I thanked for their participation and asked them to start by telling me about their role in the organisation. Then I continued to the interview questions:

1. Regarding the business model: does your company develop property to sell or to rent out? In which segments? And in which countries are you operating?
2. How does your organisation understand digitalisation or DT, what does it consist of, in your organisation? What activities does it entail there?
3. Does your company have a Digital Strategy (Deloitte, 2021), where you list goals, something that it wants to achieve? On paper only or actually implemented?
4. What drives digitalisation?

Follow-up: Do you think the good economic situation of the Dutch market has any effect in the implementation of new technologies? (Klee, 2021) Is the Dutch RE in a comfort zone?

5. Is there any difficulties in digitalisation / DT, in respect to the implementation of technologies? (Braesemann & Baum, 2020) Anything that generates frustration? Or resistance?
6. Would you say your organisation is data-driven (Worzala et al. 2020)? Can you give examples?

7. Does digitalisation / DT, and the implementation of new digital technologies, have an impact on the cost of buildings?
8. Does sustainability or energy efficiency have anything to do with digitalisation? How?
9. Does your organisation have the teams and skillsets (DeLisle et al., 2019) to enable digitalisation? How does the company solve the HR issue?
10. Do you think that exists a mismatch between the timeframe of RE projects and the timeframe of technology implementation? (Nowik, 2018) Why?
11. Do you see any changes in the way your company has been operating due to digitalisation?
12. Is there an speeding up of digitalisation because of COVID (Mohanta et al. 2018) and work from home?
13. Are there any trends in RE technology you see coming? Maybe from other countries or competitors? Follow-up: Blockchain technology? Something else?
14. How has digital technologies changed your work? Can u give examples?
15. How do you think your work will change five years from now?
16. Do you think anything from your work, any tasks, can be in the future substituted by AI applications? How can you harness tech to make your work better?