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Faculty of Business Economics

Master of Management

Master's thesis

Decoding Disruptive Innovation: A Case of Early-Stage PropTech Developments

Nicolas Hawa

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

SUPERVISOR :

dr. Relinde COLEN



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Thank you!

Summary

In an ever-changing competitive market, even well-established firms are prone to disruption. The effects of disruptive innovation on incumbent firms have been exhaustively researched and studied by Christensen (1997), Schmidt & Druehl (2008), Danneels (2004), Larson (2016), and many others. However, few researchers have discussed how incumbents can navigate through disruptive innovation. For instance, the sensing method is the first step into recognizing and exploiting disruption. Literature by Calia, Guerrini, & Moura (2007), Bonzom & Netessine (2016), and Cruz-Sanchez et al. (2020) introduce the different sensing mechanisms. Furthermore, Guo, Pan, Guo, Gu, & Kuusisto (2019), Anthony, Johnson, Sinfield, and Altman (2008), Cooper, Edgett, & Kleinschmidt (2002), and Weinreich, Şahin, Inkermann, Huth, & Vietor (2020) introduce multiple ways for incumbents to seize the disruption through innovation evaluation and creating an innovation portfolio. Finally, Teece (2007), Porter (1980), Charitou and Markides (2003), Banker, R. D., Wattal, S., & Plehn-Dujowich, J. M. (2011), Tushman and O'Reilly III (1996), and Bles, J., Kemp, R., Maas, J., Mosselman, M., & May, Z. (2003) thoroughly discuss the transformation and reaction to disruption phase of the incumbents.

This study aims to identify the potential disruption of PropTech onto the construction and real estate industry and the challenges that incumbent firms experience within PropTech. As such, a research question was proposed: "how can incumbent firms recognize and prepare for disruptive innovations?" In other words, this thesis also aims to uncover the mechanisms that incumbents undertake in order to recognize and avoid disruption.

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Introduction

General Information

Innovation has long been considered one of the most important enablers of economic growth (Chandy & Tellis, 2000). Scholars such as Kumar, Scheer, and Kotler (2000) described innovation as something that is newly created and has commercial success. In 1995, Joseph Bower and Clayton Christensen wrote about disruptive innovations, a phenomenon by which a novel idea, formed in a niche market, viewed as an unattractive product or service to many well-established organizations, can, through time, redefine and transform the market with a more convenient, easily accessible and affordable product (Christensen, 1997).

When Bower and Christensen (1995) studied successful companies whose fortunes declined, they discovered that while these companies were qualified to offer cheaper products, they declined to do so. Later they were overtaken by companies that initially offered inferior products that were not appealing to customers from the high-end market segment (Bower & Christensen, 1995; Gilbert, 2005; Henderson, 1993).

Moreover, in their article "*The Incumbent's curse*," Chandy & Tellis (2000) explained that incumbent firms are hooked on their success and bureaucracy. They fail to introduce new innovations and become stagnant. Adding to that, the theory of disruptive innovation revolves around companies that innovate and allocate the majority of their resources to their mainstream products and technologies in order to keep retaining their most profitable and existing customers (Rasool, Koomsap, Afsar, & Panezai, 2018). More so, incumbents like Kodak, Xerox, and Blockbuster have become almost non-existing due to disruptive technologies and innovations.

Since the introduction of disruptive innovation, several studies have underlined the importance of disruptive innovation as (1) an inevitable process for better products and services, (2) a change of the entire process within industries making branded products or services redundant, as well as, (3) a process that requires the maximum use of a firm's dynamic capabilities (Chandy & Tellis, 2000; Charitou & Markides, 2003; Christensen, Raynor, & McDonald, 2013; Denning, 2016).

That being true, some studies suggest different actions and reactions to exploit disruption. For instance, one study suggested that incumbents should wait and not act, while closely observing the market for an opportunity to acquire the start-ups with disruptive potential (Christensen & Raynor, 2013; Christensen & Overdorf, 2000). Another proposed recommendation argues that incumbents should consider an ambidextrous approach. While the company's core focuses on sustained innovation, a separate unit can compete with the challenging needs of the market by exploring disruptive innovation (Assink, 2006; Kim and Mauborgne, 2005). Unlike sustained innovation that focuses on mainstream customers and improving existing products (Govindarajan & Kopalle, 2006), disruptive innovation targets new markets and, most often, non-customers (Assink, 2006).

While the literature has formulated some recommendations, it has highlighted the difficulties for incumbents to follow these recommendations and react to disruptions. Also, in practice, new cases of incumbents failing to react to disruption are still emerging. One example is property technologies. Better known as PropTech, the technology-enabled innovation services in the construction and real estate industry have been following the same growth trajectories (Braesemann & Baum, 2020). A survey of 270 real estate professionals done by KPMG (2018) indicated the potential disruptiveness of PropTech. The study shows that while 97% of these real estate professionals believe that technological innovation will impact their business, only 30% of the existing incumbents say they have invested or plan to invest in PropTech start-ups. Moreover, according to Clayton et al. (2019), PropTech has been altering all aspects of the real estate business, including financing, investing, construction, building and property management, and data collection.

Considering the lack of innovation in the real estate and construction sector (O'Brien, 2020), the lack of corporate adoption or investments in PropTech, and the rise of the property technology trends in the industry, a disruption in the market is bound to happen.

Research Question

Therefore, in order to fill the gap between the threat of disruption and exploiting potential disruptive innovation, this thesis aims to introduce multiple ways incumbents can recognize and prepare for impending disruptive innovations. Hence, the research question "how can incumbent firms recognize and prepare for disruptive innovations?" was raised.

Research Methodology

The empirical study is threefold and consists of a case study of PropTech in Belgium. First, I will rely on a set of secondary data from PropTech Lab (Belgium) to analyze the areas of high start-up activity in the PropTech ecosystem in Belgium. Then, I will interview 3 PropTech venture capital firms in Belgium and 6 well-established incumbent firms to uncover the triggers, incentives, and readiness to invest in PropTech disruptive innovation.

Brief Findings

By comparing the perspective of the incumbents with that of venture capitalists, the study has generated new insights on incumbents' (in)ability to recognize and react to disruptive innovations.

Due to the dynamic and competitive characteristics of the real estate and construction industry, incumbents cannot afford to lose time on their innovation transformation. The interviews suggest that corporates aiming to invest in PropTech solutions have different methodologies to scan for new technologies. For example, a strong industry network, investing in VC funds, as well as, joining

innovation ecosystems that would lead to direct engagement with startups would provide the well-established organizations a reliable source of information for upcoming trends. Additionally, the thesis also presents different ways to evaluate PropTech Startups. For instance, many VCs and corporates begin their assessment by evaluating the startup's team, product, and market readiness. Then, along with other evaluation criteria, incumbents also evaluate the potential commercialization of the product. On the other hand, there remains a struggle for incumbent firms to keep investing in PropTech innovation. The main reason is, many firms find it challenging to translate these costs into profit, the lack of clarity, and unclear ROI.

Finally, this paper shows that in the coming years, the VCs and the incumbent firms will be investing in ESG-enabled innovations, sustainability-enabled innovations, and PropTech innovations that would help incumbents reach the EU's Green New Deal targets.

Chapter 1. Innovation

1.1 Introducing Innovation

Innovation is not a new phenomenon. Academics Rosenberg and Landau (1986) labeled innovation as a process of transforming an invention and making it economically more important than its original form. Innovation has also been dubbed one of the most essential factors for competitive advantages (Urbancova, 2013). Bower and Christensen (1995) explained that innovation is when a firm identifies a customer's need and creates a product of value by solving a problem or reacting to competition in the market. While innovation is desirable in every organization, it is difficult to create or sustain due to technical, commercial, and regulatory uncertainty, extensive research and development costs, as well as spillovers and ubiquitous problems (Pisano, 2019).

Additionally, discovering new solutions to problems can be complex and complicated. According to Satell (2017), to better understand the problem that needs solving, management should consider asking two fundamental questions. First, "how well is the problem defined?" and second, "who is the best at solving that problem?". Consequently, Satell (2017) follows up the questions with an innovation matrix that categorizes innovation in four quadrants: Basic research, breakthrough innovation, sustained innovation, and disruptive innovation.

The first type in the quadrant, basic research, is where research departments and academic partnerships lie. An innovation is searched for when the problem and the domain are not well defined (Satell, 2017). For decades, firms that do not have the resources to search and develop novel ideas have turned to universities and research centers for access to scientific, engineering, and innovative minds (Lutchen, 2018). Second, breakthrough innovation, an innovation that is created when the problem is well defined but is hard to solve (Satell, 2017). Such innovations are researched and developed through open innovation strategies and other methods of collaborations that have been described in detail through Pisano and Verganti (2008) the innovation mall, innovation community, elite circle, and consortium framework. The third quadrant, sustained innovation, seeks to improve

existing products rather than develop novel ones (Satell, 2017). Through standard research and development labs, corporate venturing units, and mergers and acquisitions, well-established firms usually cultivate this type of innovation internally.

The final quadrant is disruptive innovation. A reinvented technology or business model that generates new values, markets, and industries. Bower and Christensen (1995) described disruptive technologies are inventions that initially underperform established ones in serving the market but eventually replace the existing ones.

1.2 Disruptive Innovation

Clayton Christensen first presented the theory of disruptive technologies in 1997. He explained the phenomenon by which a novel idea, formed in a niche market, viewed as an unattractive product or service to many well-established organizations, can, through time, redefine and transform the market with a more convenient, easily accessible, and affordable product (Christensen, 1997). Initially, disruptive inventions only satisfy one well-defined market segment with minimum requirements below the mainstream market. Thus, incumbents, on the mainstream performance metric or higher, consider the technology unsuitable. Disruption can happen in two different ways. Incumbents may overlook segments in the market where entrants may target an inferior product to the well-established organization. Otherwise, entrants may create markets where no market exists and transform non-customers into paying customers (Hopp, Antons, Kaminski, & Salge, 2018). The latter has been labeled a blue ocean strategy (Kim & Mauborgne, 2005).

The term disruptive innovation can also be misunderstood. Notwithstanding the ubiquity of disruption, the classification of disruptive innovation can be complex and complicated to senior managers (Schmidt & Druehl, 2008). Furthermore, research by Anthony (2005), Christensen (2006), and Danneels (2004) helped categorize disruptive innovation. However, the three classifications by Schmidt and Druehl (2008) are more widely used: (1) low-end disruption, (2) new-market disruption, and (3) disruptive innovation. They are also presented below in table 1.

Low-end disruption refers to a new product or service that enters the low-end market segment and serves the "good enough" customers (Larson, 2016). Generally, low-end disruption companies are firms that focus on lower profit markets. In their article, Charitou and Markides (2003) denoted the example of low-cost airlines against traditional full-service airlines, as low-end disruption. Adding to that, in 1999, 62 million passengers accounted for 23.2% of the market share flying with low-cost carriers, most remarkably AirTran Airways, JetBlue, and Southwest Airlines. Almost 10 years later, that number increased to 119 million passengers (Tan, 2016).

However, new-market disruption occurs when new businesses target non-customers (Larson, 2016). This disruption usually creates new categories and new industries (Sampere, 2016). According to Schmidt and Druehl (2008), this category can be sub-categorized into two sections. For instance, Bower and Christensen (1995) presented a fringe-market low-end entry, discussing the disruption

of the 5.25-inch hard disk from a fringe-low end market relative to the 8-inch hard disk. In 1985 when the 8-inch hard disk was the conventional technology, their primary high-end market segment was the mainframe computers (Schmidt & Druehl, 2008). While the smaller hard disks offer less storage capacity, they still paved the road to new personal computers and laptops (Bower & Christensen, 1995). The second section is the detached-market low-end entry, better known as the blue ocean theory. This philosophy refers to a business that creates a whole new market that erupts from the stronghold of the competition (Kim & Mauborgne, 2014).

The blue ocean phenomenon introduces 3 types of non-customers that can be influenced into becoming potential customers (Kim & Mauborgne, 2005). The first-tier, the "Soon-to-be" non-customers, sit on the edge of the market. They are potential buyers waiting to leave the market as soon as a better opportunity arises. The second-tier customers have been aware of the product or service but consciously refuse to engage. However, it is an unexploited segment waiting to be engaged. The third and final tier are the non-customers. These individuals have never thought of the product or service offering because their needs have been aligned with other alternatives (Kim & Mauborgne, 2005).

These 3 categories explain why disruptive innovation is a process whereby new entrant firms challenge incumbent businesses for a piece of the market and then, with time, successfully render the existing product obsolete and effectively become the conventional technology (Christensen, Raynor, & McDonald, 2013). Precisely, disruptive innovation has been exhaustively assessed through the works of (Anthony, 2016; Christensen, 2006; Clark, 2003; Gebremeskel, Tesfaye & Nguyen, 2012). For instance, in 1981, Kodak sales hit \$10 billion, but the competitive pressure was rising from other Japanese brands such as Fuji and digital photography (Gavetti, Henderson, & Giorgi, 2005). By the year 1997, the sales of digital cameras increased 75%, and by the year 2001, the sales of the analog cameras dropped (Lucas Jr & Goh, 2009). This resulted in Kodak keeping just 20% of their employees.

Type of Disruptive Innovation	Type of Diffusion	Description	Example
Low-End Disruption	Immediate low-end entry	Low-end entry begins directly when the new technology is introduced.	Low-cost airline relative to full-service airlines

New-Market Disruption	Fringe-market low-end entry	Before entry begins, buyers of the new market would have bought existing products if only the old ones were less expensive.	5.25-inch relative to 8-inch disk
	Detached-market low-end entry (Blue Ocean)	Before entry begins, this new market is detached from the current market that price reduction of the existing product would not have attracted the new customers to buy it.	Yellow-tail wine relative to traditional win
Disruptive Innovation	Low-end entry	The new product enters the existing low-end market and then diffuses upward to take over high-end products.	Digital photography relative to film photography

Table 1 Categories of disruptive innovation, inspired by (Schmidt & Druehl, 2008).

What these cases and several more studies of firms that have lost their competitive advantage have in common that disruptive innovations share specific characteristics (Bower & Christensen, 1995). First, they present different products or services, attracting new customer segments (Christensen et al., 2013). Second, disruptive innovations start as small businesses with low margins (Charitou & Markides, 2003). Third, in time, firms that introduced these disruptive innovations will grow to capture a large piece of the market, displacing the mainstream technology from the market (Adner, 2002).

Chapter 2. Disruption Threats and Incumbent's Perspectives

2.1 Threat of Disruption for Incumbents

When considering the three categories of disruptive innovation, another similarity is remarkable: the reaction of the incumbents. Since disruptive innovation stems from the strategic role of focusing on the interest of customers (Hopp et al., 2018), incumbents tend to concentrate on sustained innovation (Christensen et al., 2013) and choose to allocate some of the company's investments toward improving existing technologies rather than venturing into disruptive innovation.

When incumbent firms, in an industry, focus on improving the quality of their products (sustained innovations), they tend to overlook the gap created for entrants that introduce disruptive technologies in less-profitable segments (Christensen, 1997). Over time, the newcomers improve their products on a disruptive trajectory and move up the market (Danneels, 2004). As research and development evolve and investments are made into the innovation, the innovation's technology matures, and its performance improves to a point where it can fulfill the market's requirements (Danneels, 2004). Therefore, disruptive innovations become market-dominant products and tend to replace the incumbents as the mainstream technology.

More so, established firms are reluctant to introduce disruptive innovations due to a perception of low rewards and incentives (Chandy & Tellis, 2000), investments in short-term projects, poor planning, bureaucracy routines, and above all, traditional organizations tend to stay close to their customers (Bower & Christensen, 1995). Put differently, since incumbents are more customer-oriented, they tend to be hesitant in long-term project investments that do not represent clear short-term profitability.

Christensen and Raynor (2013) identified four essential elements that characterize incumbents across the theory of disruptive innovation: (1) incumbents are improving along two performance trajectories, (2) incumbents who usually focus on sustaining innovation often surpass customer needs, (3) incumbents have the ability to respond to disruption, but they fail to make the most out of it, and finally (4) incumbents struggle as a result of the disruption.

First, in their book "*The Innovator's Solution*," Christensen and Raynor reason that incumbents are getting better along a technology trajectory. The theory suggests that despite the customers' change of demand over time, two different performance trajectories co-occur (Christensen et al., 2018). As shown in Figure 1, one trajectory addresses the rate of product improvement for which consumers can use, while the other tackles the rate of product and service innovation improvement. As a result, when well-established firms overperform the market, they leave a gap at the bottom for new entrants to undertake.

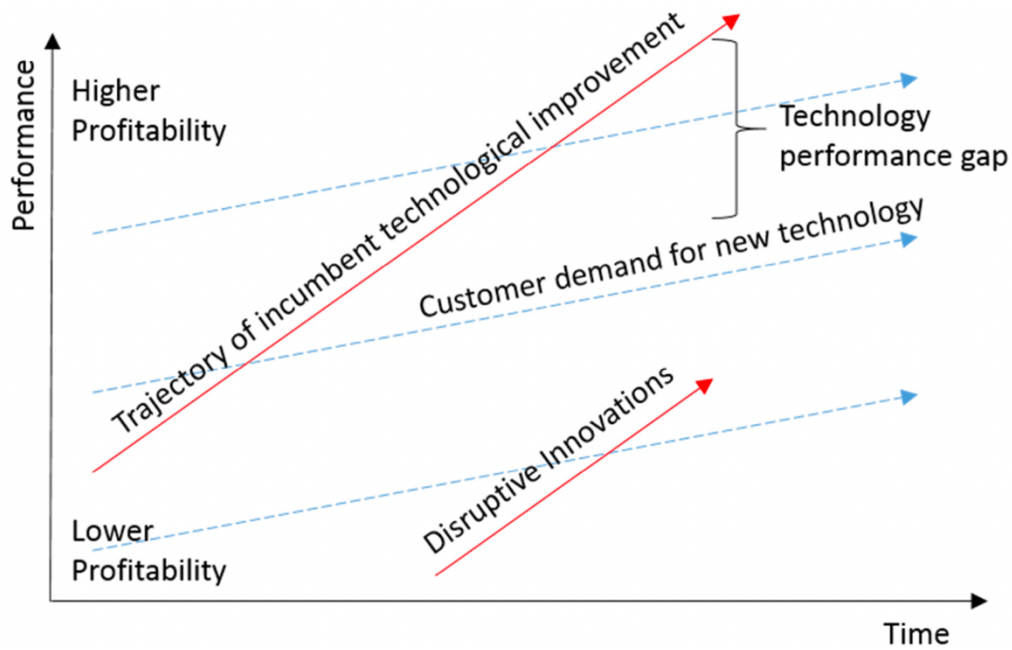


Figure 1 From Christensen, C. M., McDonald, R., Altman, E. J., & Palmer, J. E. (2018). *Disruptive innovation: An intellectual history and directions for future research*. *Journal of Management Studies*, 55(7), 1043-1078.

Second, there is an expected unique trajectory of improvement in every market provided when innovative companies introduce new technologies (Christensen & Raynor, 2013). Such an improvement trajectory is the result of sustained innovation. Managers usually focus on fulfilling their customer needs that bring-in high-margin profits to their current business. Nevertheless, they are narrow-sighted about the threats that might arise from low-end customers or new markets. In other words, incumbents along the sustained innovation trajectory predominantly overshoot their customer needs (Christensen & Raynor, 2013).

The third element of Christensen and Raynor’s theory is that incumbents possess the capability to respond to disruptive threats but fail to exploit them. They argue that entrants with disruptive innovations almost always avoid competition as they target new and low-end market segments. Particularly, Christensen and Raynor note that competitors enter the market with products and services that are “good enough” as those currently available. While these products and services are less expensive and more convenient, they are inferior to existing products based on sustained innovation, which the incumbents have to offer.

The last crucial element of disruptive innovation is that incumbents struggle to catch up and eventually fail due to the disruption. In his *“The Innovator’s Dilemma,”* Christensen asserts that the disruptors that fill the gap created in the low-end market will eventually take over the current products and services in the existing markets and “ultimately crush the incumbents” (Christensen & Raynor, 2013).

Hence, what is evident with the emergence of disruptive innovations by new entrants in the market, is that current technologies have the tendency to render obsolete (Kostoff, Boylan, & Simons, 2004). More so, incumbents who floundered to maintain their leading positions in almost every industry

were unsuccessful in recognizing early disruptive innovation and failed to sense the nonobvious problems that need to solve in the future. For this reason, Christensen and Raynor (2013) argue, to stay away from disruption, incumbents should consider innovation a necessity rather than an option and a warning rather than a prediction (King & Baatartogtokh, 2015). In other words, an array of research by Blee, Kemp, Maas, Mosselman, and May (2003), Bonzom and Netessine (2016), Charitou and Markides (2003), Cruz-Sanchez, Sarmiento-Muñoz, and Dominguez (2020), O'Reilly III and Tushman (2013), D. Teece, Peteraf, and Leih (2016), and Wood, Pfothenauer, Glover, and Newman (2013), suggest a diverse set of strategic innovation approaches that can prepare incumbents for disruption. Strategic innovation is defined as a strategic revolution in a company's business model that results in a new way of facing innovation competitiveness (Schlegelmilch, Diamantopoulos, & Kreuz, 2003).

2.2 Preparing for Disruption: The Perspective of The Incumbents

A disruption process necessitates incumbents to identify and manipulate technologies and market opportunities (Cruz-Sanchez et al., 2020). To do so, established organizations must understand future technologies and build on their own competitive advantage and dynamic capability (Assink, 2006). The term "dynamic" refers to the company's continuous-adapting character with its external environment, while "capability" stresses the strategic role in finding, adjusting, and incorporating internal and external resources, skills, and functions in a competitive market (Teece & Pisano, 2003).

Allowing for dynamic capabilities to integrate into disruptive innovation has been framed by Cruz-Sanchez et al. (2020) in three categories: sensing, seizing, and transforming. More so, companies need to undergo a sensing approach of the external environments for potential trends and possible disruptions (Assink, 2006). Once the technological innovation has been identified, incumbents should organize their resources to address the recognized opportunities and capture their value (Teece et al., 2016). When that is completed, established organizations should "break conventional modes of thinking" and allow for constant change and transformation (Teece et al., 2016). Even so, dynamic capabilities govern the change in the incumbents' capabilities and require long-term commitment (Drnevich & Kriauciunas, 2011). They are crucial in scanning disruptive innovation, responding to transformational shifts, integrating the new technologies into the business, and responding to disruptive innovation (Karimi & Walter, 2015).

2.2.1 Sensing

To survive hypercompetitive environments, sensing technologies and customer demand transformations are essential for established firms to allow disruptive innovation (Teece et al., 2016). Moreover, Christensen (2003) offered evidence that incumbent firms lost their leading positions by staying close to their customers. For that reason, building on the theory of dynamic capabilities, it is crucial to establish an understanding of the market (sensing) and to identify the opportunities for disruption in both the new markets and the low-end market segments (Cruz-Sanchez et al., 2020).

Such actions will also help incumbent firms gain a competitive advantage in competitive markets through sensing for novel technologies and changes in customer demands.

Furthermore, sensing means collecting and sorting information from external environments (Kump, Engelmann, Kessler, & Schweiger, 2019), and according to Teece (2007), sensing involves scanning innovations, marketplaces, customer demands, and technological developments. That is true because, on the one hand, established firms can exploit disruption in new markets that they had no knowledge or access to, whereas, on the other hand, identifying advancements in existing technologies can generate new product and service values that can be easy to use, cheaper, and accessible to more customers (Cruz-Sanchez et al., 2020).

In that account, Meyer and Marion (2010) emphasize that incumbents should be more alert to survive disruptive technologies. One way by which organizations can scan potential innovation and be aware of future trends is through innovation networks (Calia, Guerrini, & Moura, 2007). As described by Gilbert, Ahrweiler, and Pyka (2014), innovation networks are a way where organizations such as academia, research centers, innovation campuses, corporates, small-to-medium-sized (SME) companies, public authorities, and venture capitalists interact for the purpose to "exchange and generate knowledge."

An excellent example for sensing can be universities as a source of information (Cruz-Sanchez et al., 2020; Dooley & O'Sullivan, 2007). Another source of information, as stated by Cruz-Sanchez et al. (2020), is being aware of the activities and investments made by the competitors in the industry, as well as suppliers.

Another form of sensing is startup engagement. This win-win situation between a corporation and a startup has been recognized as a quick and reliable source of innovation information (Bonzom & Netessine, 2016). Well established firms have eight fundamental ways to engage with startup companies: (1) Mergers and acquisitions, (2) investments, (3) spin-offs, (4) accelerators and incubators, (5) events, (6) support services, (7) startup programs, and lastly (8) co-working space (Bonzom & Netessine, 2016). Adding to that, it has been identified in the same report that 52.5%, or 262 out of 500, of the world's biggest public companies, are working with startups (Bonzom & Netessine, 2016). The most common interaction is through corporate venture capital, which is used by 73.5%, 68 out of 100, of the top companies (Bonzom & Netessine, 2016).

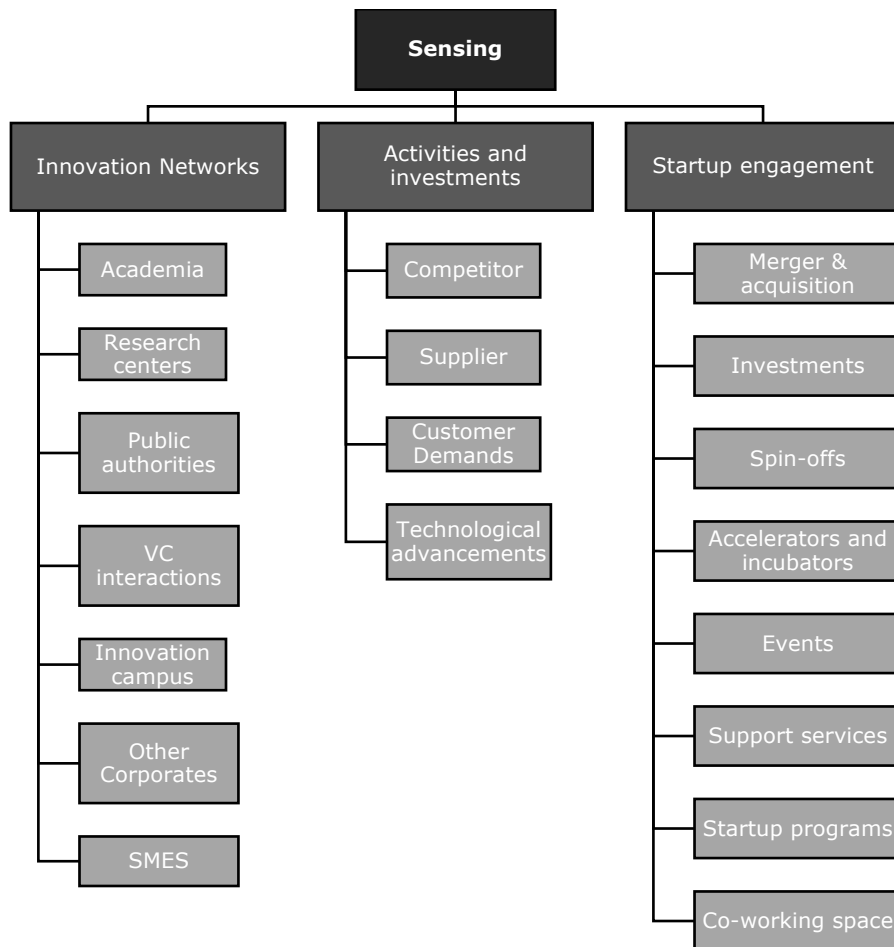


Figure 2 Sensing activities incumbents can perform to scan for potential disruptive innovation.

2.2.2 Seizing

While sensing represents the incumbents’ capabilities to identify, scan and sense early disruption in the industry, seizing, on the other hand, is the response mechanism by established organizations that involves a strategic, long-lasting “irreversible” investment as a reaction to a potentially disruptive threat (Helfat & Peteraf, 2015). Additionally, Prasetya, Fontana, and Afiff (2018) explain that seizing is crucial to an incumbent’s compatibility to ride a disruptive innovation wave.

Moreover, Prasetya and Fontana (2016) explain that firms should overcome the fear of failure in order to make an irreversible investment and seize the opportunity. Teece (2007) explains that seizing an opportunity makes the long-term decision to move from sensing to transforming. More so, Charitou and Markides (2003) reason that the incumbent’s readiness to respond to disruptive innovation is through evaluating their motivation and ability to respond to disruption. Fundamentally, in order to seize the potential of disruptive technology, in the low-end market segment, Cruz-Sanchez et al. (2020) argue that incumbents should be confident that (1) the good-enough innovation would satisfy the low-end customer segment, (2) they can generate eye-catching incentives from low price rates, and (3) the novel innovation is disruptive to all incumbents in the industry. In addition to these critical factors, incumbents should also evaluate their internal and

external dynamic capabilities to assess whether the innovation is aligned with their innovation portfolio and can respond to disruptive innovation.

2.2.2.1 Evaluating

A good assessment of the disruptiveness of an innovation during the early stages can decrease or block likely failures of well-established firms (Guo, Pan, Guo, Gu, & Kuusisto, 2019). More so, in the case of disruption innovation, the fundamentals of successful strategies lay in evaluating the organization’s ability to respond and being motivated to respond (Charitou & Markides, 2003). More so, Brad, Murar, and Brad (2016) emphasize that if incumbent firms can identify and evaluate disruptive technologies before entering the market, managers could transform these potential disruptions into opportunities. As for Charitou and Markides (2003), an established firm can be motivated to respond to innovation by two different factors, the threat of the innovation to the incumbent’s business and the rate at which the innovation is growing.

With that in mind, Guo et al. (2019) reason the use of technological features, market dynamics, and the external environment as the three dimensions to gain quantitative information for evaluating disruptiveness. The technological feature, such as integration, leadership, maturity, diffusivity, and the simplification of the technology, play a fundamental role in the disruptiveness of the innovation. At the same time, market dynamics such as niche market, value network, and cost reduction are essential to evaluate where, when, and how effective will the potential disruption occur. Furthermore, the external environments such as macroeconomic factors, legislation, regulations, and public policies are critical factors to potential disruption evaluating adherence to public safety and public standards. Table 2, highlighted by Guo et al. (2019), summarizes all the categories.

Category	Indicator	Definition	Explanation
Technological feature	Integration	The level at which the innovation merges with existing products/services.	Innovation with a higher Integration rating means the innovation can be more easily introduced or adopted. A higher Integration rating also means less future development is required. This has built on the existing measures proposed by Govindarajan and Kopalle (2006)

Leadership	Potential developments, utilization, and applications to new products.	This measures the potential of adopting related technologies and the possibility of fostering related markets. Walrave, Talmar, Podoyntsyna, Romme, and Verbong (2018) reason disruptive innovations are considered and developed by business ecosystems.
Maturity	Maturity and reliability of the complementary products or services or the related infrastructures during the early stages.	Complementary technologies, markets, and related infrastructures are vital in adopting and commercializing innovation. Dijk, Wells, and Kemp (2016) illustrate that the innovation's lack of supporting infrastructure for electric vehicles could be compromised.
Diffusivity	Easiness to diffuse the product or service among users.	This measurement evaluates how strong the innovation can spread into the market. According to Hang, Chen, and Yu (2011), a strong diffusion into the market is a crucial feature of disruptiveness.
Simplification	Improving the satisfaction of users through simplified technologies.	The easier the technological advancement is, the more desirable a product or service to the target customer. Keller and Hüsigg (2009) state that simple products are more in favor of users.

Market dynamics	Niche Market	Introducing innovation in a new niche market.	Scanning and seizing an opportunity is a fundamental characteristic of disruptive innovation (Hardman, Steinberger-Wilckens, & Van Der Horst, 2013)
	Value Network	Gaining profits throughout the valued network. Ie. upstream, downstream, and all other collaborations.	Klenner, Hüsigg, and Dowling (2013) evaluated this indicator because rather than evaluating the attack on established value networks, this dimension evaluates the profitability from the innovation.
	Cost Reduction	Introducing the innovation in the low-end market segment means the product or service can be provided at a lower cost.	The original theory of disruptive innovation by C. Christensen (1997) refers to the emergence of innovations and technologies in the low-end market segment with low-end products offering "good enough" quality.
External environments	Policy	The scale of policy-related impact can be both positive and negative on the development and adoption of the innovation.	Legislations and policy regulations have positive and negative consequences on developing disruptive innovation. These public policies have been researched and discussed heavily by Dijk et al. (2016); Hang et al. (2011); van den Broek and van Veenstra (2018).

Macroeconomics	Influence of macroeconomic situation on the adoption and development of technology/innovation.	Ulku (2004) states that the correlation between growth models and technological developments is positive, while Tellis (1988) explained that the price elasticity of demand could be affected by macroeconomic influences.
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Table 2 Definitions and explanations of the selected indicators, inspired by (Guo et al., 2019).

Anthony, Johnson, Sinfield, and Altman (2008) developed another tool to evaluate the disruptiveness of innovation: the "Disrupt-O-Meter." An evaluating tool based on nine areas of analysis and their rationale, ranging the innovation from the least disruptive to the most disruptive. While the tool can oversimplify the evaluation process, it provides a checklist to see whether the innovation is taking a disruptive tactic (Anthony et al., 2008). Table 3 portrays the nine different criteria for evaluation, their objectives, and how they are compared to the existing market.

Area	Least disruptive (0 points)	Somewhat disruptive (5 points)	Most disruptive (10 points)	Rationale
Our first-year target is...	the mass markets	a large market	a niche market	Disruptive solutions typically start in limited foothold markets.
The customer thinks the target job needs to...	get done better	get done more cheaply	get done more easily	Customers should seek improvements along new dimensions such as simplicity and convenience.
Customers will think the offering is...	perfect	good	good enough	Customers should think the solution is "good enough" early on.
Price will be...	high	medium	low	Pricing is complicated, but disruptive solutions are generally

				inexpensive compared to existing solutions.
The business model is...	what we have always done	...with a few tweaks	radically different	Disruptive approaches often follow very different business models.
Channel to market is...	100% existing channel	at least 50% new channel	entirely new channel	Disruptive approaches often use distinct channels to market from established products and services (Start-ups should answer this and previous questions from the perspective of industry incumbents).
The competitor will think...	I need to do this tomorrow.	I need to watch this carefully.	I do not care	Disruptive solutions take advantage of competitive weaknesses and blind spots.
First-year revenue will be...	huge	average	small	Patient for growth, impatient for profits implies slow, steady start.
Required investment over next 12 months is...	slow average	average	below average	Disruptive solutions typically do not involve "Buck Rogers" solutions, so they require relatively below-average investment to move forward.

Table 3 Inspired From "The innovator's guide to growth: Putting disruptive innovation to work" by Anthony et al. (2008). Harvard Business Press.

A third evaluation tool, the evaluation tree, has been described by Zubizarreta, Ganzarain, Cuadrado, and Lizarralde (2021). The evaluation tree represents 3 criteria (factors) and 13 indicators (characteristics) designed to evaluate business sustainability when tasked with performing a disruptive innovation project. The first factor is the market, where the projects are established. The

second criteria are the firm's internal factors and actions to perform its business. Finally, the third factor is the external factor, which refers to the external competition in the industry and the firm's socio-economic environment.

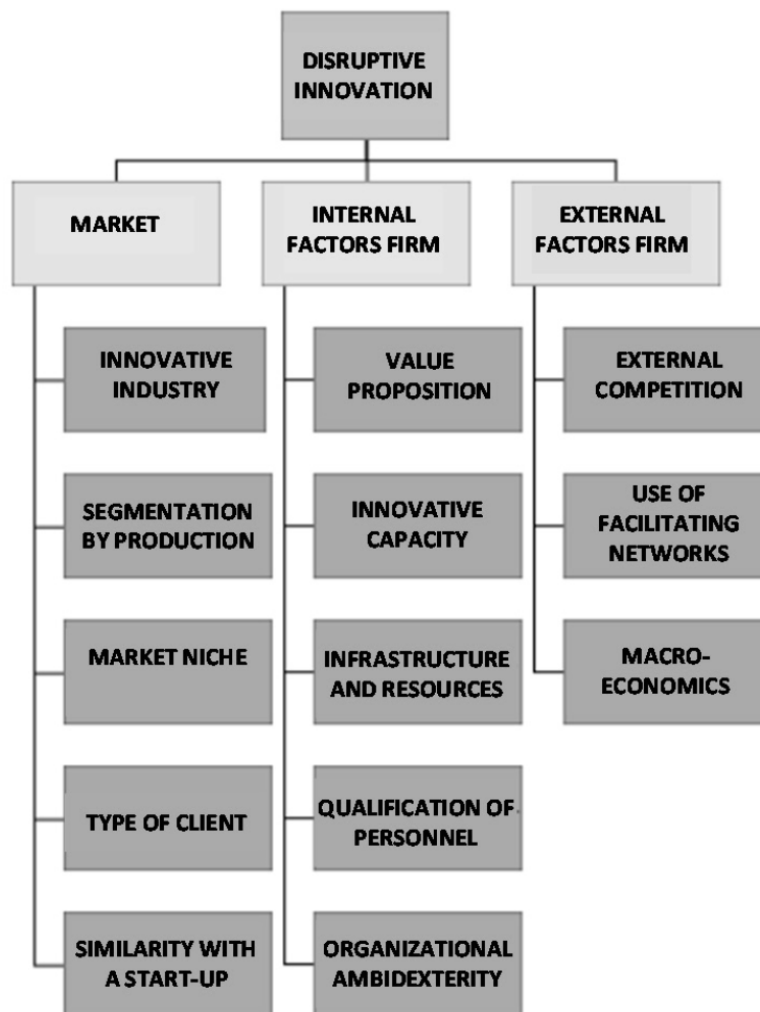


Figure 3 From "Evaluating disruptive innovation project management capabilities" by Zubizarreta, M., Ganzarain, J., Cuadrado, J., & Lizarralde, R. (2021).

2.2.2.2 Innovation Portfolio Management

Additional to evaluating disruptive innovation, managers are left in a predicament on whether they should pursue disruptive potentials over sustaining their existing product, especially considering the low comparison and high uncertainty of disruptive innovations (Weinreich, Şahin, Inkermann, Huth, & Vietor, 2020). Hence, creating an innovation portfolio management (IPM) can help established firms recognize prospective, early-stage-development innovations of high novelty, including the firm's own innovation projects developed (Cooper, Edgett, & Kleinschmidt, 2002).

As it has been mentioned earlier, recognizing and exploiting disruptive innovation is crucial for firms to assign and relocate their resources for both disruptive and sustained innovation (Weinreich et al., 2020). The purpose of an innovation management portfolio is to classify early-stage innovation (Eversheim, 2003) and undertake suitable projects (Cooper et al., 2002). More precise, IPM can

serve four fundamental goals when taking on the challenging task of managing a portfolio of high uncertainty: (1) value maximization, (2) balance, (3) strategic fit, and (4) the right number of projects (Chaparro, de Vasconcelos Gomes, & de Souza Nascimento, 2019; Cooper et al., 2002).

Value maximization denotes calculating a business value through a quantitative financial method, such as the net present value (NPV), expected commercial value (ECV), productivity index (PI), and scoring model as portfolio tools (Cooper et al., 2002). However, in order to accurately quantify value maximization, firms need to obtain high-quality data that can be extracted from previous comparable projects (Weinreich et al., 2020). The scoring model is used for project prioritization with projects being scored at six different criteria: (1) strategic alignment, (2) product advantage, (3) market attractiveness, (4) ability to leverage core competencies, (5) technical feasibility, and finally (6) reward versus risk (Cooper et al., 2002).

Second, for Cooper et al. (2002), a portfolio balance helps scale the levels of risk, innovativeness, and target horizons. To build a solid portfolio, Cooper et al. (2002) introduced 5 parameters that help incumbents balance the risk of innovation investments: (1) Reward or profitability, (2) how well the innovation fits with the incumbent's strategy or business, (3) proprietary innovation and a platform technology, (4) market maturity and market need, (5) the availability of technical and tacit knowledge available. Also, Chao and Kavadias (2008) indicate that a balanced portfolio has a "direct effect" on the established organization's ability to undertake projects with different levels of innovation.

The third goal is a strategic fit. According to Cooper et al. (2002), this objective should allow the incumbent firm to acquire a finalized portfolio of projects that reflect holistically the business's strategy. More so, to realize strategic fit, a well-established firm can either include strategic parameters into the scoring framework, with a probability of success meter or implement the "Strategic Buckets Model" (Cooper et al., 2002). The latter is defined by the incumbent's spending targets which could be reflected in its business strategy. In other words, Cooper et al. (2002) argue that although this may seem simple, however, senior management will be forced to develop a vision and strategy for their new business plan and make fundamental choices along different dimensions: (1) strategic goal, (2) Diversifying, (3) Product line, (4) Project type, (5) technology versus market awareness, (6) Strategic geographical expansions.

After the categories have been defined, the projects that have been allocated into their respective buckets are ranked according to value maximization and probability of success. Moving forward, after the projects have been ranked, the management team begins sorting the resources into 3 different buckets: (1) platform projects, which includes innovations that can generate platform growth, (2) new products and services, and (3) other maintenance, support, and sustained innovation. Killen, Hunt, and Kleinschmidt (2008) add that the strategic fit permits organizations to penetrate new markets, develop technologies, and back high-value spending on long-term endeavors.

Finally, Cooper et al. (2002) underline that managers are left with several pending projects to be activated with too many projects to undertake and few resources to manage these projects. With that in mind, the fourth goal of innovation portfolio management is for organizations to choose the right number of projects to pursue. This key element in the innovation portfolio management allows established firms to analyze and allocate the resources needed for different projects. Accordingly, the result will present information on whether the incumbent firm has the right number of projects to undertake, which department is lagging behind or might be wasting company resources, and how efficiently the people in different departments are working (Cooper et al., 2002).

Weinreich et al. (2020) argue that Cooper et al. (2002) innovation goals can narrow down potential disruptive innovations and help incumbent firms evaluate and select disruptive innovation in an innovation portfolio. More so, for Weinreich et al. (2020), the value orientation in innovation portfolio management is represented through the incumbent's customer value and target-based businesses.

As a result, Weinreich, Şahin, Huth, Breimesser, and Vietor (2021) presented the five steps to integrate disruptive innovation in an incumbent's value-oriented innovation portfolio management (figure 4). The first two steps of Weinreich et al. (2021) framework portray identifying potential innovation. To have a positive idea screening process, an alignment between the customer's needs (degree of fulfillment) and product realization (business model) should strategically complement each other (Weinreich et al., 2021). Idea screening can also be exploited to create new innovative ideas that can generate new functions and challenge customer demands (Weinreich et al., 2021). Additionally, the primary step in the framework can establish reliable feedback for incumbents to decide whether to pursue new innovation ideas or offer substitute offers, such as bundling of services (Ruhe, 2010).

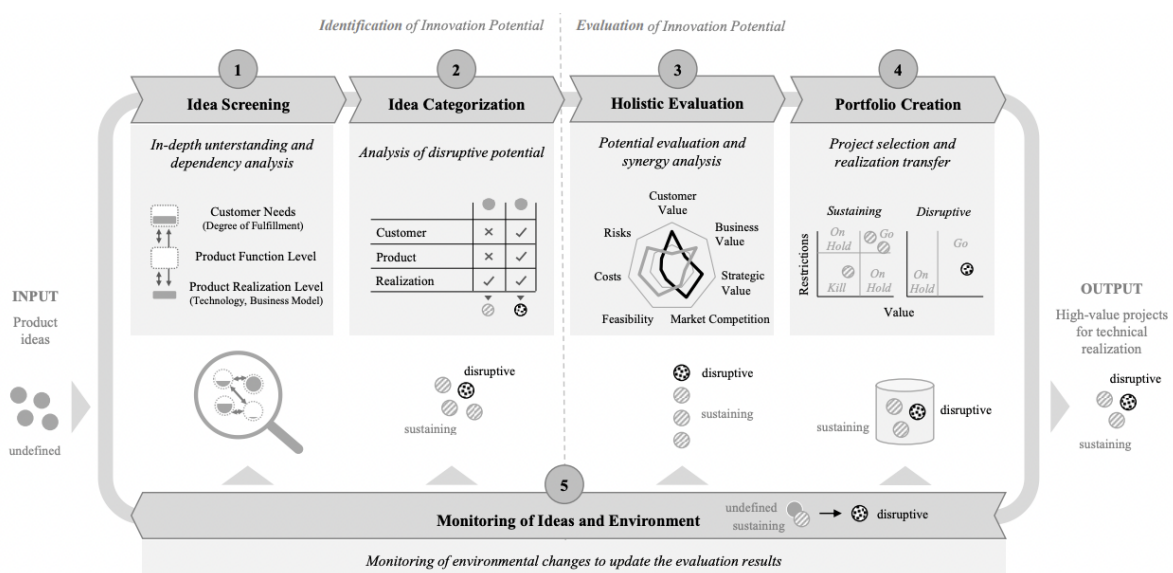


Figure 4 Methodological concept to integrate disruptive innovation into value-oriented portfolio planning. From Weinreich, S., Şahin, T., Huth, T., Breimesser, H., & Vietor, T. (2021). How to manage disruptive innovation-a conceptual methodology for value-orient.

The next step is idea categorization. Utilizing the data gathered from external forces, such as during the idea generation process and idea screening, this step's objective is to establish the disruptive potential of an idea. Table 4, developed by Weinreich et al. (2021), presents the three criteria features, customer, product, and realization, in order to categorize whether the innovation is disruptive or sustained. To have a higher disruption probability, the innovation should have higher disruptive criteria (Weinreich et al., 2021).

Criteria	Low	High
Customer		
• Potential value for non-customers	SI	DI
• Potential to overfulfill the needs of the main customers	DI	SI
• Importance/size of the customer segment at market launch	DI	SI
• Importance/size of the customer group with further product development	SI	DI
Product		
• Performance of original product attributes (valued by main customers)	DI	DI
• Performance of new product attributes (not valued by main customers)	SI	DI
• Price compared to the alternative solution	DI	DI
• Effects on the company's other products	SI	DI
Realization		
• Potential for further development of the technology (price, performance)	SI	DI
• Maturity of the intended technology	DI	SI

Table 4 From Weinreich, S., Şahin, T., Huth, T., Breimesser, H., & Vietor, T. (2021). How to manage disruptive innovation-a conceptual methodology for value-oriented portfolio planning. Procedia CIRP, 100, 403-408.

As for evaluating the innovation potential, Weinreich et al. (2021) divide the section into two categories, holistic evaluation, and portfolio creation. Respectively, to allow for a holistic evaluation, firms should assess both sustained and disruptive characteristics for innovative ideas (Weinreich et al., 2021). More so, the framework suggests utilizing Cooper et al. (2002) reasoning by focusing on value maximization, the strategic fit of the innovation, as well as, the balance of the portfolio. Şahin, Huth, Axmann, and Vietor (2020) defined seven standpoints to which these categories are evaluated: customer value, business value, strategic value, market competition, feasibility, costs,

and risks. Over and above that, Weinreich et al. (2021) indicate Cooper et al. (2002) scoring method as an alternative evaluation technique to evaluate early-stage product ideas.

Further on, when incumbents are done with screening, categorizing, and evaluating, they need to select the innovative ideas that have the highest potential in order to designate resources to realize the development of the product (Weinreich et al., 2021). Based on Cooper et al. (2002) introduction of portfolio maps, this dimension splits between sustained and disruptive innovation. That has been justified by helping incumbents allocate specific company resources for both innovations instead of only dispensing resources to sustained innovation (Weinreich et al., 2021).

Forasmuch as innovation is greatly influenced by external factors such as customer demands, market developments, and new technologies (C. Christensen et al., 2013; Cooper et al., 2002; S Weinreich et al., 2020), incumbent firms should pay attention to external developments as means to re-evaluate their product ideas (Weinreich et al., 2021).

Figure 5 summarizes the seizing tools discussed above.

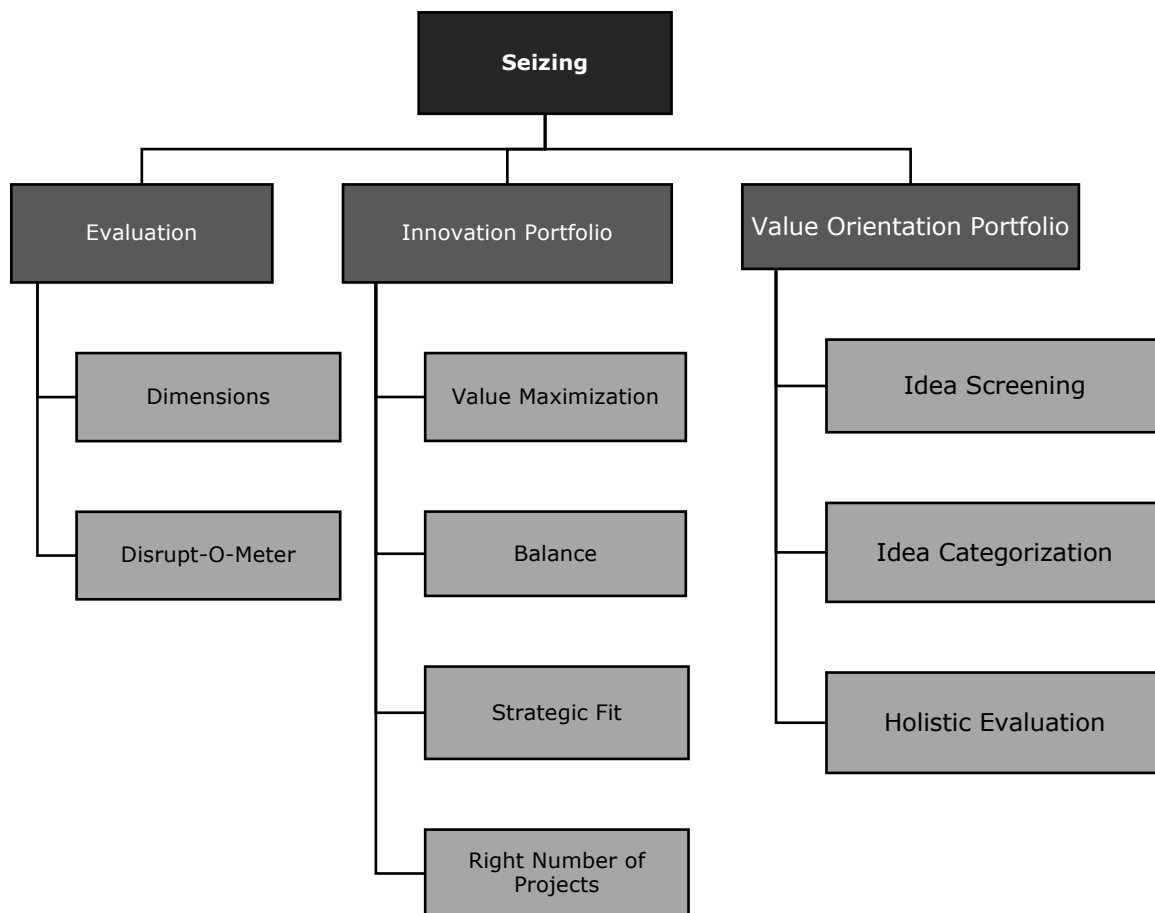


Figure 5 Seizing activities incumbents can perform to Evaluate and choose potential disruptive innovation.

2.2.3 Transforming

Following sensing and seizing stages, transforming is the realization of the firm's strategic plans to re-evaluate and redistribute the organization's resources, capabilities, and process (Kump et al., 2019). More so, according to Teece (2007), transformation is a crucial dimension of a firm's dynamic capabilities. Teece (2007) also reasons that transformation is the organization's ability to re-calculate and strategically decide corporate change.

2.2.3.1 Reacting

In 1980, Porter projected the three generic strategies to attain a competitive advantage in the market: differentiation, cost leadership, and focus. For instance, when companies undergo the differentiation strategy, they tend to focus more on customer and brand loyalty while providing their product or service with a unique selling criterion (Sharp & Dawes, 2001). Differentiation has also been documented as an adequate reaction to disruptive innovation (Vielledchner, 2010).

Furthermore, in order to achieve cost leadership and win a possible price war, incumbents should be able to recognize early-stage disruptive innovation and benefit from lowering the prices while maintaining profitability. That is realizable through the first-mover advantage, the learning curves, and later economies of scale (Kerin, Varadarajan, & Peterson, 1992).

The third generic strategy, introduced by Porter (1980), is the focus strategy. Focusing on a specific customer segment or niche market may provide exceptional potential success (Simon, 2009). That is true since a niche market can either be inferior to other competitors, or the incumbents' skills and resources (know-how) are too large (Schot & Geels, 2007).

While Porter (1980) introduced the three strategies to reach a competitive advantage, many authors such as Banker, Wattal, and Plehn-Dujowich (2011), Danneels (2004), Porter (2008), Sandström, Magnusson, and Jörnmark (2009), Schön (2013), Valdani and Arbore (2007), and Viellechner and Wulf (2010) began asking questions and searching for more reasons to how some incumbents maintained their market-leading positions and overcame the disruption.

One explanation developed by Charitou and Markides (2003) proposed five different ways to respond to disruption. The first is to concentrate on the existing business. In particular, when a product or service seems doubtful to affect the incumbent's market, it is recommended for firms to concentrate on their own business. Charitou and Markides (2003) suggested that firms can address their customers with targeted marketing instead.

The second strategy is closely related to the potential growth of an incumbent. In other words, while the innovation can be regarded as soon-to-be disruptive, for some incumbents, it may not present

a positive impact on their development. Therefore, these incumbents would decide to ignore the disruptive innovation and allocate their resources to improving and sustaining their products instead (Charitou and Markides, 2003).

The third category is to disrupt the disruptor. A great description presented by Charitou and Markides (2003) is that instead of offering products only at a lower price to gain absolute cost leadership, firms can “disrupt the disruptor” and provide products or services at an affordable price but with high quality and style compared to the low-end competitors. For example, Charitou and Markides (2003) explain that instead of offering lower-end trips to their customers, British Airways focused on boosting their end-users’ satisfaction by providing luxurious travel solutions.

The fourth approach is to embrace innovation through a new business unit. In their research, Charitou and Markides (2003) discovered that many incumbents who opt to adopt the new disruptive innovation were inclined to create a new separate business entity or company. This finding is closely related to Tushman and O'Reilly III (1996) theory to an ambidextrous approach, which will be discussed further.

The fifth response is to accept and scale-up. Many incumbents should use their dynamic capabilities, such as industry know-how and sales offerings, as well as their resources to overtake the disruptor and gain a competitive advantage (Charitou & Markides, 2003).

On the other hand, as an alternative response to Charitou and Markides (2003) and Porter (1980) strategies, Banker et al. (2011) propose mergers and acquisitions (M&A). Schmidt (2018) adds that when the organization has successfully sensed, scanned, and evaluated a potentially disruptive innovation, incumbents can undergo M&A to utilize the technological know-how, as well as the innovation’s capabilities for their own benefit.

2.2.3.2 Ambidextrous Approach

Another strategic reaction that has been comprehensively researched by Tushman and O'Reilly III (1996) is organizational ambidexterity. For Weinreich et al. (2020), potentially disruptive ideas emerge from customer and market demands. Such demands are established based on precise requirements (Weinreich et al., 2020). For instance, managing a disruptive innovation in an innovation portfolio requires evaluating the level of disruptiveness of a product idea (Weinreich et al., 2020). As the success of disruptive innovation is unclear, incumbents tend to allocate most of their resources to sustain their existing products (Christensen et al., 2013). Therefore, established organizations need to focus on their dynamic capabilities, such as exploring new innovation and exploiting their existing business (Tushman & O'Reilly III, 1996). In other words, in order to constantly evaluate the value proposition of the innovation, Weinreich et al. (2020) reassure the importance of ambidexterity in a firm’s portfolio management process.

An ambidextrous organization is a firm that has developed a separate unit, whose mission is to explore new innovation possibilities while the existing business can focus on improving and sustaining their current products or services (O'Reilly & Tushman, 2004).

More so, Hafkesbrink and Schroll (2014) differentiated between utilizing the firm's resources and capabilities to explore potential disruptive innovation, while on the other hand, making good use of the company's existing skills in order to exploit their current resources. O'Reilly III and Tushman (2013) explained organizational ambidexterity as:

"The ability of an organization to both explore and exploit—to compete in mature technologies and markets where efficiency, control, and incremental improvement are prized and to also compete in new technologies and markets where flexibility, autonomy, and experimentation are needed."

More so, the study of Felício, Caldeirinha, and Dutra (2019) shows that incumbents that possess a solid reaction to disruptive innovation enjoy a flexible organizational structure and a culture open to new knowledge and processes. That is true since ambidexterity allows an organization to explore new technologies and markets while maintaining its traditional business (Sarkees & Hulland, 2009). Felício et al. (2019) also argue that an ambidextrous organization has the ability to sense and recognize disruptive innovation trends, while consequently, they work on developing regulations and procedures to exploit these disruptive technologies.

In relation to the previously mentioned literature, incumbents should also take into consideration the challenges that come with ambidexterity (Bledow, Frese, Anderson, Erez, & Farr, 2009). While an ambidextrous organization can be beneficial to search for disruptive innovation and sustain the existing business (O'Reilly & Tushman, 2004), conflicts between the two units might arise due to resource scarcity, internal competition, as well as different practices between exploiting and exploring (Felício et al., 2019). In order to decrease the tensions between the different departments in the firm, scholars Fang, Lee, and Schilling (2010) and O'Reilly and Tushman (2004) suggest that the organization should consider separating both units and allow top management to oversee the progress. Figure 6 from O'Reilly and Tushman (2004) clearly shows how an ambidextrous organization separates the exploitation practices of their existing business from their exploration processes in their emerging business.

Ambidextrous organizations

establish project teams that are structurally independent units, each having its own processes, structures, and cultures, but are integrated into the existing management hierarchy.

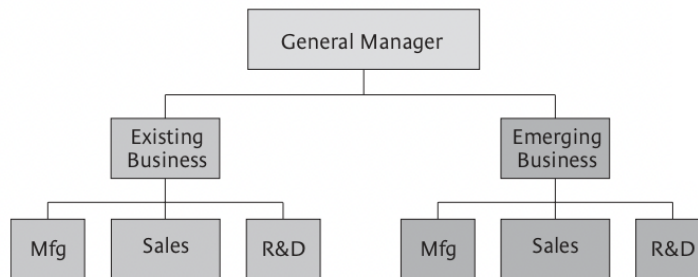


Figure 6 From O Reilly, C. A. and M. L. Tushman (2004). "The ambidextrous organization." *Harvard business review* 82(4): 74-83.

Following the same chain of thought, Raisch (2008) documented Nestlé's structure separation for its Nespresso project. To protect Nestlé's extensive production of their traditional business, Nestlé's top management decided to create a new separate unit and "move outside Nestlé's main coffee structure" to protect their Nespresso's venture (Raisch, 2008). By doing so, the new unit, Nespresso, was able to explore innovative opportunities, as well as promote their own business structure with their own production, distribution, and commercial guidelines, away from Nestlé's traditional organization (Raisch, 2008). Additionally, a structural separation allows incumbents to create an independent unit outside their original business. At the same time, both independent units can share existing skills, resources, and capabilities to foster a new venture and target different customer segments.

2.2.3.3 Trade Barriers as Preventive Actions

Another strategic option to restrict disruption is market entry barriers (Han, Kim, & Kim, 2001). While new entrants are known to rearrange the levels of productivity and long-term industry competitiveness, they are viewed as elements of disruption (Audretsch, 2001). Although the impediment to entry does not eliminate long-term market penetration, it sometimes prolongs the arrival of disruptive innovation into the market (OECD, 2007). Blees et al. (2003) categorize and describe both structural and strategic barriers in their report.

Respectively, the structural barriers are obstacles found in the market, which make the market unprofitable for new entrants. (Church & Ware, 2000). Consequently, Blees et al. (2003) introduced several endogenous and exogenous barriers to entry. Through the extensive list of impediments in Blees et al. (2003) report, I highlight eight obstacles presented by McAfee, Mialon, and Williams (2003) that can impact the level of disruptiveness in the industry:

1. Economies of scale: while several firms are willing to exploit disruptive innovation, other incumbents are prepared to take advantage of their economies of scale (Chevalier-Roignant, Flath, & Trigeorgis, 2019). King and Baatartogtokh (2015) reported that at least 40% of their study cases changed their business models in order to obtain economies of scale and therefore limit market entry. Incumbents can exploit economies of scale when their cost of production, distribution, and service provided is at a minimal level while maximizing operation or increasing plant capacity (Blees et al.,2003). In other words, incumbents that benefit from scale economies are known to be found on the Minimum efficient scale (MES) (Stigler, 1983).

2. Switching costs: reflect the certain expenses that will incur on customers that purchase products or services from new market entrants (Oyeniyi & Abiodun, 2010). Following the same chain of thought, Blees et al. (2003) note that customer switching cost should also consider the price of the complementary products bought by the buyer. For instance, to deal with switching partialities, incumbents, such as Apple, Microsoft Windows, and Google Android, have begun providing platform services as part of their business strategies in order to protect their existing market share (Dzhain, Nykänen, Penttinen, & Saarinen, 2015). Additionally, Chen and Hitt (2006), Dzhain et al. (2015), and Klemperer (1987) identified five switching cost categories, Search costs, contractual cost, learning cost, complimentary costs, and brand relationship cost. Table 5 explains the relationship between each cost barrier and the incumbent. Therefore, incumbents are left to decide between either adapting to technological innovations or sustaining existing products with new business strategies.

Switching Cost Category	Example
Search cost	Customers of an incumbent’s mobile platform will refrain from switching to another platform provider as this will involve spending a lot of time and effort searching for alternative platforms.
Contractual cost	Ending a contract with a service provider may involve loss of potential monetary loss as well as the loss of a loyalty program. Incumbents can offer lucrative service bundles to existing customers when considering strategic alternatives.

Learning cost	Customers who decide to shift to an alternative platform may require more time learning how to operate the new platform and the new applications on that platform.
Complementary cost	Complimentary investments such as the availability or purchase of third-party applications can discourage the buyer from shifting to a new platform.
Brand relationship cost	A psychological barrier that refers to the emotional attribute of highly ranked products or high-status brands. Incumbents that market their products as a superior class than others usually tend to exploit this type of barrier.

Table 5 Examples of switching costs on mobile phone platforms, inspired by Dzhain et al. (2015).

3. Brand loyalty: Dedicated and enthusiastic customers are always there to protect the incumbent's products or services against new market entrants (Blees et al., 2003). In order to avoid disruption, incumbents raise their brand loyalty barrier through discount schemes, such as air-miles, loyalty programs, and loyalty cards (Blees et al., 2003).

4. Capital requirements: Established organizations that invested in large financial capitals and operated on lost costs have raised the barriers against new market entrants (Bain, 1956). In other words, initial high capital requirements create two types of difficult situations: first, it can be complicated for start-up ventures to get a loan, or second, if the start-up managed to get a loan, their interest risk would be higher due to unperceived guarantees (Blees et al., 2003). Therefore, regardless of the innovation, in some cases, large capital requirements may create barriers to entry (Reed, Storrud-Barnes, & Jessup, 2012).

5. Absolute cost advantages: Blees et al. (2003) also refer to absolute cost advantage as a situation where, at any given point, the cost of production is higher for the new player compared to the established organization. In addition, Blees et al. (2003) explain that an incumbent gains an absolute cost advantage when they gain an early-mover advantage.

6. Information advantage: Unregistered skills, protocols, and operational routines are considered precious resources to an incumbent's information advantage (Blees et al., 2003). Better known as tacit knowledge, a firm's ability to effectively utilize its internal capabilities

for efficiency benefits can result in cost advantages for the incumbent and a drawback for the new entrant (Blees et al., 2003).

7. Organizational advantage (vertical integration & diversification): McAfee et al. (2003) argue that controlling the supply chain for faster production (vertical integration) as well as exploiting multiple employee skills (diversification) in an incumbent's organization can present the new market entrant with a disadvantage. An entrant should then consider penetrating the market with two or more levels to match the existing organization's cost (Blees et al., 2003). Incumbents with monopolistic access to crucial production or knowledge facilities have high organizational advantages and are hard to disrupt (Blees et al., 2003).
8. Asset specificity: Refers to the possibility to reallocate the incumbent's existing assets to alternative use without compensation on the value of production (Blees et al., 2003). Assets with high specificity impose high losses if the project fails; thus, asset specificity can be considered an incumbent's high barrier of entry against a new entrant (McAfee et al., 2003). However, if a start-up or an entrant invests in high asset specificity, this should act as a commitment signal, which later would trigger a price war with an incumbent firm (Blees et al., 2003).

On the other hand, compared to structural barriers, Lutz, Kemp, and Dijkstra (2010) explain that strategic barriers are concerned with the incumbents' behavior, such as contract agreements, to deter market entry. Besanko, Dranove, Shanley, and Schaefer (2009) present three types of strategic barriers:

1. Limit Pricing: A dominant firm that practices limit pricing intentionally sets a low price to discourage competition (Besanko et al., 2009). Discouraging entry may provide an incumbent firm with monopolistic characteristics, ready to set a low price to convince potential competitors that either has no demand for the product or service in the market, or the profits are irrelevant to the established organization (Besanko et al., 2009).
2. Strategic bundling: In order to block entry, well-established firms can offer a bundle of products and services that are sold, collectively, at a price lower than it would cost to buy them separately (Besanko et al., 2009). Therefore, while offering a complete bundle of services at a lower price, the firm provides customers with a better deal than buying each product from different competing firms.
3. Predatory pricing: Occurs when incumbent firms price their products or services below their cost price in order to force competitor firms out of business or a way to deal with new firms that want to enter the market (Besanko et al., 2009).

While an incumbent's reaction and retaliation to disruptive technologies are as important as erecting barriers of entry, if a new entrant threatens the firm's market position (Blees et al., 2003), barriers

to entry, whether structural or strategic, can help incumbent firms sustain their market position (Harrigan, 1983) and avoid disruption.

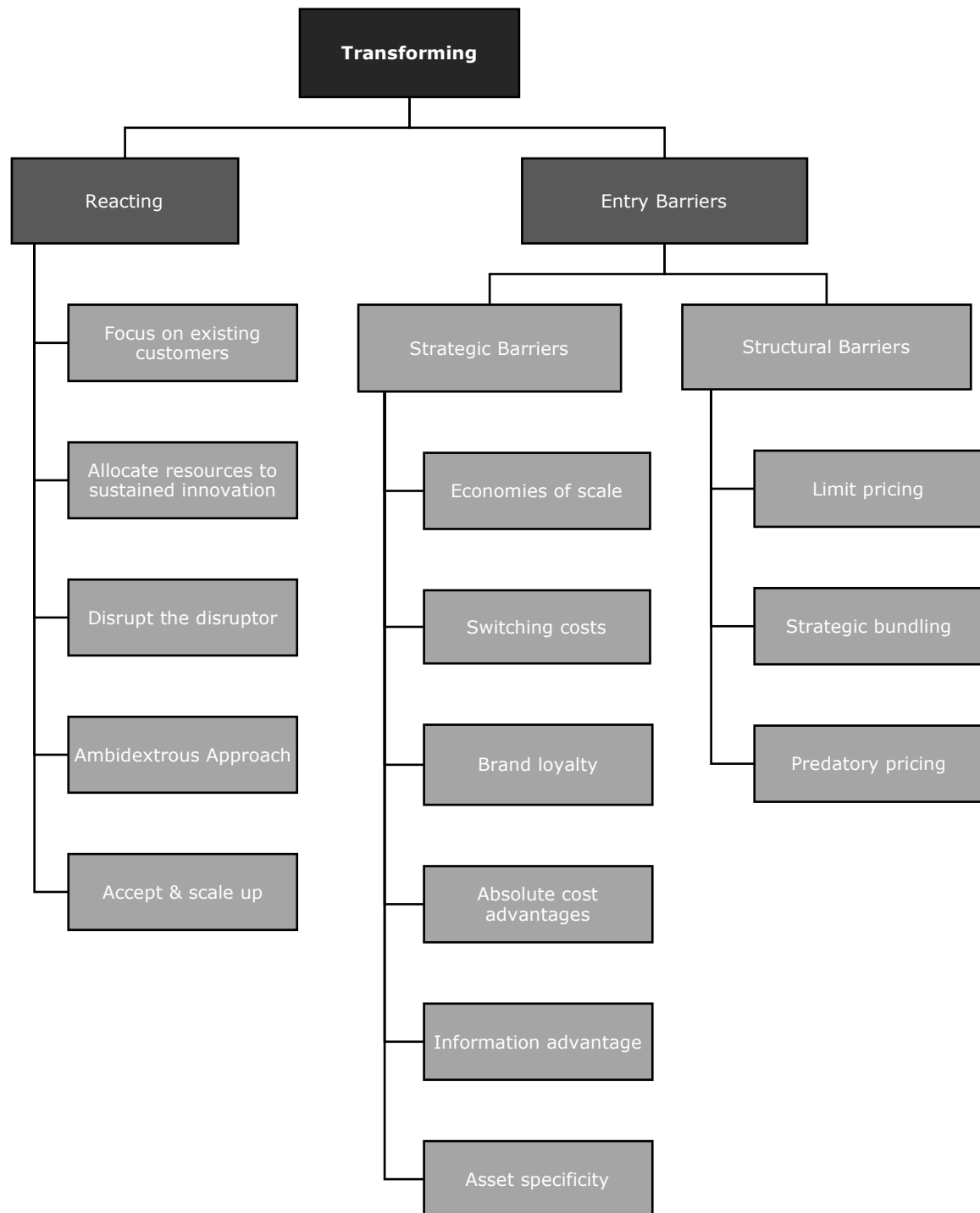


Figure 7 Transforming activities incumbents can do to either react to or protect from potential disruptive innovation.

Chapter 3. Methodology Overview

3.1 Research Approach

This study builds on Christensen et al. (2013) theory of disruptive innovation by focusing on potential disruptive innovations in the construction and real estate industry. Any technology-enabled innovation in the built world is considered property technologies or PropTech (European PropTech Association – PropTech House [EPTA], 2020a). Baum (2017) also reasoned that property technology innovations (PropTech) would disrupt and transform the real estate and construction industry.

In that relation, I will develop an in-depth analysis of the PropTech industry. Then, I will present some key findings of the industry and its macro-economic trends from a data set of over 2,400 companies shared with me during my work with PropTech Lab Belgium. Being part of PropTech Lab Belgium, the PropTech community of startups, scale-ups, VC, and industry incumbents, I help incumbent firms develop an innovation focus and then work with the organization to scan, evaluate and select PropTech innovations for pilot projects.

Upon analyzing the literature of PropTech, the case study will introduce the potential disruptiveness of PropTech and the reason behind having an in-depth analysis of the industry. In addition to the literature and secondary data, I will present the activities in PropTech from both the investors' (venture capitalists) and the incumbents' perspectives. Investors' perspective is essential for this study because, while generated profits measure the success of corporations, the value of technology-enabled startups is measured by financial backings valuation (Baum, Saull, and Braesemann, 2020). In other words, more investments made by venture capitalists mean a higher success probability. Hence, investors' perspective on new technologies is likely to generate insights helpful in identifying (sensing) and evaluating (seizing) disruptive innovations. I will conduct 3 interviews with 3 of the top 10 PropTech venture capital firms in Europe to get comprehensive insights into potential PropTech trends. Then, I will conduct 6 different interviews with real estate and construction professionals in order to gain a complete understanding of how incumbent firms scan for technologies, how these firms evaluate these technologies, what are their transformation or reactions to new innovations in the industry, and what are the technologies they consider to be disruptive.

Consequently, a discussion chapter will focus on learning from the VCs multiple ways incumbents can scan, evaluate and prepare for potentially disruptive innovations. The final chapter will include the conclusion, limitations, recommendations, and suggestions for future research.

Chapter 4. Rise of Property Technologies

4.1 Define PropTech

The real estate and construction industry are fundamental sectors of any economy (Siniak, Kauko, Shavrov, & Marina, 2020). For instance, Tostevin (2021) research shows that the total value of all of the world's real estate reached \$326.5 trillion in 2020, four times greater than the world's GDP and 96% higher than the world's total value of gold ever mined. Nevertheless, the world's most significant asset type is also the world's last industry to adopt innovation and technological advancements (Baum, 2017). For Baum (2017), although the real estate and construction industry is famous for not quickly accepting changes, the technology-enabled innovators in the built world have gained market share away from traditional organizations. For example, in 1980, software solution companies such as Autodesk, Yardi, and Argus re-shaped the way professionals manage and operate real estate, construction, and asset management operation (Baum, 2017). Moreover, with the online-residential gaining traction between 2005 and 2015, several startup companies reacted to a market disruption by acquiring multiple companies, for example, the \$2.5 billion purchase Trulia by Zillow (Baum, 2017).

Siniak et al. (2020) also added that the digital transformation of real estate and the enormous implementation of emerging technologies, such as the internet of things (IoT), data analytics tools, artificial intelligence (AI), Building Information Modeling (BIM), blockchain and more, has facilitated the rise of property technologies (PropTech). While the expression "PropTech" has become a hot topic, the agreed clear definition of the word has still not been made (Tagliaro, Bellintani, & Ciaramella, 2020). However, researchers such as Baum (2017), Maududy and Gamal (2019), Porter et al. (2019), and Shaw (2020) agree that the prime goal of PropTech is to develop an efficient and effective process to the traditional real estate value chain.

Following the same mindset, the European PropTech Association - PropTech House recognizes proptech as "any innovation (technological, technical, or business model) in the real estate value chain and across all asset classes" including housing, office, retail, industry and logistics, hospitality, and healthcare (European PropTech Association – PropTech House [EPTA], 2020b). More so, any technological-enabled innovation in the following fields of expertise such as architects, engineers, general contractors, sub-contractors, product suppliers, developers, property, facility, asset managers and operators, as well as real estate investment trusts (REIT's), institutional investors, and owners can be branded as proptech innovations (EPTA, 2020b).

In their article, Maududy and Gamal (2019) also claim two different methods to explain PropTech. First, PropTech can work as an assistance provider: actors in PropTech develop tools to help facilitate and efficiently perform tasks. In other words, PropTech is the result of efficient and effective processes (Maududy & Gamal, 2019). Second, PropTech can be innovations developed to change business models, company processes, services, facility and asset management, and operations.

4.2 Categories of PropTech

Because PropTech can be broadly defined, a large number of PropTech firms can be recognized in Europe. A total number of 3,219 PropTech companies were recorded as active (Unissu, 2019). These figures represent a more active PropTech market in Europe. Nevertheless, the European PropTech Association recognized that Europe has yet to create its first unicorn PropTech startup, rivaled by 22 PropTech unicorns in the US (European PropTech Association – PropTech House [EPTA], 2019). There are two reasons for that. First, the EU PropTech market is fragmented into 28 diverse countries (EPTA, 2019). Second, there is a lack of series B and C (later stage) venture capital funding (EPTA, 2019).

To help standardize the European PropTech market, Europe has decided to standardize the market by segmenting the PropTech ecosystem into five subcategories, covering the building lifecycle: finance and invest, design and build, market and transact, manage and operate, live and work (European PropTech Association – PropTech House [EPTA], 2020a). Figure 8 represents the 5 segments of the real estate value chain.

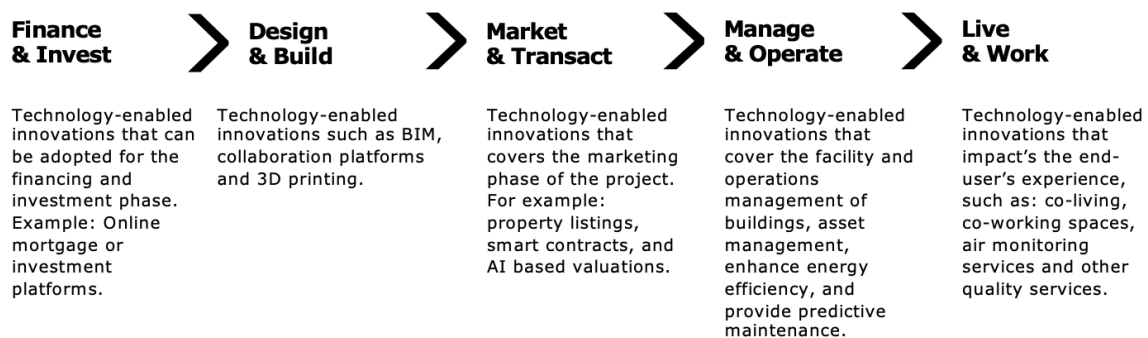


Figure 8 5 segments covering the value chain of Real Estate. Inspired from European PropTech Association. (2020). Retrieved from <https://www.proptechhouse.eu/>.

Aligned with the above, Maududy and Gamal (2019) presented several technologies aligned with the European PropTech Association categories. For example, technology-enabled innovations that offer data to enhance transaction and management services and help keep, retrieve, and present data to management systems, product search, and documentation can be found in the manage and operate category (Maududy & Gamal, 2019). A (2020) PropTech Directory by PWC and PropTech Lab (2020) gave examples of startups, such as Smovin, SpaceFlow, Wattsense, and WeSmart, that offer IoT solutions to optimize and automate asset, facility, and operation management in the manage and operate category.

Another category of innovations Maududy and Gamal (2019) is finance and invest, and market and transact. They note that the development of PropTech is due to the rise of technologies in the transaction process (Maududy & Gamal, 2019). For example, crowdfunding platforms, lending platforms, and new payment systems are speeding up the financial and investment processes, too

(Lee & Shin, 2018). A real estate innovations overview report done by KPMG (2020) present several players in the market and transact, as well as finance and build, for instance, BeeBonds, a Belgian crowdlending platform that allows investments in local projects. While, for example, HappyWait is a French online platform that allows users to generate and sign contracts (KPMG, 2020).

In addition to that, we see that startups in the co-living and co-working sectors are in their validation phase, while the startups in the design and build category have just begun seeing growth (EPTA, 2020b). Respectively, Siniak et al. (2020) introduce BIM and online corporate platforms as part of the design and build category, whereas Baum (2017) presents the sharing space platforms (co-living and co-working) as part of the live and work category (Walrave et al., 2018). For instance, the KPMG (2020) report introduces Neanex, a startup in Antwerpen that developed an open BIM integration and a digital twin platform to facilitate and minimize failure costs and improve communication and management throughout the project life cycle. PWC and PropTech Lab (2020) introduce IKOAB, Belgium's startup for co-living spaces.

4.3 Macro-Economic Trends, Growth and Trajectories

A follow-up study to Baum (2017) explains that while the number of PropTech startups between 2008 and 2015 was rising, there has been a fall in the number of innovating firms between 2016 and 2018 (Baum, Saull, and Braesemann, 2020). This observation can be clarified by merger and acquisition activities in the industry (Baum, Saull, and Braesemann, 2020). These developments are visualized by Figure 9 and Figure 10, respectively.

In order to highlight Baum, Saull, and Braesemann's (2020) logic, Figure 9 presents 3 different diagrams. First, on the left, the number of firms founded, then the center graph describes the fundings made, and finally, the total funding per firm in three categories, (1) FinTech, (2) PropTech, and (3) Real Estate (Braesemann & Baum, 2020). The figure shows three stages of growth.

Between the years 2000 and 2003, only a few PropTech startups were founded. However, 200+ startups were established for the real estate sector and 600 startups for the finance industry (Braesemann & Baum, 2020). Consequently, between 2004 and 2015, a 1000% increase was recorded in the second stage to PropTech startups, in contrast to a 156% and 233% increase to the real estate and finance industries, respectively (Braesemann & Baum, 2020). In addition to that, Braesemann and Baum (2020) also noted that by 2015 the number of PropTech startups was close to the number of non-PropTech real estate firms.

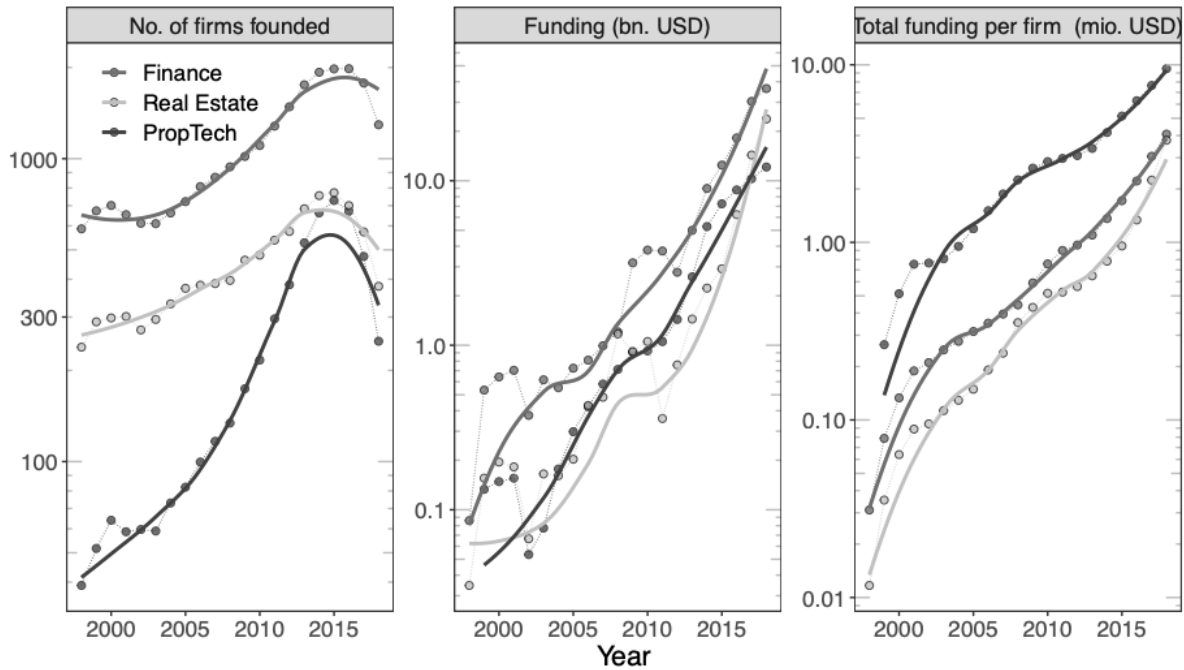


Figure 9 Number of PropTech firms and funding over time, compared to other real estate firms and firms in finance. From Braesemann, F., & Baum, A. (2020). PropTech: Turning real estate into a data-driven market? Available at SSRN 3607238.

Second, while there was a dip in the number of PropTech startups founded in the years between 2016 and 2018, the mid-graph and right-most graph of the above figure, figure 9, shows the funding and total funding of startups have not just continued to grow exponentially, but were higher than both the real estate and financial sectors (Baum, Saull, and Braesemann, 2020). That is true due to the “technology-to-technology mergers” and PropTech mergers and acquisition (M&A) activities shown in figure 10.

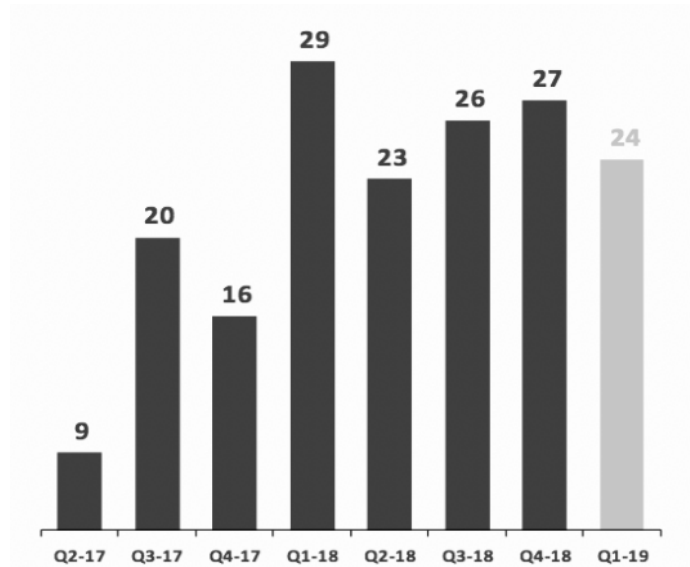


Figure 10 Quarterly PropTech M&A activity by deal count, 2017-2019. From Baum, A., Saull, A. and Braesemann, F. (2020). PropTech 2020: the future of real estate. Tech. rep. Oxford, Saïd Business School, University of Oxford.

More so, Faraudo (2019) argues that technology-driven industries are measured by the number of investments made and not exclusively by profits. In other words, to better portray the success of the technology-led PropTech startups, Baum, Saull, and Braesemann, (2020) suggest to look at how many investments have been made by several venture capital firms, PropTech accelerators, and traditional real estate companies into these startups. Respectively, after analyzing 3,219 European PropTech companies, Unissu, an online portal that creates, manages, and provides quantitative PropTech analysis, presented that over \$10 Billion has been raised for PropTech startups in Europe, with the United Kingdom, Germany, and France leading the PropTech funds raised chart (Unissu, 2019). Figure 11 shows how much money has been invested in European startups by 2019.

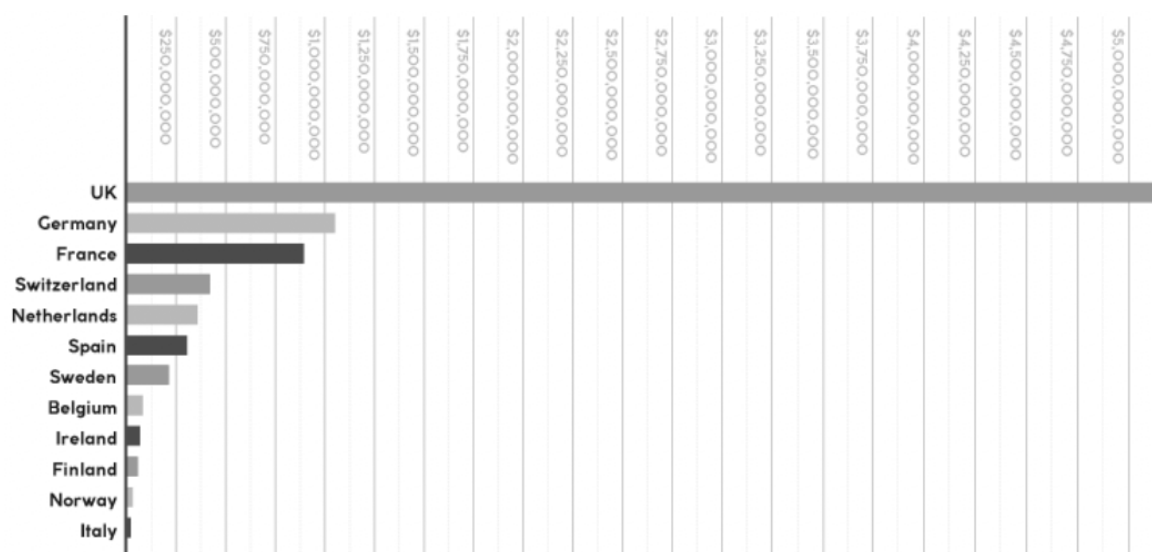


Figure 11 Total PropTech funding for leading European countries. From Unissu (2019). "Global PropTech Analysis: Europe." from <https://www.unissu.com/proptech-resources/proptech-europe>.

To a greater extent, Deloitte (2020) reported that the global perspective of the current funding size of the PropTech ecosystem is equivalent to where the finance technologies (FinTech) startups were 8 years ago. Additionally, with the recorded 44.8% (CAGR) FinTech growth and reported \$78.2 billion of funding being raised for PropTech startups (Deloitte, 2020), the potential growth success for the PropTech ecosystem is present.

Over and above all of that, it is essential to mention the main drivers of technology-enabled PropTech innovation. For instance, European PropTech Association – PropTech House [EPTA] (2020c) pinpoints two criteria: user experience and efficiency. Respectively, due to the democratization of the data provided through the digital world, as well as the upturn in quality of life, end-users can now access instant, transparent, and mass-personalized products and services (EPTA, 2020c). Additionally, due to the rise of urbanization, sustainability, and climate change legislation, smart cities, and smart mobility regulations, PropTech startups and firms developed many tools to collaborate, integrate, predict, visualize and automate tasks efficiently and effectively (EPTA, 2020c).

The European PropTech Association – PropTech House mapped potential PropTech-driven innovation trends that could possibly have an impact on the macro-economic developments in the real estate and construction industry (EPTA, 2020c). Figure 12 represents the diverse innovation prospects that are highly likely to have an effect on the built world industry. For example, EPTA (2020c) presents the continuous development of integrated BIM solutions, IoT, and big data control that can help accelerate and improve real-time collaborations platforms, project planning tools, and wireless monitoring.

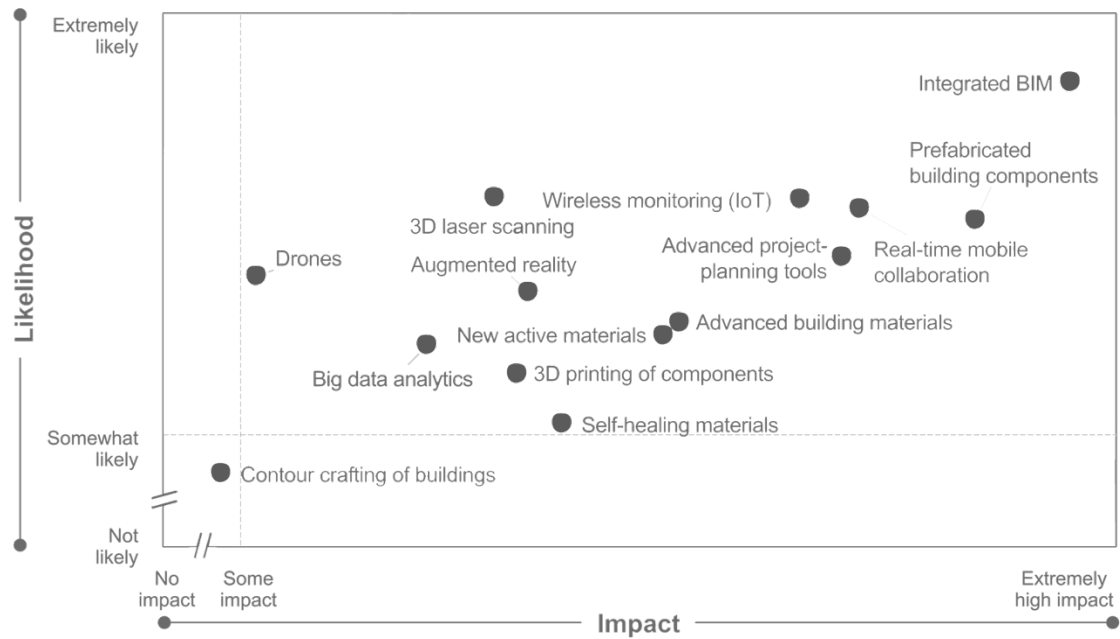


Figure 12 Impact-likelihood matrix of new technologies. From Association, E. P. (2020b). *Why PropTech a Priority? Paper presented at the Webinar European Space Agency.*

In the following chapters, I will present the data on the activities of the PropTech start-ups in Europe. This information will later be checked against the insights obtained from the interviews with both the incumbents and venture capitalists. After that is done, we will have a clear illustration of how the incumbent firms are either engaging, reacting, and evaluating innovations or whether they are seeking/asking for different requirements.

Chapter 5. Activity in PropTech

5.1 Data by Categories

Having previously introduced the 5 classifications of PropTech, this section will focus on categorizing the startups' level of maturity based on their category, asset class, and technology. Therefore, I will use the database of over 2,400 PropTech startup and scale-up firms that have been shared with me during my work with PropTech Lab Belgium. This database includes the names of the companies, their specific activities, the domain and category they operate in, the founding date of the firms, their current stage of maturity, their country and city of origin, their field of specialization, the driver of innovation, and the asset classes they operate in.

First, having analyzed and categorized the diverse set of companies, it became evident that technology innovations vary between the two drivers: efficiency and user experience. For instance, when comparing both drivers (efficiency and user experience), the results show, in figure 13, that within the European PropTech market, more firms focus on developing tools and services specifically in the manage and operate category. In addition to that, these tools help automate, facilitate and speed up cooperation, communication, and reporting processes to achieve higher efficiency gains. Also, Figure 10 presents the variation of a number of firms innovating between different categories. For example, the efficiency gains between live and work in relation to manage and operate.

If we consider the new innovations that are developing in the less competitive markets in PropTech as niche markets, then according to Christensen (1997), these technologies would later disrupt the mainstream industry.

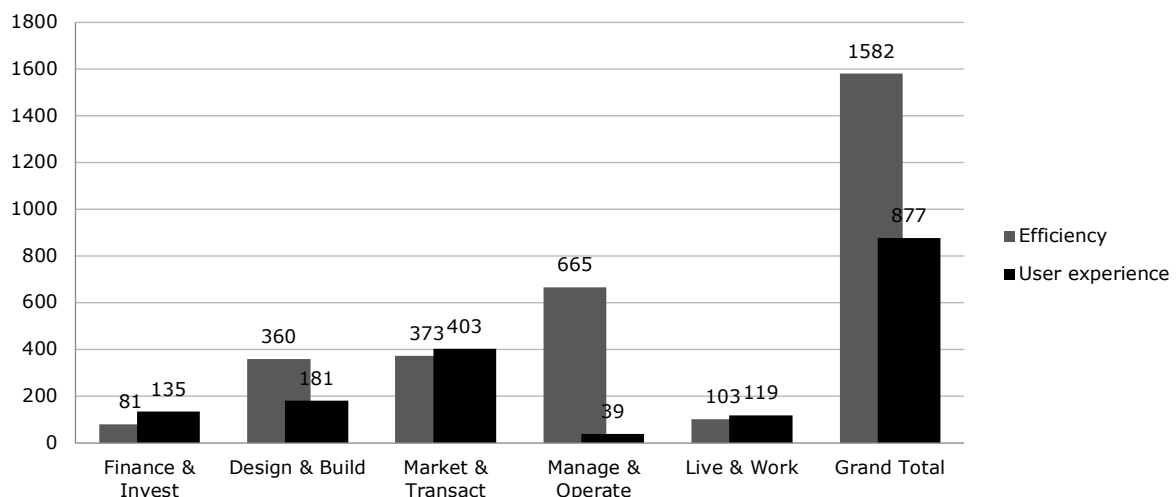


Figure 13 Which domains & drivers of innovation are the most frequently occurring? From EU PropTech Association and PropTechLab database.

The following in-depth analysis represents the startups and scale-ups activities in PropTech within their specific category. Moving on, the first set of technologies I analyze falls under the finance and invest category. Hence, more than 50% of the innovations are concentrated towards one PropTech service, investment platforms. In other words, there is still room for new innovations and technologies to be developed in the less competitive sub-categories. For instance, for the finance and invest category, in Figure 14, there have been 107 accounted for firms that provide digital investment platforms, and only 19 other firms focus on tokenization of assets.

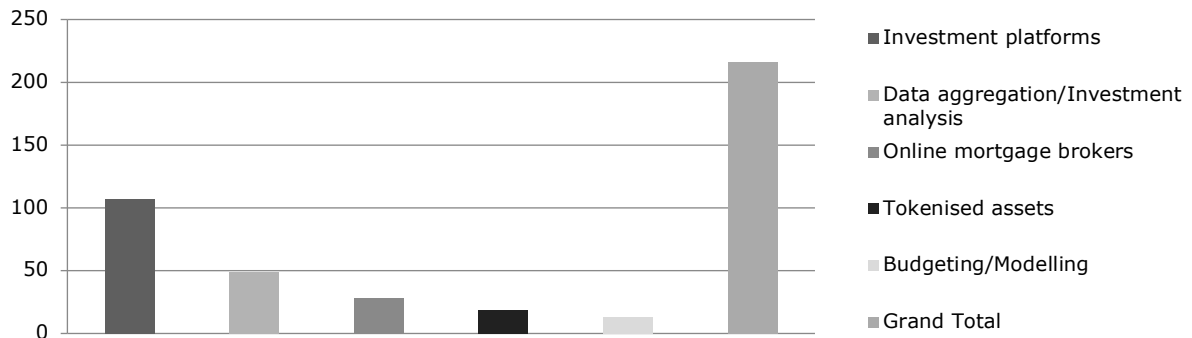


Figure 14 Innovations in Finance and Invest. From EU PropTech Association and PropTechLab database.

The second category to analyze is Design and Build. Figure 15, below, places BIM solutions, collaboration platforms, and 3D/VR visualization tools as the top 3 most active innovations in the design and build category. Such technology-enabled innovations help all the players in the real estate value chain to perform their job efficiently (Baum, Saull, and Braesemann, 2020).

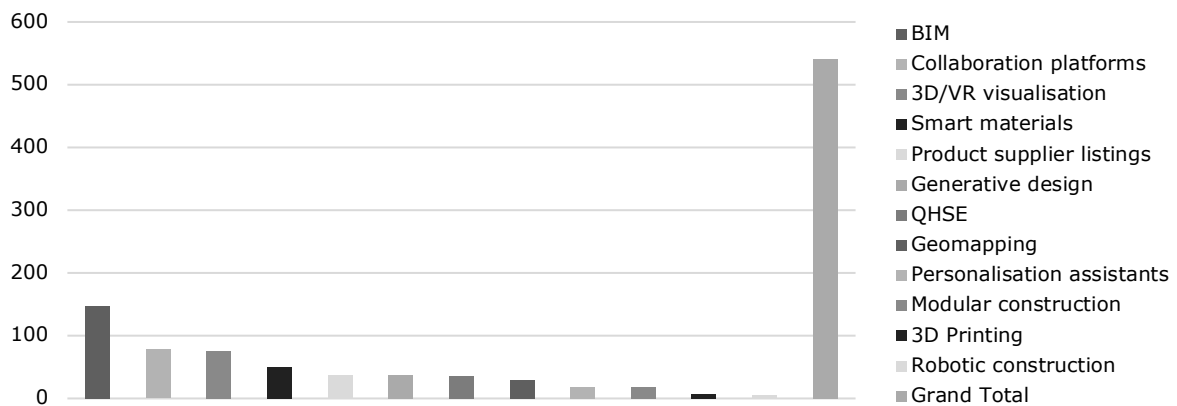


Figure 15 Innovations in Design & Build. From EU PropTech Association and PropTechLab database.

Furthermore, the Market and Transact list, Figure 16, shows that more than 50% of the startup activities are in property listings and marketplaces, online real estate agents, 3D and virtual reality. Therefore, first movers within smart contracts and rent-to-buy solutions could also be a successful activity to innovative startups. Also, for the Manage and Operate category, Figure 17, startups are more active in developing ERP systems, intelligent infrastructure, and energy efficiency solutions.

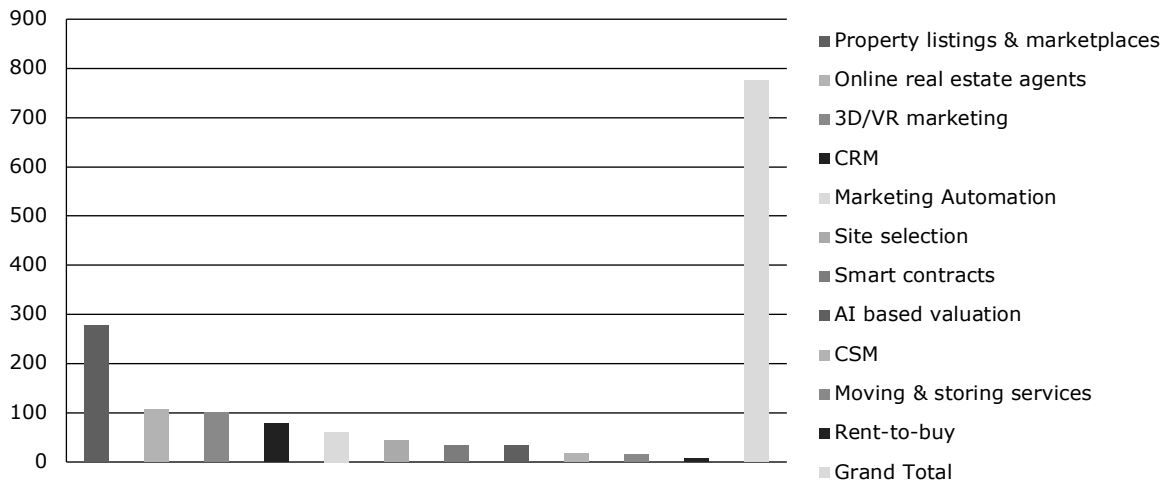


Figure 16 Innovations in Market & Transact. From EU PropTech Association and PropTechLab database.

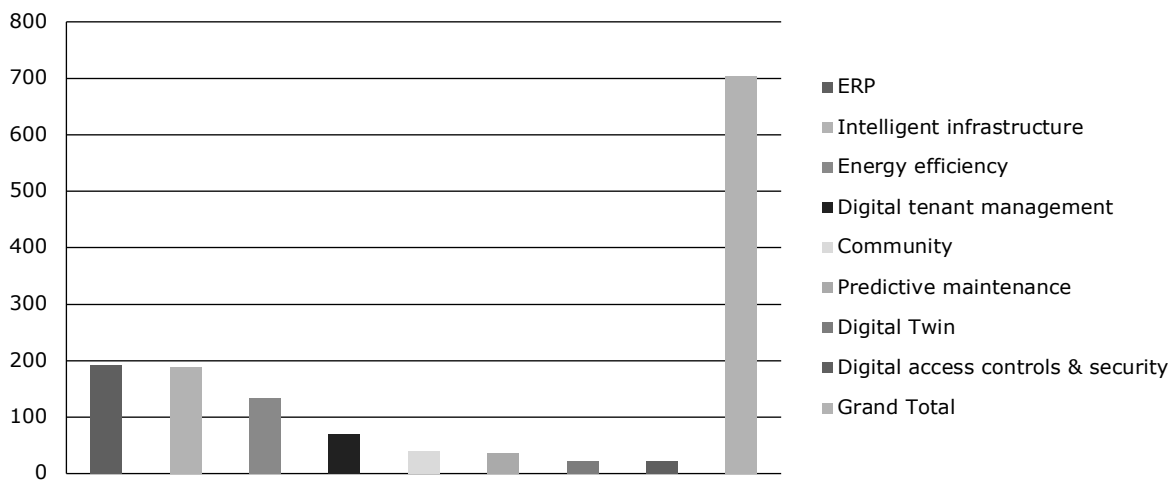


Figure 17 Innovations in Manage & Operate. From EU PropTech Association and PropTechLab database.

Finally, for the last category, innovations that are being developed in the live and work section, Figure 18 primarily focuses on the sharing economy and the on-demand services and well-being of the end-user. Examples of sharing economy technologies or innovative business models include co-living, co-working, parking mutualization, and co-cooking.

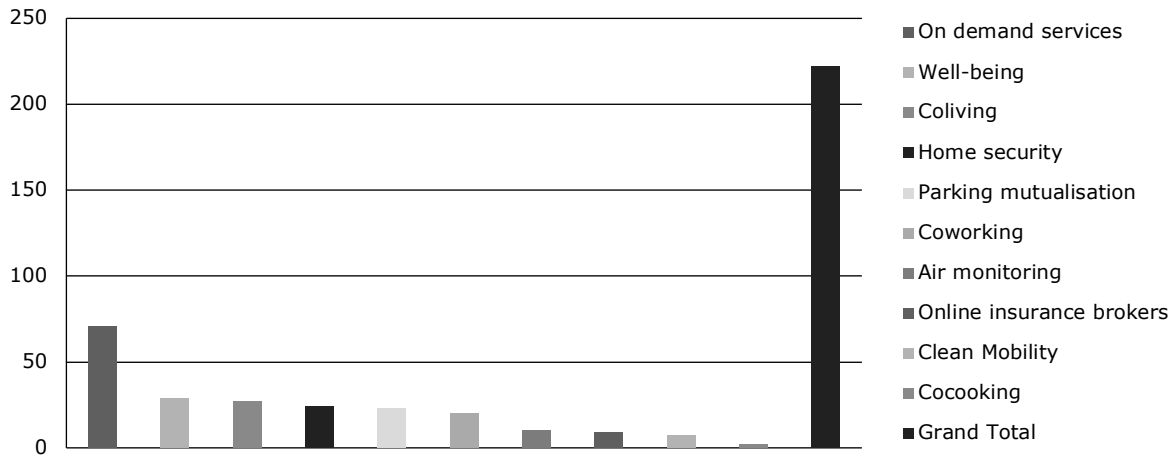


Figure 18 Innovations in Live & Work. From EU PropTech Association and PropTechLab database.

Having analyzed the technologies and innovations that are currently active in each PropTech category, Figure 19 lists the top 10 most recurrent startup activities in PropTech. In summary, 1,409 startups, out of the database of 2,400 analyzed firms are actively developing technologies for property listing services, ERP systems, Intelligent infrastructure service, BIM solutions, energy efficiency platforms, investment platforms, online real estate agents, 3D and VR marketing, CRM tools, and collaboration platforms. This means, while more than 50% of the analyzed startups are concentrated along with the top 10 recurrent technology themes, the PropTech ecosystem can predict potential disruption in the other 36 innovation families. Hence, there is a potential for a lot of new entries and M&As. For example, tokenization of assets, geo-mapping, robotic construction, 3D printing building, rent-to-buy platforms, digital twin, and clean mobility could be innovation focuses of the future.

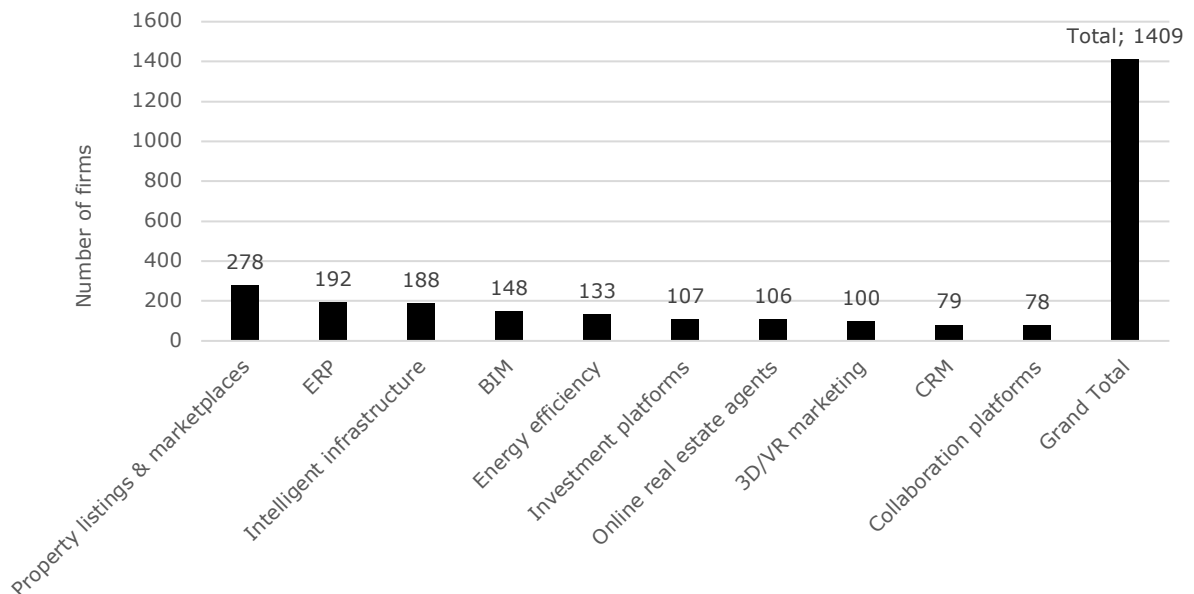


Figure 19 The most recurrent startup activities in Europe? From EU PropTech Association and PropTechLab database.

More so, after analyzing more than 2,400 PropTech firms, data shows, Figure 20, that 81% of these startups and scale-up firms are yet to become matured while 5% have been acquired. Therefore, with many technologies and innovations that still need to be accepted and adopted, we can also predict a lot of potential growth activity to happen in the future.

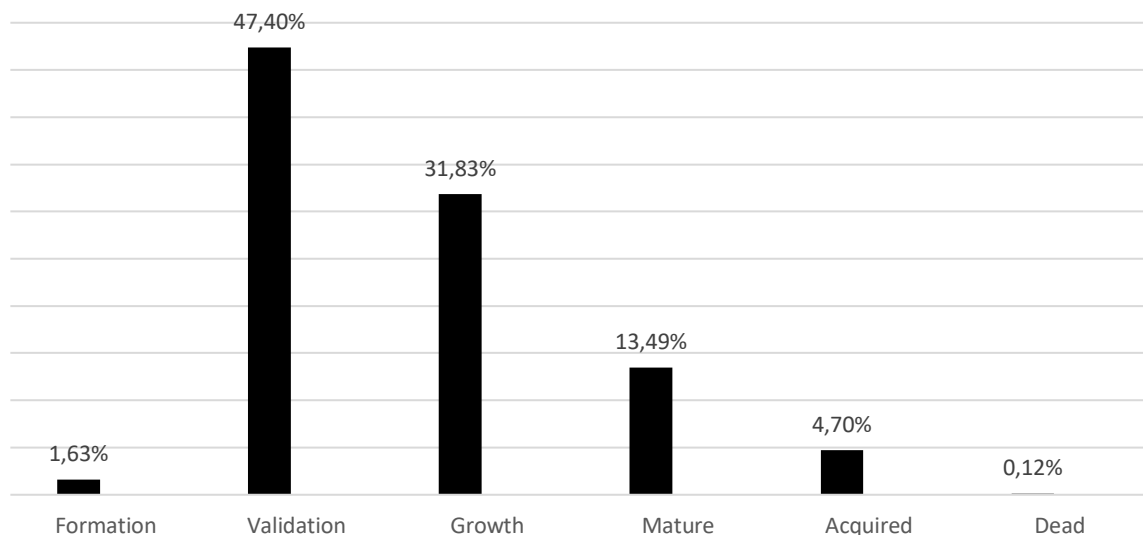


Figure 20 Stage of Maturity. From EU PropTech Association and PropTechLab database.

Chapter 6. Case Study Description

6.1 Describe the Case

Multiple experts have stated that technological-enabled innovation in the real estate value chain is unavoidable (Association, 2019, 2020b, 2020c; Baum, Saull, and Braesemann, 2020; Braesemann and Baum, 2020; Maududy and Gamal, 2019; PWC and PropTech Lab, 2020; Siniak et al., 2020; Tostevin, 2021; Unissu, 2019). More so, the figures above justify the reasoning that the real estate and construction industry is undergoing a digital transformation phase (Braesemann & Baum, 2020).

More so, an industry evaluation by KPMG (2018), surveyed 270 real estate professionals, which resulted in alarming results. It has been noticed that there is a misalignment of information and understanding between the incumbent firms and the innovating startups (KPMG, 2018). While 97% of the incumbent firms surveyed agree that PropTech innovations will impact their business flow, only 30% of traditional companies plan to invest in PropTech technologies (KPMG, 2018). Furthermore, when asked if the incumbent firms view PropTech as an opportunity or a threat, 73% acknowledge property technologies as an opportunity, yet more than 50% classified themselves below the 5/10 scale with regards to their digital stage maturity (KPMG, 2018).

Additionally, KPMG (2018) investigated the potential long-term and short-term PropTech technologies incumbent organizations will use to impact the industry. 30% of the well-established organizations labeled automation to have a short-term impact with a short-term utilization opportunity. At the same time, 27% selected big data analysis to be implemented in the short term, as well as to have a short-term effect. However, traditional firms considered artificial intelligence to have a long-term effect on the industry.

To add to that, when RICS, Association, Surveyors, and GoReport (2020) researched and surveyed 476 professionals in the UK and the EU, they reported that 79% of the incumbent firms do not utilize business intelligence software, 61% of the well-established firms do not invest in PropTech innovations, and 52% do not have the tacit knowledge to use technology-enabled innovations. More so, RICS et al. (2020) present 13 different reasons why incumbent firms choose against PropTech adoption. For instance, fear of change, lack of clarity, unsure ROI, and happy with traditional methods are some of the reasons that are aligned with prior research on why traditional firms get disrupted (Chandy and Tellis, 2000; Christensen and Raynor, 2013; Christensen et al., 2013; Larson, 2016).

Putting it differently, the challenges that are holding back incumbents to adopt PropTech innovations are similar to the reason why incumbent firms get disrupted in the first place. Figure 21 shows that 22% of the incumbent firms agree that there is a lack of digital leadership from the management, 38% are unsure about the return on investment, 39% still consider PropTech a cost rather than an investment, and 39% are still happy with the traditional methods.

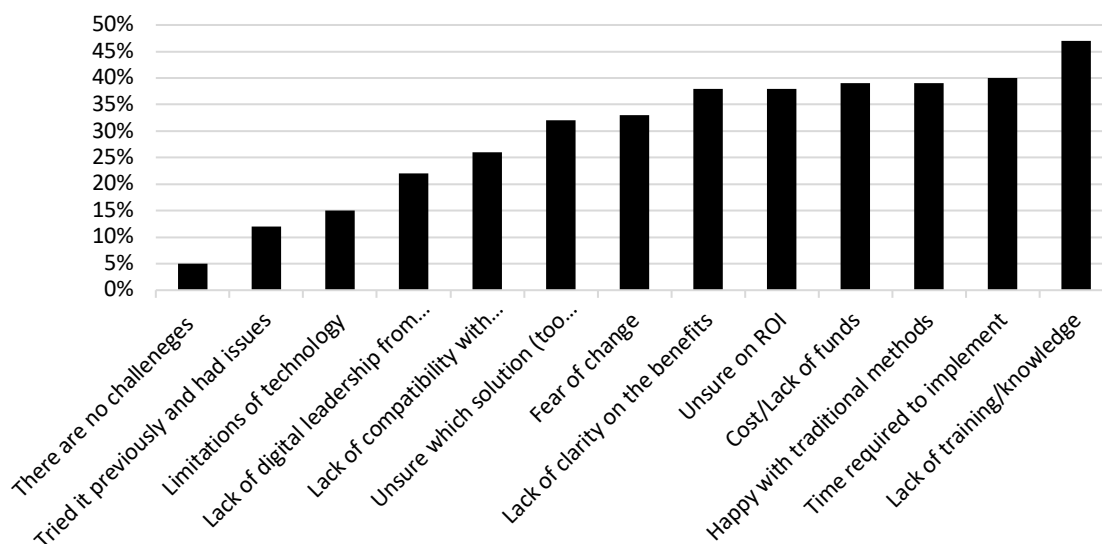


Figure 21 Challenges holding back the adoption of PropTech RICS, Association, T. S., Surveyors, S. o. C., & GoReport. (2020). *Technology - Its Position and Impact on Surveying*.

It will be especially interesting to check whether the venture capitalists are concentrating on the categories in which also most startup activity can be observed.

Chapter 7. Venture Capital Activities in PropTech

Fundraising through venture capital (VC) has always been a fundamental source of financing to many successful startups (Gompers, Gornall, Kaplan, & Strebulaev, 2020). One of the many roles of venture capital firms in the market is to pinpoint essential stages in a startup's journey, such as pre-investment screening, contracts, post-investment follow-ups, and continuous consulting and advising (Gompers & Lerner, 2001). More so, in different sectors, venture capital firms seem to provide a beam of hope to a comprehensive innovation landscape (Bloom, Jones, Van Reenen, & Webb, 2020).

It is crucial to understand how VCs source prospective startups in the pre-investment stage. In their report, Gompers et al. (2020) were able to conclude that almost a third of the VC deals come from their own private networks, another 28% are self-generate, 20% come from other investor recommendations, 8% are from portfolio companies, and only 2% of the deals come from quantitative sourcing; that is VC firms gather information from a diverse set of sources to be able to recognize potential high-returns.

Furthermore, following the same chain of thought of Teece (2007) sensing and seizing, the next step would be selecting a startup for investment. Kaplan and Strömberg (2004) discovered that many VC firms tend to value the characteristics of the startup's management, the market readiness, the technology being developed, the product created, and the startup's business model. More so, by order of importance, Paul A Gompers et al. (2020) conclude that venture capital firms agree that the management team is a critical factor in their decision making, then comes the business model, the product, the market, and industry, finally the valuation and the VC's ability to add value comes last.

7.1 Setup of Interviews

The purpose of interviewing the VCs is two folds. First, investments can be seen as an indicator of potential market disruption (Faraudo, 2019). Potential disruptive innovations within PropTech can be recognized and, in the next step, compared with the technological interests of incumbents. Second, I will explore how VCs scan, evaluate, and invest in new technologies to possibly recognize methods of sensing and seizing described in the literature review. Furthermore, this exploration of the VC's perspective will enable a more in-depth discussion of the sensing and seizing activities of the incumbents who will be interviewed in a second step.

I have contacted 5 of the most active PropTech VCs in Europe, of which only 3 venture capital firms agreed to be interviewed. The online interviews were approximately 60-minutes long. Table 6 represents the profiles of the interviewed VCs.

Description	VC1	VC2	VC3
Fund-size	\$85 Mil.	\$50 Mil	200 Mil
Position	Senior investment manager	Senior associate	Chief Data Officer
Location	Europe	Europe	Europe
Method of interview	Online	Online	Online

Table 6 Characteristics of each VC and the summary of the interview.

To begin with, the interview questions were divided into 3 sections. First, the intent was to understand how the VCs view PropTech and highlight their investment interests. The second category of questions was aimed to recognize how VCs scan and evaluate these startups and innovations. Finally, the third category was meant to underscore the expected effects on the incumbents, as well as the VCs' perspective on the future of PropTech.

7.2 Disruptive Potential in PropTech

All 3 venture capital representatives make introductory statements. For instance, they agree that the digitization movement in PropTech is overwhelming and with limitless potential. They also agree that technology-enabled construction and real estate innovation create an overlap of sectors in different industries within the built-world market. For example, the technologies that operate in the finance and invest categories, such as blockchain and tokenization, are an intersection of both the finance and the construction industries.

Interestingly, VC1, VC2, and VC3 indicated that their current portfolios include startups that focus on collaborative platforms, real estate market listing services, and facility and property management platforms. However, their future investments will target innovations to help reach the European Commission climate initiatives such as the Environmental, Social, and Governance (ESG) goals and the Green New Deal. This is noteworthy because it is aligned with the Commission's plan and budget of €1.8 trillion to reach "zero" net-carbon emissions within the construction and building, incentivize energy-efficient buildings, increase climate-proofing of buildings, and enforce strict rules on energy performances of buildings (Commission, 2019). In relation to that, all 3 VCs indicated they are now continuously seeking and funding innovations that target climate change, sustainability, and the ESG goals. For example, VC1 explained:

"This is why we are investing in clean-tech such as energy efficiency, smart buildings, electrical charging stations, technology-enabled circular economies, and innovations targeting ESG goals and the Green New Deal. Real estate is the second least digitized industry in the world, and the potential is limitless."

As well, VC2 added:

"What is happening right now is that we are in a climate crisis, and that will make us shift towards new solutions. I think to be successful and to grow in the next few years, a move into the logic of implementing ESG solutions into business processes is crucial".

In many ways, the answers of the venture capital firm representatives regarding their current investment interest explain why the three categories, design and build, market and transact, and manage and operate, have the highest number of startup activities (Figure 13). For instance, most of the existing technologies in the VC portfolios are aligned with the highest-ranked startup activities. For instance: collaboration platforms, property listings and marketplace, digital tenant management, and intelligent infrastructure. Also, analyzing both the VCs' following investment considerations and the minimal startup activity in live and work and finance and invest, we can predict a surge of PropTech startups focused on enabling ESG goals, climate change, and green energy innovations in the coming years.

Consequently, all of the 3 VCs agree that the growth of PropTech startups has just begun to show momentum and predicted a timeframe of 5 to 7 years for PropTech innovations to become the mainstream technology. This explains the reason why these VC representatives view PropTech as either an opportunity or an opportunity-enabler. More so, while all 3 VC representatives agree that PropTech innovations have the potential to disrupt the industry, they assert that the technology-driven innovations should be regarded as opportunities for incumbent firms, stating that PropTech can be considered as a threat to traditional firms if these corporates are reluctant to digitize their processes.

It is also essential to highlight that before asking any question regarding disruptive innovation, I first re-stated and introduced Christensen et al. (2013) definition of the theory. In this relation, 2 out of 3 VCs agreed that there had been a disruption in the industry; nevertheless, not as effective as the disruption in the United States. There are two reasons. First, VC1 suggests that in Europe, many landlords have been satisfied with their business models until it was too late to change. Therefore, they were forced to catch up to the trend. Second, VC2 states that many startups have opted to create a blue ocean, which, with time, proved to be a booming segment to target. On the other hand, VC3 claims that the fragmentation of the European PropTech ecosystem is only prolonging a real disruption that is bound to happen.

7.3 Sensing Activities

Having previously highlighted the importance of VCs in the early-stage innovation investments and their recent development of interest towards technology-enabled ESG and climate-cautious goals investments in PropTech, it is fundamental to understand how these VCs recognize potential PropTech innovations and what are their evaluation criteria. Hence, the interview with the venture firms has provided an in-depth analysis of their sensing and seizing strategies.

When analyzing all of the 3 VC responses, we notice that each venture capital firm uses a set of resources to scan for exciting startups. For instance, VC1 indicates that they have two strategies to scan and sense for technologies. First, the inbound strategy is a more direct policy to invite startups *"to come and pitch."* They also scan different online communication platforms such as LinkedIn and their website to reach new startups. On top of that, VC1 also showed interest in attending networking conferences where they have the possibility to interact with innovators during big events. On the other hand, as part of their outbound strategy, VC1 indicates that their own research department uses scouting platforms such as Crunchbase and Pitchbook to recognize potential startups and technologies. Also, they are in partnership with one of the higher-ranked academic institutions in Europe and provides them with more knowledge on market and industry trends.

Furthermore, an interesting observation has been made. While each VC has a unique way of scanning for new innovation, all of the 3 VCs I interviewed agree that one of their primary sources of information comes from their contacts and networks. For instance, VC1, VC2, and VC3 explain that their funds are well connected with their venture partners, such as the advisors to the VC, the angel investors, and other professionals, that provide a lot of new deal flows because of their well-established network with other prominent players in the industry. For instance, VC2 said that their fund is well connected to the value chain of different actors in the construction and real estate industry that new deal flow requests come from several companies in the market.

However, while VC2 revealed their fund also searches through PropTech and non-PropTech funds in the market as a source of recognizing innovation, they remain cautious at looking at universities for the same. They reason that the innovation from academia usually tends to be in their very early stages of idea development and would require nurturing. At the same time, VC2 does not focus on incubation.

For VC3, sensing means is a combination of different segments and processes. For instance, each defined segment has to have specific notions of validating whether an investment is relevant or not. For example, the location of multiple companies in the same domestic market is a good indicator that the innovation has potential. Another good sign that an innovation has potential gains is its anticipated adaptability to other products. In other words, VC3 said: *"We also look at a set of different complementary entities related to the actual product that has been able to put together."* Additionally, VC3 expressed that they also seek the feedback of experts or teachers to validate some of their assumptions to clarify some of the technologies in the PropTech innovation ecosystem.

Therefore, in support of the earlier literature on the different sensing mechanisms, we notice that the VCs prefer 8 different sensing tools, Such as startup engagement, networking conferences, own research, research centers, academia, corporate contacts, SMEs, and other VCs. However, 2 new sensing means, the startup's geographical location and a set of complementary innovations, have been mentioned here.

7.4 Seizing Activities

Nonetheless, not all startups are successful. CB Insights (2021) analyzed more than 110 startups and classified 12 reasons why startups fail. These include: startup's bankruptcy, no market for the product, underperformed product, startup's unclear business models, legal issues, team issues, cost issues, not the right time for the product, unqualified product, investor misalignment, wrong change of direction, and finally burnout. Moreover, investors have put in-place evaluation criteria for their due diligence process. That is why it was vital to understand how VCs evaluate the selected innovations and to later compare them to the seizing activities of the incumbent firms.

Respectively, VC1 named 4 of the 12 reasons why startups fail. He explains, in his experience, usually (1) the market was not right, (2) the product did not have enough features, (3) the product had too many features or a (4) disharmony between the founders/investors. For VC1, there are 3 elements that are important when making a decision. The first is the team behind the technology or product.

"When you are investing in a business, you need to partner with the men and women for the long-term, maybe 10 years or more, so you need to be sure that this marriage is going to work".

The second element is market readiness. There are multiple ways on how to proceed with that. VC1 continues by saying: *"We only talk to industry experts, but we talk to existing customers, customers in the pipeline, and potential customers that we have in our network, that might eventually become customers. We just try to understand (1) if there is a need for this product, (2) if people are willing to even pay for something like this and (3) if they have tried something else".* In reference to their article: *"Measurement framework for assessing disruptive innovations. Technological Forecasting and Social Change"*, VC1's evaluation strategy compliments many of Guo et al. (2019) metric of disruptiveness that was discussed in chapter 2.

The third criterion is that the VC should closely examine the product's unique selling point (USP). For example, VC1 explained how evaluating a beta version of a technology would be in their company. First, the innovation should be technology-enabled to digitize a traditional industry. Then, they deep-dived into what other competitor technologies are in the market and compared the team behind the product, the market to which the product will serve, the innovation in terms of accuracy,

GDPR compliance (rules and legislation), as well as the possibility of adding complementary applications to the technology.

Similarly, VC2 also considers the market, the team, and the product, for their evaluation criteria. However, it is one part of their funnel process. For instance, they use the market, team, and product scorecard to (1) determine the qualifications of the startup, (2) to define their investment thesis, as well as (3) to develop their due diligence for that specific venture. A startup's traction is also an essential factor in its process. In other words, precisely in PropTech, a high market-growth percentage usually speaks for itself, said VC2.

Nevertheless, if the traction is not visible, the fourth step in the funnel will be customer realization. That is done either by recognizing the number of product end-users or identifying the number of end-users for a competitor's product. The fifth element is studying the preliminary market. This means that for VC2 to invest in series A companies, the young startups should be capable of targeting a small niche market. Finally, the sixth element is to have a platform technology to replicate and add to the same model in different countries and for different applications.

Remarkably, VC2's innovation evaluation pinpoints different elements discussed in several pieces of literature. First, just like VC1, VC2's 6-stage funnel is aligned with Guo et al. (2019) metric of disruptiveness. For instance, (1) the integration of the technology in different systems or with other different applications, (2) the leadership team behind the innovation, (3) the maturity of the product through end-user activity, (4) the macro-economic trends such as market growth and traction, and (5) the niche-market the technology is targeting. Additionally, their evaluation mindset is also aligned with Christensen (1997) theory of disruptive innovation. In other words, VC2's evaluation strategy to early-stage innovations that target low-end customer segments with products that show strong future projections portrays their interest in scanning and evaluating disruptive innovation.

On the other hand, for VC3, their evaluation criterion is based on two dimensions. First, the technology should be placed in one of their defined categories of PropTech, for example, smart building, smart homes, smart cities, climate-tech, sharing economy, crowdfunding, 3D, VR, AR, as well as in all real estate assets, such as residential, hospitality, office, industrial, retail and land. Additionally, the second dimension is that their innovation evaluation is based on stage maturity and targeted market segment. In other words, VC3 explains: "*the assessment of an online brokerage platform would be different from an energy building management solution.*"

7.5 Expected Effect on Incumbents

Additionally, VC1 argues that although novel innovations might not disrupt an incumbent, they might disrupt the way they work (process or operation), resulting in losing their leading position in the market. Therefore, the incumbents need to separate between managing the day-to-day activity with the startup and their commercial agreement with them.

Also, VC2 and VC3 explain that due to the COVID-19 pandemic, traditional companies are now more aware of the benefits of PropTech innovation, but the relationship with innovation is complex. In other words, although well-established firms are aware of the technologies, they are hesitant to invest or totally transform their operations. Consequently, venture capital firms also believe it is difficult to see how successful an incumbent can be without engaging with PropTech startups. For instance, flexible leasing, virtual viewing properties, and online offices were present before the pandemic. However, many incumbent firms did not recognize the importance of these innovations until adopting these technologies became a necessity.

Therefore, for VC1, incumbents should create a separate business unit, an ambidextrous approach, that is actively looking for innovative startups to pilot new projects while the existing unit is busy sustaining and improving their current product. On the other hand, VC2 indicated that incumbents should invest in VC funds to create a sensing mechanism and be recognized as first adopters of novel technologies. For example, while some corporates are busy in their day-to-day activities, investing in a VC's portfolio, which is aligned with an incumbent's business and has a good track record, could help corporate firms recognize reliable early-stage technologies. However, VC3 stated that it is more about the trade-off between staffing and having the right resources. In other words, incumbents willing to integrate software-technology companies into their systems should have an innovation focus and create a sensing and evaluation mechanism.

7.6 The Future of PropTech

VC1 explains that if people compare PropTech to other technology waves in the past, PropTech unicorns of the future are being built right now. For instance, 2010-2012 saw the beginning of the Cloud-Tech wave, which later took 5 years to mature. Then, 2013-2014 saw the beginning of the FinTech wave, which now, after 7 years, has also matured with several unicorn companies. Therefore, VC1 believes that the industry might begin to see PropTech unicorns in the next 2 to 3 years. Additionally, VC1 reasons the escalation of PropTech was due to the growth of PropTech startups in the industry and the pandemic that accelerated some of the trends, such as digital transformation, VR/3D and augmented reality, asset management, and property management tools.

Respectively, the VCs were asked: *what would you hope to find in PropTech in the future?* VC1 proposed that he would like to see more end-user technologies in smart products or smart buildings that can be used on a daily basis. However, VC2 and VC3 proposed that the market is ready to increase the maturity of technologies that can ease labor or manual work and more on-site digitization. Nonetheless, as we are getting closer to 2030 and 2050, climate-tech innovations, ESG-enabled technologies, and environmental-enabled innovations within the real estate and construction industry are bound to grow and develop.

Chapter 8. Incumbent's Activities in PropTech

8.1 Setup of Interviews

In order to select an incumbent firm to interview, a selection criterion was developed. First, the corporate should have an asset value of over €50 Million. Second, the organization should either be partaking in a construction or real estate project in Belgium or be part of the PropTech Lab (Belgium) ecosystem. Choosing to gain insights from an incumbent within the PropTech network would validate or negate the assumptions, in previous chapters, that incumbents are aware but doubtful to invest in early-stage innovations. The third criterion was that the incumbent firm should be part of any of the real estate and construction value chain. This means that the interviewed firm can either be an architect, developer, designer/engineer, contractor, or even an investor. The fourth criterion is that the interviewee should be a decision-maker in the firm. In other words, the interviewee should either be the head of a department, a director, or a C-Suite representative. Hence, Table 6 presents the profiles of the 6 incumbent firms.

Having set these criteria, I connected with over 20 construction and real estate corporate representatives that are members of PropTech Lab (Belgium), however, 6 of whom agreed to be interviewed. The interviews were approximately 1 hour long and were conducted online. The set of questions was divided into 4 different sections. The first part focuses on the corporate scanning process. The next category of questions focuses on how incumbents seize and evaluate the startup and innovation.

Consequently, I try to gain some insights into how corporates would transform or react to potential disruptive innovation in PropTech to uncover the incentives and readiness of these firms to invest in PropTech disruptive innovation. In the final segment of the interview, the incumbent highlights their general pains and challenges in the industry. The last part of the interview is also key because it will help highlight the triggers of these incumbents to venture into PropTech innovations. Table 7 below highlights the profiles of the 6 incumbent firms interviewed.

Description	Inc1	Inc2	Inc3	Inc4	Inc5	Inc6
Position in the Value Chain	Developer	Engineering	Developer	Asset Mgt.	Developer	Construction
Interviewee Title	Head of Innovation	Lead Design and Engineering	Innovation Director	CEO	CEO	Development Manager

Asset	< €100M	< €100M	> €100M	> €100M	> €100M	< €100M
Valuation						

Table 7 Characteristics of the incumbent firms.

8.2 Sensing Activities

Various exciting observations have been made during the interviews with the incumbents. In relation to that, Inc1 explained they have always considered themselves smart movers rather than first movers because that has always been the hierarchical decision of the firm. Nonetheless, after becoming a member of PropTech Lab, they have selected 3 different focus themes to develop: (1) innovation, (2) digitization, and (3) sustainability. They also segmented their vision of innovation into PropTech Lab's 5 categories: finance and invest, design and build, manage and operate, market and transact, live and work. They also use the network within the Lab's ecosystem to get in contact with startups. Inc1 said: *"the diversity of professionals, experts, innovators, and investors in the ecosystem of PropTech Lab has provided us a reliable channel to many startups we are now working with on different projects."*

On top of that, Inc1 monitors different supplier activities in the market. They reason that, more times than often, these suppliers are more aware of the new tools and software being developed because *"they have more time to discover and scan for innovation."* However, Inc1 believes that searching, scanning, and recognizing early-stage potential successful innovations is difficult in the construction and real estate industry because the innovations in the development phase are kept hidden from the public. That is why they have hired a full-time innovation manager tasked to recognize potential innovations for future investments and adaptation.

Likewise, Inc3 is also part of different PropTech Networks. In addition to PropTech Lab, Women in PropTech and PropTech Think Tank, Inc3 continuously attends conferences, exhibitions, and seminars to stay up-to-date with all types of technology-enabled innovations. In addition to that, Inc3 said that all large corporate firms in the industry are very well connected to each other. Therefore, any interest from any incumbent would signal a potential positive trend. More so, Inc3 dedicates a speed-dating event for startups to pitch their product to them. On the other hand, while Inc3 also monitors their competitors' activities in the market, they are aware that their innovation focus is different from their competition, and therefore indicated this is not their primary source of sensing.

Similarly, Inc5 also said their first source of innovation inspiration is their network. Talking to peers in the industry as well as being part of different organizations and ecosystems such as PropTech Lab has always provided the organization with reasonable projections to innovation trends for the market. Being well connected with different players and actors in the industry, their network has served as a robust innovation-scanning technique for so long. More so, while connecting with architects, designers, engineers, realtors, and asset and property managers, Inc5 always tries to understand the market needs through their customers. In addition to that, Inc5 agreed that suppliers

could also be a source of inspiration, as they are constantly testing and developing new solutions to the market. However, if that is not the case, they will go into conversations with startups that might result in partnerships. Rarely, Inc5 said: *"Would we monitor our competitors' activities because following other firms' investments is not aligned with our founder's vision and strategy."*

Contrary to Inc3, Inc2 said their innovation sensing mechanism is a bottom-up approach by monitoring their clients', partners', suppliers', competitors', and other non-competitor firms' activities. In other words, when employees get inspired through various channels, they will communicate it to the upper management, who will take the decision to either adopt or reject the innovation. What has also been an interesting observation is that because Inc2 is an international player, their global network allows them to perform the same sensing activity in different countries and then exchange different ideas for different countries.

Similarly, Inc4 also uses its international network to get creative inspiration from different European countries. More so, being part of Belgium and Eastern Europe, Inc4 has joined two different PropTech ecosystems. Inc4 said: *"This would give us 10 years of competitive advantage ahead of other firms because Eastern European countries have the ability to take risks"*. In addition to that, they have an open-door policy for innovative startups that have a good quality product to try their technologies on different projects. That is why startups that are not visible in the market are approaching them directly. One of the other strategies discussed during the interview was that, while Inc4 is also interested in what the competition is doing, it is not the ideal way of sensing for innovation because the Eastern market is still a maturing market and lacks the resources to adopt technologies from other countries.

Nevertheless, they take the initiative to communicate and engage with solutions suppliers. For instance, engaging with smart parking providers would attract new customers to Inc4. Hence, Inc4 said: *"It is a combination of having a well-known name in the market, attracting the attention of startups to share ideas, speaking to different suppliers, and still looking at different parts of Europe to see what is available there and see if it can be implemented."*

In like manner, Inc6 uses 3 ways of innovation-sourcing. First, because they are well-established in the real estate and construction industry, the firm uses their network as a primary source of innovation sensing to learn about different opportunities and upcoming trends. During the interview, Inc6 mentioned that they attend a lot of network opportunities that deliver interesting discussions about market trends, potential disruptions, and technologies. Second, their internal environment and their external ecosystems. Internally, the team constantly shares articles of new innovative developments and market insights through academic papers that the team is reading. While on the other hand, their external ecosystems, such as the PropTech Lab, provide them with practical insights from different members of the community. Moreover, while they do not invest time in contacting startups, they keep their doors open for startups to initiate engagement with them. However, on a group level, Inc6 will only seek technologies that pass their evaluation criteria and show potential trends for the future of the industry.

Therefore, unsurprisingly, the primary sensing mechanism used by all incumbent firms is the network they have established throughout the years. This system enables incumbent firms to signal, communicate and indirectly share inspirations between their respective firms. Second, incumbents use different PropTech networks such as PropTech Lab and other exhibition and conference events. PropTech Lab, as one of the incumbents explained, provides them with practical and theoretical information and services to connect with upcoming market trends and startups of the community. Third, while the incumbents also expressed their interest in engaging with startups, the different levels of engagement differ. That has been justified by the corporate's geographical location and the scale of projects they are undertaking. The last 2 sensing mechanisms were monitoring of suppliers and competitor activities. Respectively, on the one hand, incumbent firms see suppliers as having more time to search, test, and develop new innovations. On the other hand, while many incumbents agree that competition is healthy for the industry, they also agree that each organization has different innovation targets and projects requiring different technologies to adopt. Hence, looking at the competitor's activity is the least favorite.

8.3 Seizing Activities

Consequently, after scanning, sensing, and recognizing the innovation and the startup, the next step is the seizing activities of the incumbents. While each incumbent presented their own methodology in evaluating startups, all 6 incumbents repeatedly focused on Cooper et al., (2002) scoring method, presenting their 3 key elements: (1) the product, (2) the team, and (3) the market readiness. This was the expected mindset because corporations need tangible and obvious characteristics to assess. For instance, because the real estate and construction industry have a long-term relationship with the end-user, Inc1 focuses on the instant benefits of the product and the efficiency and reliability of the after-sales services of the startups. They would internally test the technology in their own company buildings and then scale it up to future projects. Inc1 explains:

"The simple and direct criteria help us choose the startups that are the most reliable and fast to implement their technologies for our assets. Also, because we are Real Estate for Real People, we need to quick wins from low hanging fruits".

However, for the long-term (disruptive innovation) targets, on top of the short-term evaluation criteria, Inc1 would also require an in-depth analysis of future market readiness, end-user acceptance, legislations, and patent guarantees.

On the other hand, while again the product, market, and team are the key evaluation elements, Inc2 makes 2 exciting statements. First, for Inc2, there is no one evaluation standard for technologies; instead, it is a case-by-case assessment process. Because they are an international company, they also consider the geographical location of the startup to meet the different geographical needs. The second criteria they would look into is the speed of the product's commercial value. In other words, for example, because they are an engineering company, how quick and

straightforward can an investment in BIM solutions be realized. Investing in a technology or innovation that is hard to commercialize would not be a logical activity for Inc2. Nonetheless, if the technology has multiple innovative solutions in the sustainability metrics, it will be included in their growing portfolio, which will be later selected into their incubator program for pilot projects.

For Inc3, an interesting observation was noticed. Even though Inc3 also evaluates the product, team, and market, they also focus on their 3 main points: (1) disruptiveness, (2) sustainability, and (3) user experience. When evaluating disruptiveness, Inc3 asks 3 questions: *"How can the startup's technology increase the valuation of our properties? How can the technology position our buildings better? How can the technology help us maintain our leading position in quality of service to the end-user of the buildings?"* In addition to that, the disruptive technology should also be present as a novel idea and not a mainstream solution. Because, for Inc3, if the technology is mainstream, it will come from big industrial and I can request it from big industrial companies. This is a logical criterion for sustainability as it is aligned with the EU Commission regarding the Net Zero emissions goals. Finally, Inc3 justifies the importance of looking at the user experience of a product by explaining that the user experience is *"something that is totally forgotten from the building sector, yet it exists in all other industries."*

Inc4 reasons that incumbents, such as themselves, need guarantees that a startup would still be in the market in 5 years. Hence, a strong management team and a market that needs the offered product can be good indicators of a startup's potential. Also, for Inc4, one of the elements they consider when evaluating a startup and its technology is whether they can implement the innovation into new projects and scale the solution in existing buildings. In other words, Inc4 highly values platform technologies that can be adopted in several other assets or previous products.

For Inc5, the company's interest is divided into 2 categories: (1) intellectual interest and (2) business interest. On the one hand, if the technology solves an existing need and a similar product is found in the market, it is considered a business interest, and the company will be willing to invest in it. If there is a business interest, the incumbent will study the use-cases of the startup, including their unique selling point (USP), their date of establishment, the management and team, and the market they are operating in. However, if the technology is too radical and the market is not ready for it, they will only keep an eye on it. For example, the current market is not ready for taxi drones, drone delivery, and drone sharing technologies, so this remains an intellectual interest rather than a business interest. Inc5 justifies this by claiming: *"that is something we would like to do; yet, I do not think that someone will choose to live in our buildings just because of a landing pad over their house. It is like an added value, but not the most important thing"*.

Lastly, though Inc6 does not believe in *"creating a solution for a non-existing problem,"* they also know that innovation comes in different forms: product innovation, business model innovation, alternative innovations, and technological innovation. Adding to that, Inc6 also states that if a startup introduces themselves, Inc6 would assess 4 elements: market readiness, the team behind the product, market interest, and the legislations around the technology. For market readiness,

interest, and regulations, if the technology does not have the required documentation for instant adoption, Inc6 is unwilling to invest in an unproven technology. Furthermore, the mindset and goals of the startup should be aligned with that of Inc6. For instance, a non-climate cautious solution would not excite Inc6 to invest. That is justified by having a long-term business commitment, and as an incumbent, they cannot afford to take unnecessary risks.

Accordingly, incumbents continuously reported 4 common elements vital to their evaluation process: (1) the importance of analyzing and studying the market, (2) the team behind the innovation, (3) the product itself, and (4) having an innovation portfolio management system. Additionally, Inc1, Inc2, Inc3, Inc4, Inc5, and Inc6 continuously presented themselves as smart-movers rather than pioneers in innovation. Again, this is not surprising because studies show that incumbents are less likely to be assertive risk-takers.

8.4 Transforming Activities

Accordingly, the incumbents have developed specific actions to react to potentially disruptive innovations and transform their organizational strategies into investors ready for innovation. For instance, Inc1 is currently transforming its internal structure to provide more innovation focus to upcoming projects and retrofit innovations in the existing. Besides allocating resources to sustain their innovation and focusing on the existing customers through redesigning their existing buildings, Inc1 also plans to scale up the technologies they have tested onto their future projects. During the interview, Inc1 explains: *"For the long-term innovation focus, technologies such as blockchain and tokenization can be quite disruptive. We chose to go down the 2-sided path, sustained and disruptive, because we need to provide and develop instant innovations and technologies for our customers. On the other hand, we need to plan for the future of the real estate and construction and analyze some innovations that can become disruptive"*.

On the other hand, now more than ever, Inc2 realizes that their clients are expecting more from them. More so, this was also accelerated by the new EU legislation and regulations. Therefore, in the last 2 years, they have directed their innovation focus towards a short-term and a long-term plan. To be able to quickly serve the market and scale up the use of the technology-enable innovation, Inc2 prefers to internalize the evaluated innovation by merging and acquiring the startup. Inc2 justifies this decision by explaining the reason behind acquiring the startup: *"First, we do not have a lot of time to focus on developing our own innovations. Second, creating a tailor-made product and then testing it out on different phases also takes time. We also know that we are not the first movers or huge risk-takers in the industry. So, if we see that a startup's innovation or technology is good and qualified, we acquire the startup and then tailor-made some specific details to our standards"*.

Conversely, Inc3 and Inc4 prefer integrating a PropTech solution into their buildings rather than acquiring startups. For both incumbents, there are several reasons not to buy the startup. First, Inc4

explains that competition is healthy. Therefore, granting the startup the option to pilot their own technologies would allow the innovation to develop further without the constraints of a corporate. Inc3 adds that it is easier to abort a project with an early-stage innovation if they just partner with the startup. However, both organizations also claim that if an exceptional startup shows significant potential with their innovation, it is possible to be a shareholder company in an independent new company with its own business model and its own team and invest in the startup. In other words, Inc3 and Inc4 would invest in other startup companies, as a holding company or a shareholder company, if the innovation is unique, disruptive and the incumbents can benefit from its success.

Respectively, Inc5 explains that although they realize that some technologies such as 3D printing, blockchain, tokenization, and grid technologies present potential disruption to the industry, they believe that it is still early for a positive growth to their business. The CEO believes that as a construction and developer company, they are more concerned about implementing and investing in new strategies to achieve the EU strategies and decrease the carbon emissions from the real estate and construction industry. In addition to that, Inc5 also believes there are industry barriers that would prevent a sudden disruption. Inc5 explains: *"We saw the adoption of smart contracts in other countries; however, this is quite difficult to work in Belgium. We have different legal entities that will not accept being cut off, such as registration offices, notaries, legal offices, and realtors. Therefore, it is not on an organization level, rather on an industry as a whole"*.

For Inc6, after realizing the potential of PropTech innovations, they have underlined their organizational strategy for the next couple of years. They have understood the EU legislations, the regulations of decreasing carbon emissions, and the importance of user experience. Hence, they have combined all these elements into a modular architecture. This concept allows Inc6 to bundle different offers into one project strategically. In other words, modular architecture and modular construction is a systematic process of pre-fabricating homes and installing them directly on site. This procedure allows Inc6 to offer their customers a wide range of pre-selected designs, materials and finished at a competitive market price. In addition to that, while technologies such as tokenization and blockchain as of the incumbents' interest now, they are not of added value to their customers. Nevertheless, if they were to move into an investment market, that would be one of the things they have to keep in the back of their heads.

8.5 Challenges Within PropTech Innovations

Interestingly, a link can be made between the reactions and transformation activities the incumbent firms are doing and their challenges within the innovation ecosystem. In other words, while corporates are aware of disruptive innovations such as blockchain, tokenization, energy mutualization, and climate cautious technologies, they are more reluctant to invest in them heavily. For instance, Inc1, Inc2, Inc4, and Inc6 said that the most challenging part of innovation is its commercialization. The reason is that the risk of not seeing an early return on investment (ROI) and the difficulty of not being able to translate the cost into an investment or profit generation

mechanism are some of the challenges that are pulling back incumbents to invest in these technologies.

The second challenge present by Inc3 is the sense of skepticism when it comes to PropTech innovations. With an ample amount of innovations that are being developed, Inc3 believes there is uncertainty towards the direction of the industry. *"The biggest challenge also for innovation is to turn the lack of certainty to opportunity. As developers, we love to change the city, buildings, and different spaces. However, the question is in which direction and which innovation is the best for us?"* Inc3 expressed.

Additionally, for Inc5, their biggest innovation challenge is to change the mindset of people. Aligned with the findings of RICS, Association, T. S., Surveyors, S. o. C., & GoReport (2020), changing the shareholder's mindset of traditional business methods is a complicated task to overcome.

Chapter 9. Discussion

For the incumbents, it is vital to understand how to look for technology, what process they will use, how they will be sourcing for startups, and how to manage these companies. Therefore, the purpose of investing in startups should be two-fold: managing startups and the commercial agreement with them. When established organizations venture into an investment with a startup, they tend to work closely with the startups and ask for exclusive rights regarding their products. In order to help startups progress, corporates should separate the decision-making process between investing in technologies, managing startups, and the commercial agreement they have with them.

It is also crucial to point out that, in line with previous literature introduced by Chandy & Tellis (2000), a disruption in the construction and real estate industry is bound to happen due to the established firms' reluctance to invest in early-stage innovation because of the low rewards and vague incentives. Another indicator of potential disruption in PropTech is the incumbents' decisions of staying closer to their customers. In their study, Bower & Christensen (1995) also found that focusing solemnly on existing customers can blind the incumbent from the importance of innovating.

Accordingly, the case study introduced the innovations within PropTech's 5 categories. More so, from secondary data presented by PropTech Lab, it was clear that startups are most active in digital innovations such as investment platforms, BIM, property listings, collaboration platforms, and CRM software. However, data also show that 47.40% of EU startups are developing innovations in niche markets and are still operating in the validation phase. According to Christensen (1997), technologies that are operating in low-end markets have the potential of disrupting the market, because with time, as the innovation evolves and investments are made, the technology can overtake the existing product (Danneels, 2004); hence, startups that are still in the early stages of endorsements have the potential of disrupting the market.

With that in mind, the interviews with the incumbent firms have resulted in two interesting discoveries. First, while it was clear that the corporate firms share similar sensing mechanisms to search for technologies, it comes with no surprise that they also share the same interest in similar technologies in PropTech. On top of that, it also comes with no surprise that although the incumbents are aware of the potentially disruptive technologies in the industry, they are hesitant to invest and implement them.

Chapter 9. Conclusion

At first, this master thesis began by introducing innovation and the four quadrants. An in-depth explanation was then provided for Bower and Christensen (1995) theory of disruptive innovation. Accordingly, this paper listed multiple ways to disrupt the incumbents' market position or their product or service existence and the diverse set of tools the well-established organization can utilize to prevent or overcome disruption. Having established that chain of thought, a research question was raised: how can incumbent firms recognize and prepare for disruptive innovations? This paper also introduced PropTech as a disruptive movement to the traditional real estate and construction industry. Hence, the purpose of this study is first to analyze whether PropTech could lead to potential disruption. Second, to examine whether there is an alignment of activities between the startups, the VCs, and that of the incumbent firms. Third, this study also aims to uncover the readiness of the corporates to invest in PropTech disruptive innovation. Finally, the thesis intends to highlight the incumbents' best practices to prevent disruption.

9.1 Main Findings

Some findings have been realized. While the literature presented multiple ways for established organizations to recognize and react to disruptive innovations, the interviews with the VCs and the incumbents have pinpointed the most common behaviors. For instance, the venture capital firms and the corporates agree that having a solid network is the primary sensing tool to discover new potential PropTech innovations. A strong network can indicate and communicate what new technologies are likely to grow to different stakeholders. Additionally, conferences, events, and exhibitions also allow the incumbent to get to know the startup's team and product, which is key in evaluating the qualifications of the startup. Other common sensing mechanisms between the VCs and the established firms are engaging with innovation centers such as PropTech Lab and engaging with startups on pilot projects and initial small-scale projects.

Respectively, both the VCs and the incumbents agree that the 3 key elements in evaluating potential disruptive innovation include the team, the product, and the market readiness. While that is true, some differences have been made. First, incumbents also focus on product commercialization and the legislation and regulations that come with the technologies. These criteria are expected to be evaluated by the incumbents because Guo et al. (2019) highlighted similar disruptive technological features, market dynamics, and external forces indicators in their study. Another way incumbents and VCs prefer to evaluate innovations is with an innovation portfolio management system. Through value maximization, a balanced portfolio, a strategic fit, and having the correct number of projects, an IPM helps categorize the innovations into quick investments or future investments, respectively (Cooper et al., 2002).

While almost 18% of the PropTech startups have matured or have been acquired by corporates (Figure 20), other startup activities are yet to receive validation from the market. More so, secondary data show that more than half of the total number of startups mainly focus on the design and build, market and transact, and manage and operate segments of the real estate value chain. In other

words, almost 1,400 new venture firms are focused on innovations in property listings and marketplaces, ERP systems, intelligent infrastructure, BIM, energy efficiency, investment platforms, online real estate agents, 3D/VR marketing, CRM systems, and Collaboration platforms.

Accordingly, all venture capital firms interviewed agree that the digitization movement in PropTech is overwhelming and with limitless potential and that technology-enabled innovation in the construction and real estate industry is creating an overlap of sectors in different industries. For example, the technologies that operate in the finance and invest categories, such as blockchain and tokenization, are an intersection of both the finance and the construction industries. Also, aligned with the EU's green new deal and climate-cautious regulations, all 3 VCs have decided to focus on investing in startups that are active in technology-enabled innovations aimed at decreasing the industry's CO2 emissions and helping property managers, asset managers, real estate companies and other industry players achieve these new goals.

Similarly, incumbents expressed that their short-term innovation focus is on technology-enabled innovations that efficiently execute tasks and promote positive end-user experience in different categories. For example, innovations with high-startup activity, such as asset management, facility management, digitization of processes, digital community platforms, circular economy, energy-saving, green technology, and on-demand services, are crucial for the incumbents. On the other hand, PropTech innovations with low-startup activities such as gird-technologies, energy sharing applications, modular construction, smart contracts, blockchain, and tokenization have the potential of disrupting the industry.

Furthermore, the incumbent challenges, such as unclear ROI, difficulty to commercialize the innovation, and innovation uncertainty align with the indicators to potential disruption that was previously highlighted in the literature. In other words, the PropTech challenges of the corporates are clear markers of possible industry disruption.

Moreover, in line with Charitou and Markides (2003) five different ways to respond to disruption, incumbents have expressed multiple ways to react to potential disruption. First, doing nothing and remaining close to their customers to serve their existing customers is one of the methods the corporates choose to undertake. Second, having an ambidextrous approach or becoming a shareholder within a startup is familiar to some incumbents. Third, one of the incumbents explained that their company usually acquires the startups to internalize their products. Finally, the last method of reacting to an innovation disruption is by taking advantage of the company's strong foothold in the industry and being able to mass-customize product offerings to their clients. The figure below presents the top preferred activities for incumbents to recognize and prepare for disruption.

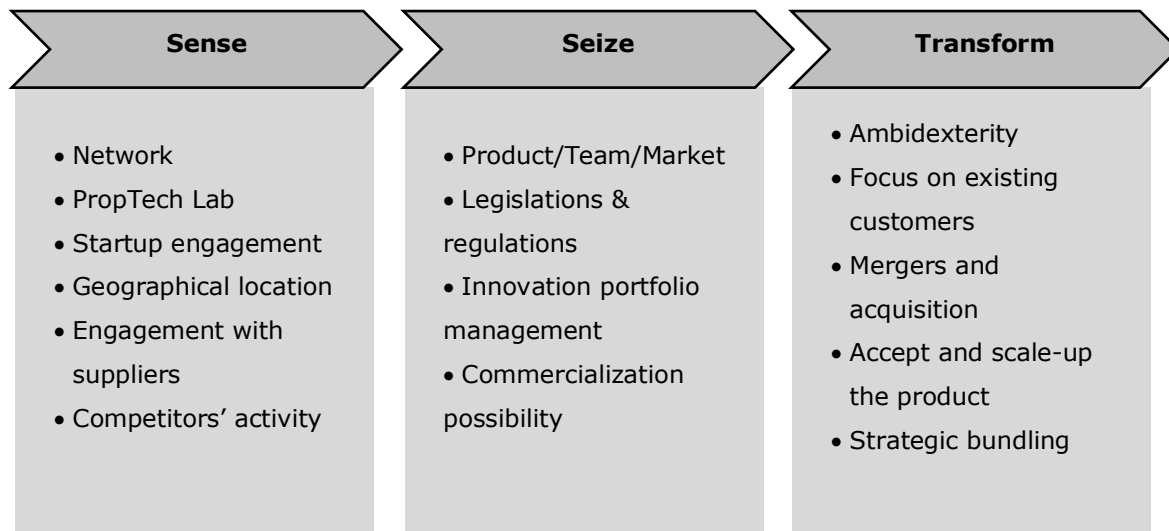


Figure 22 Steps to scan, seize, transform and react to disruptive innovation.

9.2 Limitations & Recommendations

While the information contributed to this thesis comes from exceedingly valuable references and sources such as PropTechLab (Belgium) and several highly ranked venture capital firms and real estate and construction corporates, this research also sees some limitations. First, it is essential to note that this thesis conducted a limited number of interviews with VC firms and traditional firms. Hence, it is recommended to study the market further for a more detailed study. Second, there has been minimal previous research on property technologies as an industry, and few investigations looked at the effects of disruption innovations in PropTech. Therefore, while this study presented insights on potential disruptive innovations in PropTech and perceptions on the incumbent's sensing, seizing, and transforming mechanisms against the VCs, this study could not further examine the incumbent disruptions in detail.

In addition to that, it was clear that one of the reasons for the lack of disruptive innovation in the construction and real estate industry is that the European traditional real estate market is risk-averse. Meaning, while the current market is witnessing new technology-enabled innovation, the digital transformation of the real estate value chain is slow. Nevertheless, Dirk Paelinck, The Chairman of the European PropTech Association – PropTech House, explained that in order to cope with the EU new Green Deal, the real question incumbents should ask themselves is not whether they should invest in PropTech innovation but rather which PropTech innovation and how? Following the same chain of thought, this question presents the basis of future research in PropTech.

References

- Adner, R. (2002). When are technologies disruptive? A demand-based view of the emergence of competition. *Strategic management journal*, 23(8), 667-688.
- Anthony, S. (2016). Kodak's downfall wasn't about technology. *Harvard business review*, 15, 1-5.
- Anthony, S. D. (2005). Do you really know what you're talking about. *Strategy & Innovation*, 4.
- Anthony, S. D., Johnson, M. W., Sinfield, J. V., & Altman, E. J. (2008). *The innovator's guide to growth: Putting disruptive innovation to work*: Harvard Business Press.
- Assink, M. (2006). Inhibitors of disruptive innovation capability: a conceptual model. *European journal of innovation management*.
- Audretsch, D. B. (2001). Research issues relating to structure, competition, and performance of small technology-based firms. *Small business economics*, 16(1), 37-51.
- Bain, J. S. (1956). Advantages of the large firm: production, distribution, and sales promotion. *Journal of marketing*, 20(4), 336-346.
- Banker, R. D., Wattal, S., & Plehn-Dujowich, J. M. (2011). R&D versus acquisitions: Role of diversification in the choice of innovation strategy by information technology firms. *Journal of management information systems*, 28(2), 109-144.
- Baum, A. (2017). PropTech 3.0: the future of real estate.
- Baum, A., Saull, A. and Braesemann, F. (2020). *PropTech 2020: the future of real estate*. Retrieved from Oxford: <https://www.sbs.ox.ac.uk/sites/default/files/2020-02/proptech2020.pdf>
- Besanko, D., Dranove, D., Shanley, M., & Schaefer, S. (2009). *Economics of strategy*: John Wiley & Sons.
- Bledow, R., Frese, M., Anderson, N., Erez, M., & Farr, J. (2009). A dialectic perspective on innovation: Conflicting demands, multiple pathways, and ambidexterity. *Industrial and Organizational Psychology*, 2(3), 305-337.
- Blees, J., Kemp, R., Maas, J., Mosselman, M., & May, Z. (2003). Barriers to entry. *Zoetermeer, Scientific Analysis of Entrepreneurship and SMEs*.
- Bloom, N., Jones, C. I., Van Reenen, J., & Webb, M. (2020). Are ideas getting harder to find? *American Economic Review*, 110(4), 1104-1144.
- Bonzom, A., & Netessine, S. (2016). How do the world's biggest companies deal with the startup revolution. *INSEAD Business School and 500Startups*.
- Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: catching the wave.
- Brad, S., Murar, M., & Brad, E. (2016). Methodology for lean design of disruptive innovations. *Procedia CIRP*, 50, 153-159.
- Braesemann, F., & Baum, A. (2020). PropTech: Turning real estate into a data-driven market? Available at SSRN 3607238.
- Calia, R. C., Guerrini, F. M., & Moura, G. L. (2007). Innovation networks: From technological development to business model reconfiguration. *Technovation*, 27(8), 426-432.
- Chandy, R. K., & Tellis, G. J. (2000). The incumbent's curse? Incumbency, size, and radical product innovation. *Journal of marketing*, 64(3), 1-17.

- Chao, R. O., & Kavadias, S. (2008). A theoretical framework for managing the new product development portfolio: When and how to use strategic buckets. *Management science*, 54(5), 907-921.
- Chaparro, X. A. F., de Vasconcelos Gomes, L. A., & de Souza Nascimento, P. T. (2019). The evolution of project portfolio selection methods: from incremental to radical innovation. *Revista de Gestão*.
- Charitou, C. D., & Markides, C. C. (2003). Responses to disruptive strategic innovation. *MIT Sloan Management Review*, 44(2), 55-63A.
- Chemouny, R., Weir, A., & Pyle, A. (2018). *The Road To Opportunity. An annual review of the real estate industry's journey into the digital age*. Retrieved from <https://assets.kpmg/content/dam/kpmg/fr/pdf/2018/11/fr-KPMG-Global-PropTech-Survey-2018.pdf>
- Chen, P.-Y., & Hitt, L. M. (2006). Information technology and switching costs. *Handbook on Economics and Information Systems*, 1, 437-470.
- Chevalier-Roignant, B., Flath, C. M., & Trigeorgis, L. (2019). Disruptive innovation, market entry and production flexibility in heterogeneous oligopoly. *Production and Operations Management*, 28(7), 1641-1657.
- Christensen, C. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Review Press.
- Christensen, C., & Raynor, M. (2013). *The innovator's solution: Creating and sustaining successful growth*: Harvard Business Review Press.
- Christensen, C., Raynor, M. E., & McDonald, R. (2013). *Disruptive innovation*: Harvard Business Review.
- Christensen, C. M. (2003). *The innovator's dilemma: the revolutionary book that will change the way you do business*: Harper Business Essentials New York. In: NY.
- Christensen, C. M. (2006). The ongoing process of building a theory of disruption. *Journal of product innovation management*, 23(1), 39-55.
- Christensen, C. M., McDonald, R., Altman, E. J., & Palmer, J. E. (2018). Disruptive innovation: An intellectual history and directions for future research. *Journal of Management Studies*, 55(7), 1043-1078.
- Christensen, C. M., & Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard business review*, 78(2), 66-77.
- Church, J. R., & Ware, R. (2000). *Industrial organization: a strategic approach*: Citeseer.
- Clark, G. (2003). The disruption opportunity. *MIT Sloan Management Review*, 44(4), 27.
- Clayton, J., Fabozzi, F. J., Giliberto, S. M., Gordon, J. N., Liang, Y., MacKinnon, G., & Mansour, A. (2019). The World's Oldest Asset Class Enters the 21st Century: How Technology Is Transforming Real Estate Investment. *The Journal of Portfolio Management*, 45(7), 14-23.
- Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2002). Portfolio management: fundamental to new product success. *The PDMA toolbook for new product development*, 1, 331-364.
- Cruz-Sanchez, O. M., Sarmiento-Muñoz, M. H., & Dominguez, O. F. C. (2020). Disruptive Innovation and Dynamic Capabilities Approach: Sensing, Seizing, and Transforming. In *Eurasian Economic Perspectives* (pp. 271-286): Springer.

- Danneels, E. (2004). Disruptive technology reconsidered: A critique and research agenda. *Journal of product innovation management*, 21(4), 246-258.
- Deloitte. (2020). Proptech on the move. *Real Estate Predictions 2020*. Retrieved from <https://www2.deloitte.com/nl/nl/pages/real-estate/articles/proptech-on-the-move.html>
- Dijk, M., Wells, P., & Kemp, R. (2016). Will the momentum of the electric car last? Testing a hypothesis on disruptive innovation. *Technological Forecasting and Social Change*, 105, 77-88.
- Dooley, L., & O'Sullivan, D. (2007). Managing within distributed innovation networks. *International Journal of Innovation Management*, 11(03), 397-416.
- Drnevich, P. L., & Kriauciunas, A. P. (2011). Clarifying the conditions and limits of the contributions of ordinary and dynamic capabilities to relative firm performance. *Strategic management journal*, 32(3), 254-279.
- Dzhain, N., Nykänen, J. I., Penttinen, E., & Saarinen, T. (2015). *Impact of switching costs and network effects on selection of mobile platforms*. Paper presented at the 2015 48th Hawaii International Conference on System Sciences.
- European PropTech Association – PropTech House (2019). *Demystifying PropTech*. Paper presented at the A Complete Overview of the European PropTech Ecosystem.
- European PropTech House Association – PropTech House (2020a). *European PropTech Association - Proptech House eBook*.
- European PropTech Association – PropTech House (2020b). *European PropTech Association ebook*.
- European PropTech Association – PropTech House (2020c). *Why PropTech a Priority?* Paper presented at the Webinar European Space Agency.
- Eversheim, W. (2003). *Innovationsmanagement für technische Produkte*: Springer.
- Fang, C., Lee, J., & Schilling, M. A. (2010). Balancing exploration and exploitation through structural design: The isolation of subgroups and organizational learning. *Organization science*, 21(3), 625-642.
- Farauo, F. (2019). The Truth About PropTech Funding. Retrieved from <https://www.propmodo.com/the-truth-about-proptech-funding/>
- Felício, J. A., Caldeirinha, V., & Dutra, A. (2019). Ambidextrous capacity in small and medium-sized enterprises. *Journal of Business Research*, 101, 607-614.
- Gavetti, G., Henderson, R., & Giorgi, S. (2005). *Kodak and the digital revolution (A)*: Harvard Business School Publishing.
- Gebremeskel Tesfaye, H., & Nguyen, T. H. N. (2012). Incumbent firms and Response to Disruptive Innovation through Value Network Management: Lessons from Eastman Kodak's failure in the digital era. In.
- Gilbert, C. (2005). Unbundling the Structure of Inertia: Resource versus Routine Rigidity. *Academy of management journal*, 48(5), 741-763. doi:10.5465/AMJ.2005.18803920
- Gilbert, N., Ahrweiler, P., & Pyka, A. (2014). *Simulating knowledge dynamics in innovation networks*: Springer.
- Gompers, P. A., Gornall, W., Kaplan, S. N., & Strebulaev, I. A. (2020). How do venture capitalists make decisions? *Journal of Financial Economics*, 135(1), 169-190. doi: <https://doi.org/10.1016/j.jfineco.2019.06.011>

- Gompers, P. A., & Lerner, J. (2001). *The money of invention: How venture capital creates new wealth*: Harvard Business Press.
- Govindarajan, V., & Kopalle, P. K. (2006). The usefulness of measuring disruptiveness of innovations ex post in making ex ante predictions. *Journal of product innovation management*, 23(1), 12-18.
- Guo, J., Pan, J., Guo, J., Gu, F., & Kuusisto, J. (2019). Measurement framework for assessing disruptive innovations. *Technological Forecasting and Social Change*, 139, 250-265.
- Hafkesbrink, J., & Schroll, M. (2014). Ambidextrous organizational and individual competencies in open innovation: The dawn of a new research agenda. *Journal of Innovation Management*, 2(1), 9-46.
- Han, J. K., Kim, N., & Kim, H.-B. (2001). Entry barriers: A dull-, one-, or two-edged sword for incumbents? Unraveling the paradox from a contingency perspective. *Journal of marketing*, 65(1), 1-14.
- Hang, C., Chen, J., & Yu, D. (2011). An assessment framework for disruptive innovation. *foresight*.
- Hardman, S., Steinberger-Wilckens, R., & Van Der Horst, D. (2013). Disruptive innovations: the case for hydrogen fuel cells and battery electric vehicles. *International Journal of Hydrogen Energy*, 38(35), 15438-15451.
- Harrigan, K. R. (1983). Entry barriers in mature manufacturing industries. *Advances in Strategic Management*, 2(1), 67-97.
- Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic management journal*, 36(6), 831-850.
- Henderson, R. (1993). Underinvestment and incompetence as responses to radical innovation: Evidence from the photolithographic alignment equipment industry. *The RAND Journal of Economics*, 248-270.
- Hopp, C., Antons, D., Kaminski, J., & Salge, T. O. (2018). What 40 years of research reveals about the difference between disruptive and radical innovation. *Harvard business review*, 9.
- Hüsig, S., Hipp, C., & Dowling, M. (2005). Analysing disruptive potential: the case of wireless local area network and mobile communications network companies. *R&D Management*, 35(1), 17-35.
- Kaplan, S. N., & Strömberg, P. E. (2004). Characteristics, contracts, and actions: Evidence from venture capitalist analyses. *The Journal of Finance*, 59(5), 2177-2210.
- Karimi, J., & Walter, Z. (2015). The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry. *Journal of management information systems*, 32(1), 39-81.
- Keller, A., & Hüsig, S. (2009). Ex ante identification of disruptive innovations in the software industry applied to web applications: The case of Microsoft's vs. Google's office applications. *Technological Forecasting and Social Change*, 76(8), 1044-1054.
- Kerin, R. A., Varadarajan, P. R., & Peterson, R. A. (1992). First-mover advantage: A synthesis, conceptual framework, and research propositions. *Journal of marketing*, 56(4), 33-52.
- Killen, C. P., Hunt, R. A., & Kleinschmidt, E. J. (2008). Project portfolio management for product innovation. *International journal of quality & reliability management*.

- Kim, W. C., & Mauborgne, R. (2005). Value innovation: a leap into the blue ocean. *Journal of business strategy*.
- Kim, W. C., & Mauborgne, R. (2014). *Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant*: Harvard business review Press.
- King, A. A., & Baatartogtokh, B. (2015). How useful is the theory of disruptive innovation? *MIT Sloan Management Review*, 57(1), 77.
- Klemperer, P. (1987). Markets with consumer switching costs. *The quarterly journal of economics*, 102(2), 375-394.
- Klenner, P., Hüsigg, S., & Dowling, M. (2013). Ex-ante evaluation of disruptive susceptibility in established value networks—When are markets ready for disruptive innovations? *Research policy*, 42(4), 914-927.
- Kostoff, R. N., Boylan, R., & Simons, G. R. (2004). Disruptive technology roadmaps. *Technological Forecasting and Social Change*, 71(1-2), 141-159.
- KPMG. (2018). *The Road to Opportunity - An annual review of the real estate industry's journey into the digital age*. Paper presented at The Road to Opportunity.
- KPMG. (2020). Real Estate Innovations Overview 2020. Retrieved from <https://home.kpmg/nl/nl/home/insights/2020/07/real-estate-innovations-overview.html>.
- Kumar, N., Scheer, L., & Kotler, P. (2000). From market driven to market driving. *European Management Journal*, 18(2), 129-142.
- Kump, B., Engelmann, A., Kessler, A., & Schweiger, C. (2019). Toward a dynamic capabilities scale: measuring organizational sensing, seizing, and transforming capacities. *Industrial and Corporate Change*, 28(5), 1149-1172.
- Larson, C. (2016). Disruptive Innovation Theory: 4 Key Concepts | HBS Online. Retrieved from <https://online.hbs.edu/blog/post/4-keys-to-understanding-clayton-christensens-theory-of-disruptive-innovation>
- Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. *Business Horizons*, 61(1), 35-46.
- Lucas Jr, H. C., & Goh, J. M. (2009). Disruptive technology: How Kodak missed the digital photography revolution. *The Journal of Strategic Information Systems*, 18(1), 46-55.
- Lutchen, K. R. (2018). Why companies and universities should forge long-term collaborations. *Harvard business review*, 24.
- Lutz, C. H., Kemp, R. G., & Dijkstra, S. G. (2010). Perceptions regarding strategic and structural entry barriers. *Small business economics*, 35(1), 19-33.
- Maududy, C., & Gamal, A. (2019). *Literature review: technologies and property development*. Paper presented at the IOP Conference Series: Earth and Environmental Science.
- McAfee, R. P., Mialon, H. M., & Williams, M. A. (2003). Economic and antitrust barriers to entry. *Nakip, M.(2006). Pazarlama Araştırmaları. İstanbul, Seçkin Yayıncılık*.
- Mention, A.-L. (2019). The Future of Fintech. *Research-Technology Management*, 62(4), 59-63. doi:10.1080/08956308.2019.1613123
- Meyer, M. H., & Marion, T. J. (2010). Innovating for effectiveness: Lessons from design firms. *Research-Technology Management*, 53(5), 21-28.

- O'Brien, B. (2020). PROPTECH: A DISRUPTIVE FORCE IN REAL ESTATE? *REflexion magazine*. Retrieved from <https://www2.deloitte.com/lu/en/pages/real-estate/articles/proptech-disruptive-force-real-estate.html>
- O'Reilly, C. A., & Tushman, M. L. (2004). The ambidextrous organization. *Harvard business review*, 82(4), 74-83.
- O'Reilly III, C. A., & Tushman, M. L. (2013). Organizational ambidexterity: Past, present, and future. *Academy of management Perspectives*, 27(4), 324-338.
- OECD. (2007). *Competition and Barriers to Entry*. Retrieved from <https://www.oecd.org/competition/mergers/37921908.pdf>
- Oyeniya, O., & Abiodun, A. (2010). Switching cost and customers loyalty in the mobile phone market: The Nigerian experience. *Business intelligence journal*, 3(1), 111-121.
- Pisano, G. P. (2019). The hard truth about innovative cultures. *Harvard business review*, 97(1), 62-71.
- Pisano, G. P., & Verganti, R. (2008). Which kind of collaboration is right for you. *Harvard business review*, 86(12), 78-86.
- Porter, L., Fields, D., Landau-Ward, A., Rogers, D., Sadowski, J., Maalsen, S., . . . Bates, L. K. (2019). Planning, land and housing in the digital data revolution/the politics of digital transformations of housing/digital innovations, PropTech and housing—the view from Melbourne/digital housing and renters: disrupting the Australian rental bond system and Tenant Advocacy/Prospects for an Intelligent Planning System/What are the Prospects for a Politically Intelligent Planning System? *Planning Theory & Practice*, 20(4), 575-603.
- Porter, M. E. (1980). *Competitive strategy: techniques for analyzing industries and competitors*. New York: Free Press.
- Porter, M. E. (2008). The five competitive forces that shape strategy. *Harvard business review*, 86(1), 78.
- Prasetya, D., & Fontana, A. (2016). *Seizing Disruptive Opportunities: Factors Enabling Execution of Strategic Innovations*. Paper presented at the ISPIM Innovation Symposium.
- Prasetya, D., Fontana, A., & Afiff, A. Z. (2018). *Defensive Strategy: Exploring the Incumbents' Orientation in Seizing Disruptive Opportunities*. Paper presented at the ISPIM Conference Proceedings.
- PWC, & PropTechLab. (2020). *PropTech Directory*. Retrieved from <https://www.pwc.be/en/FY20/documents/fy20-proptech-ebook-jan2020.pdf>
- Raisch, S. (2008). Balanced structures: designing organizations for profitable growth. *Long Range Planning*, 41(5), 483-508.
- Rasool, F., Koomsap, P., Afsar, B., & Panezai, B. A. (2018). A framework for disruptive innovation. *foresight*.
- Reed, R., Storrud-Barnes, S., & Jessup, L. (2012). How open innovation affects the drivers of competitive advantage: Trading the benefits of IP creation and ownership for free invention. *Management decision*.
- RICS, Association, T. S., Surveyors, S. o. C., & GoReport. (2020). *Technology - Its Position and Impact on Surveying*. Retrieved from <https://goreport.com/wp-content/uploads/2020/05/Proptech-report-2020.pdf>

- Rosenberg, N., & Landau, R. (1986). *The Positive sum strategy: harnessing technology for economic growth*: National Academies Press.
- Ruhe, G. (2010). *Product release planning: methods, tools and applications*: CRC Press.
- Şahin, T., Huth, T., Axmann, J., & Vietor, T. (2020). *A methodology for value-oriented strategic release planning to provide continuous product upgrading*. Paper presented at the 2020 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM).
- Sampere, J. V. (2016). Why platform disruption is so much bigger than product disruption. *Harvard business review*, 4(08), 1-6.
- Sandström, C., Magnusson, M., & Jörnmark, J. (2009). Exploring factors influencing incumbents' response to disruptive innovation. *Creativity and Innovation Management*, 18(1), 8-15.
- Sarkees, M., & Hulland, J. (2009). Innovation and efficiency: It is possible to have it all. *Business Horizons*, 52(1), 45-55.
- Satell, G. (2017). The 4 types of innovation and the problems they solve. *Harv Bus Rev*, 11, 2-9.
- Schlegelmilch, B. B., Diamantopoulos, A., & Kreuz, P. (2003). Strategic innovation: the construct, its drivers and its strategic outcomes. *Journal of strategic marketing*, 11(2), 117-132.
- Schmidt, A. (2018). Strategic reorientation due to competitors' disruptive innovation. In *German-Turkish Perspectives on IT and Innovation Management* (pp. 89-108): Springer.
- Schmidt, G. M., & Druehl, C. T. (2008). When is a disruptive innovation disruptive? *Journal of product innovation management*, 25(4), 347-369.
- Schön, B. (2013). *Mergers & Acquisitions als strategisches Instrument: Die Erschließung technologischen Wissens mittels Unternehmenszusammenschlüssen*: Springer-Verlag.
- Schot, J., & Geels, F. W. (2007). Niches in evolutionary theories of technical change. *Journal of Evolutionary Economics*, 17(5), 605-622.
- Sharp, B., & Dawes, J. (2001). What is differentiation and how does it work? *Journal of Marketing Management*, 17(7-8), 739-759.
- Shaw, J. (2020). Platform Real Estate: theory and practice of new urban real estate markets. *Urban Geography*, 41(8), 1037-1064.
- Simon, H. (2009). *Hidden champions of the twenty-first century: The success strategies of unknown world market leaders*: Springer Science & Business Media.
- Siniak, N., Kauko, T., Shavrov, S., & Marina, N. (2020). *The impact of proptech on real estate industry growth*. Paper presented at the IOP Conference Series: Materials Science and Engineering.
- Stigler, G. J. (1983). *The organization of industry*: University of Chicago Press.
- Tagliaro, C., Bellintani, S., & Ciaramella, G. (2020). RE property meets technology: cross-country comparison and general framework. *Journal of Property Investment & Finance*.
- Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California management review*, 58(4), 13-35.
- Teece, D., & Pisano, G. (2003). The dynamic capabilities of firms. In *Handbook on knowledge management* (pp. 195-213): Springer.
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic management journal*, 28(13), 1319-1350.

- Tellis, G. J. (1988). The price elasticity of selective demand: A meta-analysis of econometric models of sales. *Journal of marketing research*, 25(4), 331-341.
- Tostevin, P. (2021). *The Total Value of Global Real Estate*. Retrieved from https://www.savills.com/impacts/Impacts3_pdfs/The_total_value_of_global_real_estate.pdf
- Tushman, M. L., & O'Reilly III, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California management review*, 38(4), 8-29.
- Ulku, H. (2004). R&D, innovation, and economic growth: An empirical analysis.
- Unissu. (2019). Global PropTech analysis: europe. Retrieved from <https://www.unissu.com/proptech-resources/proptech-europe>
- Urbancova, H. (2013). Competitive advantage achievement through innovation and knowledge. *Journal of competitiveness*, 5(1).
- Valdani, E., & Arbore, A. (2007). Strategies of imitation: an insight. *Problems and Perspectives in Management*(5, Iss. 3 (contin.)), 198-205.
- van den Broek, T., & van Veenstra, A. F. (2018). Governance of big data collaborations: How to balance regulatory compliance and disruptive innovation. *Technological Forecasting and Social Change*, 129, 330-338.
- Viellechner, O. (2010). *Incumbent Inertia in Light of Disruptive Change in the Airline Industry: Causal Factors and Top Management Moderators: An Empirical Case-Study-Based Analysis of the Response Behavior of Four European Incumbent Airlines to Emerging Competition from Low-Cost Carriers*: ibidem-Verlag/ibidem Press.
- Viellechner, O., & Wulf, T. (2010). *Incumbent inertia upon disruptive change in the airline industry: Causal factors for routine rigidity and top management moderators*: Citeseer.
- Walrave, B., Talmar, M., Podoyntsina, K. S., Romme, A. G. L., & Verbong, G. P. (2018). A multi-level perspective on innovation ecosystems for path-breaking innovation. *Technological Forecasting and Social Change*, 136, 103-113.
- Weinreich, S., Şahin, T., Huth, T., Breimesser, H., & Vietor, T. (2021). How to manage disruptive innovation-a conceptual methodology for value-oriented portfolio planning. *Procedia CIRP*, 100, 403-408.
- Weinreich, S., Şahin, T., Inkermann, D., Huth, T., & Vietor, T. (2020). *Managing disruptive innovation by value-oriented portfolio planning*. Paper presented at the Proceedings of the Design Society: DESIGN Conference.
- Wood, D., Pfothenauer, S., Glover, W., & Newman, D. (2013). *Disruptive innovation in public service sectors: Ambidexterity and the role of incumbents*. Paper presented at the European Conference on Innovation and Entrepreneurship.
- Zubizarreta, M., Ganzarain, J., Cuadrado, J., & Lizarralde, R. (2021). Evaluating disruptive innovation project management capabilities. *Sustainability*, 13(1), 1.

Appendix

A - VC Interview Questions

Introductory questions:

1. What is the size of the firm you work for?
2. How long are you already working as a venture capitalist?
3. In which industries is the firm interested to invest in?

Key questions:

1. Which steps do you follow to find an interesting startup to invest in?
 - a. Sensing (How to gather information?)
 - b. Evaluation (Scoring Method)?
 - c. NPV and finances?
2. Which criteria determine that a startup is interesting for investment?
3. What do you think are the unique selling points (USP) within PropTech?
4. What do you think about PropTech?
 - a. Do you see it as disruption or just a financial investment?
 - b. When was your first investment?
 - c. In what areas in PropTech are you currently investing in?
 - d. In what areas in PropTech are you considering investing in?
5. Do you have any ideas about the growth of PropTech startups in Europe?
6. Do you see PropTech as an opportunity or a threat for established firms?
7. How do you compare the attitudes of established incumbent firms change towards PropTech during the last 24 months?
 - a. Which actions do you believe that established firms should take to prepare themselves for the emergence of PropTech?
8. Do you agree with the statement "Incumbent firms should engage with PropTech companies in order to adapt to the changing environment"?
9. When, if ever, do you think PropTech will be taking over the market?
 - a. Are there any specific actions that should be taken to remain market leaders in PropTech innovations?

In the below section, we will discuss "looking within PropTech for disruptive innovation".

- For the purpose of clearly explaining disruptive innovation, I will use the definition of Christensen, Raynor, and McDonald (2013): Disruptive innovation, a process whereby new entrant firms challenge incumbent businesses for a piece of the market and then, with time, successfully rendering the existing product obsolete and effectively becoming the conventional technology.
 - To clearly explain what PropTech is, I will use the definition presented by Clayton et al. (2019): Technologies that are altering all aspects of the real estate business including financing, investing, construction, building, property management, as well as, data collection.
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10. Do you agree with the above definition of disruptive innovation?
 - a. Do you want to add anything to this definition?
 - b. How do you assess disruptive ideas?

11. Would you say that you are searching for disruptive technologies when evaluating potential investments?
12. Considering your experience as a venture capitalist, have you already experienced a disruption in a market?
 - a. Could you explain its emergence and the reaction of incumbents?
13. What do you think the incumbent/established firms could learn from venture capitalists when thinking of disruptive technologies within PropTech?
14. Tell me of areas that you do not see innovation, but we should see innovation in the PropTech industry.
 - a. What would you hope to find in PropTech?

B - Incumbents Interview Questions

Introductory:

1. What is the size of the firm (employees + valuation) you work for?

Key questions:

1. How does your company stay informed on the possible upcoming technologies?
2. How does your company evaluate the potential of these upcoming technologies?
3. When a new promising technology has been identified, which actions or set of actions does your company consider?
 - a. The answers will be checked with the six actions identified in the literature:
 1. Speak to peers,
 2. Universities as a source of information,
 3. Research and development activities,
 4. Suppliers' activities
 5. Competition activities
 6. startup engagement.
 - b. Follow-up question: If an action of the incumbent is in the list above, ask *how and when* is this action followed?
 - c. Follow-up question: If an action is not followed, indicate that a particular action is mentioned in the literature and why that action(s) is not considered by the firm?
4. Are there, at the moment, any new technologies that are coming up in your industry?
 - a. How disruptive are these new technologies?
5. Does your company take actions to prevent it from being threatened by new (disruptive) technologies?
 - a. What are these actions?
 - b. The answers will be checked with the entry barriers discussed in the literature.
 - i. Follow-up question: If the action of the incumbent is in the list of entry barriers mentioned, ask *how and when* is this action followed?
 - ii. Follow-up question: If an action is not followed, indicate that a particular barrier of entry is mentioned in the literature and why that action(s) is not considered by the firm?

- c. Do you feel that any of these technologies might obtain a strong position in your market in the near or long further?
 - i. If yes Why (not)?
 - ii. If not, what are the challenges holding back a larger adoption of PropTech innovations?
- 6. Are there difficulties for an established firm, as you, to take on such new technology in comparison to entrants in the industry?
- 7. Is your company already taking action in response to some of these technologies?
 - a. Which actions for which technologies?
 - b. Do you agree with the statement "Incumbent firms should engage with PropTech companies in order to adapt to the changing environment"?

Note: Questions 3 and 4 will show and compare the awareness/recognition of disruptive innovations, of the incumbents, against their willingness to invest or how much they invested.

- 8. How has the attitude of those in the traditional industry changed towards PropTech in the last 24 months?
- 9. What is the biggest challenge for your organization?