
Investigating the Dynamics of Technology Investments Through Startup Companies in the Construction Industry: A Pilot Study

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Abstract

The construction industry is experiencing a notable growth in innovation and technology adoption, with major corporate entities increasingly prioritizing technology investment through several ways like corporate venturing or the acquisition of products from technology companies. This study investigates construction technology investments through collaboration with startups, aiming to uncover strategies for enhancing innovation in the sector. Interviews with industry experts reveal diverse approaches and decision-making metrics, highlighting mutual benefits such as enhanced digitalization facilitated by small technology firms. The results indicate that human capital and other intangible drivers, such as increasing innovation levels, play a significant role in the collaboration between construction firms and technology startups. By offering practical insights for construction companies and theoretical contributions to the understanding of collaboration for innovation, this study contributes to both academic discourse and industry practices.

1. Introduction

Construction 4.0 emerged to refer to gaining insights into the construction industry through the lens of innovation and enhanced efficiency (Bock, 2015). Due to its labor-intensive characteristics, the construction industry is not known for productivity (Hasan et al., 2018). Therefore, the adoption of technologies is expected to help the construction sector by increasing productivity. However, the adoption of advanced technology solutions is not an easy task due to the complex nature of the construction industry. In the last few decades, researchers have been investigating the opportunities and challenges of technology adoption in the construction industry (Delgado et al., 2019; Hahn et al., 2014; Pradhananga et al., 2021; Sacks et al., 2020). Previous literature shows that integrating advanced technological solutions into construction practices is a problematic issue and this integration endeavor is an ongoing process. However, even though there are a lot of barriers to overcome, collaboration with technology startups was found to help mitigate most of the problems (Brilakis et al., 2019; Sacks et al., 2020). The importance of entrepreneurship in the digital evolution of the construction industry has been highlighted by recent studies (Lam & Mok, 2023; Li et al., 2022).

On the one hand, investing in the products of young companies differs from investing in the products and services of established technology companies due to their inherent characteristics: innovation, uncertainty, high risk, and external dependency (Giardino et al., 2014). On the other hand, despite the accelerated growth of the construction technology ecosystem resulting from the increase in startup establishments (Blanco et al., 2023), no study has been conducted to understand the distinct influence of 'startup' features on the technology investment decision-making processes of construction companies. Therefore, this study aims to reveal the nuances and variations in construction companies' investment in new technologies. The author is a PhD student who focuses on the acceptance of technology startup products/services in the construction industry to enhance innovation and digitalization levels. This study plays a key role in identifying nuances in the various investment types made by corporate construction companies to determine the sample focus for further studies. This study aims to answer the following questions: 1) How do collaborations between corporations and tech startups occur in various contexts in the construction industry? 2) What are the perceived benefits and challenges associated with adopting technology startup solutions in construction projects?

2. Literature Review

2.1. Established vs Startup Technology Companies

While existing research concentrates on the adoption and acceptance of technology within the construction industry, it predominantly delves into technologies offered by established corporate entities. Nevertheless, assessing emerging digital products from technology startups using the same framework as that applied to corporate technologies may lead to overlooking crucial insights. A startup can be defined as a company aiming to develop and validate a scalable business model. Defining a company as startup depends on several company growth criteria. This definition tends to change person to person. For example, according to Wilhelm, 2018, a company cannot be considered a startup after reaching \$100 million in revenue, has over 500 employees, or is valued at \$2.5 billion or more.

Even though both established and startup companies operate in the tech sphere, their landscapes, priorities, and even gravitational pull differ drastically. Especially, finding investor is hard because of the risky and uncertain nature of the startup companies (Nanda & Rhodes-Kropf, 2013). Therefore, having loyal and valuable customers is crucial for startups. As Steiber and Alänge (2020) state, "The strength of small technology startups, as a part of large firms' ecosystems, is their ability to develop new ideas rapidly and test them with early-adopting customers, while a main weakness is a limited ability to scale up for high-volume operations." While existing literature contains some studies on construction technology investments, none of them specifically distinguish startup-specific technology investments in the construction industry.

2.2. Types of Startup Investments

For corporate companies, there are several ways to contribute to the startup ecosystem. These contributions might occur through purchasing startup products, investing in startups via corporate venture capital, or providing them with intangible resources (Kohler, 2016).

2.2.1. Corporate becomes startup customer

The main way for a company to interact with entrepreneurial endeavors is through financial backing. Mutual benefits arise when the startup secures a high-profile company

as a customer, and the corporation discovers a solution to its challenges (Kohler, 2016). Moreover, customer loyalty plays a pivotal role in the context of startups (Garzaro et al., 2020). Such a collaboration with a large corporation can represent a crucial milestone for startups in assessing their product-market fit and expanding their operations.

2.2.2. Corporate venture capital and incubation

Investing in the equity of promising external startups enables a corporation to monitor compelling technologies and markets, exert influence over the decisions of its stakeholders, and potentially gain financial returns (Weiblen & Chesbrough, 2015). Moreover, sometimes rather than exiting, large companies leverage their insights acquired as co-investors to complete the acquisition of a promising startup. Typically, this form of financing is implemented through corporate venture capital. Corporate venture capitalists might not only aim for financial performance but should also align with and support their corporate parent's strategic objectives, such as endorsing startups that develop complementary products and services. Startup incubators contribute to young companies in various ways such as funding, providing consultancy, location, and contacts (Van Weele et al., 2018). Similarly, corporate incubation aims to foster internal innovation and introduce it to the market as an emerging enterprise.

2.2.3. Non-equity investments

In the non-equity investment/collaboration model, the emphasis is placed on making compelling startup products or technologies accessible to the sponsoring organization by empowering multiple startups to develop and implement their ideas (Weiblen & Chesbrough, 2015). This progress involves making decisions faster and simplifying how governance works when dealing with startup companies.

3. Methodology and data

This study utilizes a qualitative method for understanding the decision-making process, drivers, and challenges of construction startup technology investments. Due to the existence of various cases of investing in technology startups, we conducted several interviews with construction experts involved in different technology investment approaches. The data collected through semi-structured interviews, due to the flexibility of the method for discovery research.

3.1. Data Collection

This study aims to understand the dynamics of the engagement between corporate and technology startup companies in the construction industry. First, preliminary interviews were conducted with six individuals possessing experience in the construction technology investment decision-making process. From this group, three participants were selected for further in-depth interviews, allowing us to explore the diverse characteristics of various types of collaborations with startups. As a result, semi-structured interviews provided valuable insights from three key individuals closely involved in distinct cases of corporate-startup collaborations. Table 1 shows the participant information.

The first participant is selected to understand the dynamics of the collaboration through purchasing startup products. The participant works as Virtual Design and Construction (VDC) Manager in one of the largest construction management companies in the United States and involved in VDC-related startup investment decisions. The second participant was selected to understand the collaboration with technology startups through corporate venture capital investing in startups in the built environment. The participant works as Vice President in the company and directly involved in the investment decision-making. The third participant is the Director of Innovation and Operational

Table 1: Participant information.

Interviewee	Role	Country	Experience (years)	Adopted Tech
A	VDC Manager	USA	8	Software
B	Vice President-VC	USA	12	Software + Hardware
C	Director of Innovation, Operational Technology and VDC	USA	13	Software + Hardware

Technology, and they are engaged with equity and non-equity type of collaboration with construction technology startups.

4. Results

The following sections present the results under three sub-sections: Construction company becomes a Customer, Corporate Venture Capital (CVC), and Strategic Partner. The results are also compared in Table 2 to illustrate the differences and similarities in each type of investment.

4.1. Construction company becomes a Customer

For construction companies, one of the most common ways to interact with technology startups is purchasing their products. As innovation becomes an important concept in the construction industry, big construction companies started to found teams focusing on recent technology services and products that would increase company's innovativeness. Interviewee A states their company has a team focusing on creating a dashboard showing technology products they evaluate to invest in. The company list includes technology products developed by startups, as well as by big technology companies. On the other hand, the interviewee stated "*People reach out to me via email. Sometimes it doesn't need to be me*" to explain how they stay informed about current technologies in such a dynamic environment.

They highlighted the flexibility of the offices in terms of technology adoption: "*We are decentralized. So, each office can kind of run things, how they want to run. So, we're not necessarily beholden to this with won't be our on the security side. But if there's something else, we want to try to use it. We're do that as long as it fits with them.*"

The participant was asked how they decide to invest in a technology product with referring to their most recent investment, which is a reality capture product developed by a startup. The decision-making process follows a flow in which the VDC manager meets with the startup company. If the VDC manager is positive about using the product, they then present it to the construction team. The interviewee stated that for 7 of 10 Contech products, the team do not prefer to purchase. "*It can either be the cost or there could be a different software that they want to use. Or we could have something internal that already does something like that. Has anyone in our company used them, which is another red flag like if no one's use them, you're taking a risk because the company doesn't perform well on that first outing. It's got to leave a very bad taste there once. Sorry like you're not ready.*"

The participant was asked about their data sharing policy with the startup company who

wants to improve the product. They stated *“I think they asked to use our data. I don’t see the issue with them trying to do that while we are in contract with them. But I think we get iffy about that, because we don’t want someone just holding onto our data. You know. I’m not sure of the legal reason. But I know that’s the legal team.”*

4.2. Construction company becomes a Corporate Venture Capital

Besides product purchasing, some construction companies prefer to invest in technology startups via venture capital subsidies. Interviewee B is the vice president of a corporate venture capital having more than 100 million funds geared towards investing in in built environment technologies. They state that their main partner is a construction company that executes contracts worth about 5 billion dollars annually. They summarize the collaboration as *“So we are able to leverage them with our close partnership there and the owner of the company invested \$25 million into our fund and we’re essentially able to leverage their industry expertise, you know their job sites.”*

The interviewee explains how the built environment specific funds differentiate from other fundings with *“I think the nuances are really around the potential use cases. So, because we’re kind of sitting inside a general contractor, we see a lot more opportunities and a lot more problems and we see them in a different way. We know exactly what is and isn’t a problem which helps us kind of sort through deal flow a bit faster. So that’s kind of, I guess, superpower. There’s not like 100 buyers in the space. So, you do have to kind of know exactly what is valuable for the industry and make the right bets on the right founders.”*

“You get a spectrum when you get to CVC and we’re very much on that independent spectrum. With that said, there is overlap in or I guess strategic tie in because two of the IC members also have roles within the parent company construction as full-time employees.”

Decision-making criteria for CVC investments show similarities with early-stage VC investment decision-making criteria. *“You’re looking for excellence of founders and like the fundamentals of investing. Not really like you’re looking for product market fit, you’re looking for founder market fit. You’re really looking at companies that can grow fast into a large market and capture market share.”* The firm focuses on early-stage startup investments, which are seed and series A companies. The reason behind this explained by the interviewee as *“I think for us it’s really about valuation. So, the earlier you’re able to get into the company the better the returns ultimately and because we are a financially driven fund, you want to enter at the earliest possible stage. And so, seed and Series A that’s really where you know it’s early enough where the valuation is reasonable where you can still influence what the product looks like.”*

One of the biggest advantages of CVCs is the ability for testing startups’ products. *“We do have the ability to pilot some of these technologies. And so that becomes a very crucial input to some of our diligence. And so for you know especially like robotics companies like does this product actually work, we’re able to evaluate it very, very closely. And so that is a very unique capability that most venture capital funds don’t have, and we can also provide feedback obviously from that back to the company. So like, so in their life cycle you were actually being with them and contributing their process feedback and stuff.”*

Regarding the benefits that the construction company invested in the fund, the interviewee states *“Ultimately our ultimate KPI is going to be how much this company gets bought for when it exists and when that happens that is going to be how we are returning our capital back into our investors. So that’s at the end of the day how what we care about is this company going to exit for a large enough sum to justify the time and effort spent on the investment. So that’s on our end right for the parent company. But again those KPIs are going to be different in terms of like each of the companies that they’re looking at, it could be productivity, it could be growth, it could be ROI investment.”*

On the other hand, the interviewee mentioned the disadvantages of investing construction technology by stating that *“I think it’s continuing to grow even though most of the venture market is falling down and that’s because there’s incredible headwinds for the industry like there’s incredible productivity pressures. A lot of the older generation is retiring and not enough new people are joining the industry. You need to figure out real solutions ultimately. It’s a fragmented market, you know low margins for the innovation side of things. But there’s definitely change needed in the industry, ultimately.”*

4.3. Construction company becomes a Strategic Partner

The last interviewee works as an innovation director of a general contracting company. Besides purchasing startup products, the company engaged with the construction technology startups via investing in a venture capital firm. The interviewee explains the technology investments in the company in different forms, including non-equity approaches. Therefore, this study names this case as a strategic partner. *“I’ll try to break it down first off, we definitely invest internally amongst our own departments. I would say there’s probably a \$3,000,000 internal investment every year that keeps the company giving money to our internal groups to be able to buy technology, research technology and people aligned to our innovation efforts. And with that, we also have key partnerships within universities. We just kind of stay connected with the universities as well as recruiting students and kind of partnering there. We have key industry partners and so anybody that we see that’s sort of innovative in the market. So, we have some sort of pilot program going on in the background with those that we are driving where the products go. And we’re investing in their hardware in return they let us use it, they let us kind of pilot and then give them feedback on how we want it to be shaped. And then I would say internal building ventures are just start-ups. We don’t really live on the bleeding edge with money. We help drive it with knowledge and, but we do just give our money to partner building or partnerships in the venture capital firms and they invest directly. We kind of behind the scenes are a partner with them.”*

The interviewee explains their team role as *“Our internal road map showed that we wanted to be able to capture large sites more accurately and faster. And so, we went and kind of understood that drones in space was one way to do that, but there was no real technology to do it early. When Startup Company XX hit the market, we immediately went to them and had a partnership. We said, all right, this is what we want to do, what is your product currently doing? And for four years we helped them navigate their product to be able to be construction ready. At that point, a venture capital firm said “hey, we’re looking at the drone space and there’s these three companies we’re looking to invest”, and we say we have worked for three years to help Startup Company XX get to where they want to go. We think that’s who you should pick because they’re market ready. And then that will drive them on where to place their money based on them knowing we’ve evaluated the space.”*

The interviewee summarizes the main aim of such technology investment *“And so our company is very invested in allowing me and resources to try to solve these big problems we’ve had for ages with new technology. I think those are the two main goals to be better builders and be innovative and not move backwards. I think when you start to throw money at things, when you start to get more on the bleeding edge of innovation, you don’t want to feel like you’re just throwing money away, right? If you can measure return, if you can understand, hey, is it moving the key business or if we’re giving money to a venture partner that they’re generating revenue off that money, at least something it’s it feels better. So, the goal isn’t to make a bunch of money.”*

5. Main Findings and Limitations

This study aims to discover the nuances in construction technology investments through collaboration with construction technology startups. The interview results we obtained from industry experts engaged in various collaboration approaches with technology startups revealed several ways to enhance innovation levels within construction companies. Although each approach has different decision-making metrics or perceptions of disadvantages, the common benefit is contributing to the digitalization of the construction sector by supporting small technology companies. Table 2 summarizes the main differences between each type of collaboration approach.

Table 2: Interview Results.

	Interviewee A	Interviewee B	Interviewee C
How to find tech startups	Email, Social media	Investor data room, Accelerator programs	Conferences, Expos, Investment advisory panels
Type of the innovation	360 reality capture camera	>70% AI	Drones, PM software
Cost-benefit indicators	Focused on more qualitative benefits	Different KPIs for each type of investment (e.g. transactional and hardware revenues), User and revenue growth, ROI	Qualitative Moving forward, Being more innovative
Benefits	Finding solutions from different perspectives, Flexibility of features	Being able to pilot the products before investing, Using the knowledge of people having operational excellence	Passion and energy of the startup company, Leading to rethink status quo, Learning together
Disad.	New for the employees, Slow improvement, Need for updates	Applied industry, Fragmented industry	Time spent in trial and error, Trying to solve a specific problem of one customer

For startups, success hinges on acquiring investors and loyal customers, as well as establishing a reliable business model to avoid failure. Figure 1 illustrates the similarities and differences between the collaboration types. From the customer's standpoint, construction companies prefer to invest in startups due to their product flexibility and willingness to make adjustments as needed. On the other hand, as demonstrated by Steiber and Alänge, 2020 corporate companies focus more on intangible benefits such as increasing

innovation and technology levels when collaborating with technology startups. These findings align with our results for the construction industry. However, corporate venture capitalists share similarities with traditional venture capital firms; their role is to invest in companies that promise high returns upon exit. In particular, investors like venture capital firms provide not only funds but also strategic business support, which can be beneficial for startups seeking support from corporations.

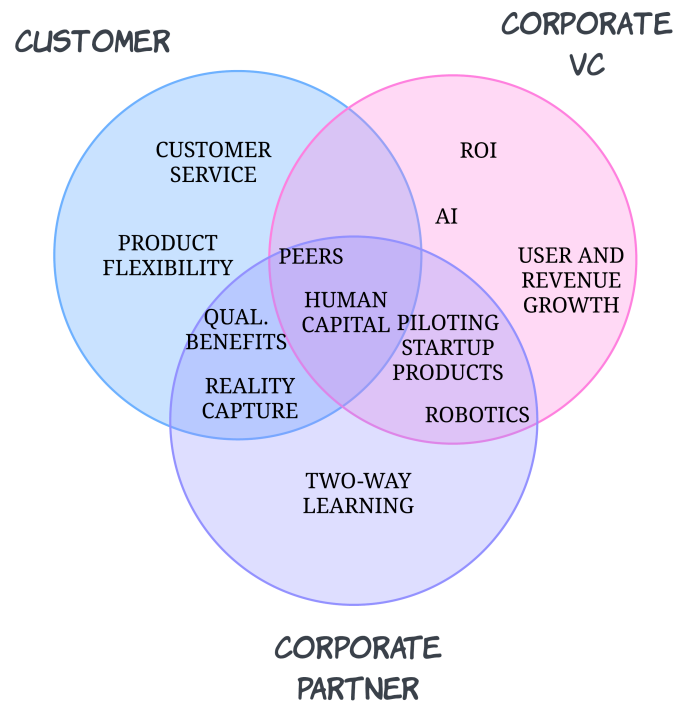


Figure 1: Construction industry-technology startups collaboration types.

This study offers practical insights for construction companies by revealing the benefits and strategies associated with collaborating with technology startups. It may help construction firms in making informed decisions to enhance their innovation levels and drive progress in efficiency, safety, and sustainability. Additionally, it provides valuable support for startups in understanding construction companies' preferences and expectations, thus increasing their chances of success. The study contributes theoretically by deepening our understanding of collaboration dynamics and the role of corporate venture capital in the construction industry. Overall, the study advances both practical knowledge for industry stakeholders and theoretical understanding of innovation dynamics within traditional sectors.

One limitation of this study is the relatively small number of interviews conducted with industry experts, which may constrain the generalizability of the findings. The insights drawn from these interviews provide valuable qualitative data; however, a larger sample size could offer a more comprehensive understanding of collaboration dynamics and innovation strategies within the construction industry. It's important to note that this study serves as the exploratory component of the first author's dissertation work, implying that while it lays the groundwork for future research, it may not encompass the full breadth of the topic. Further research is planned with a larger and more diverse sample, which could provide deeper insights into the nuances of construction technology investments and collaboration approaches. The authors aim to uncover the drivers and challenges encountered by construction companies when engaging as customers for

startups, as well as to evaluate the acceptance and effectiveness of technology adoption.

6. Conclusions

The study explored construction technology investments through startup partnerships, revealing insights from industry experts. Different collaboration models were examined, highlighting ways to boost innovation in construction firms. Startups needed investors, loyal customers, and a robust business model to succeed. Construction companies prefer startups for their flexibility, while corporate entities, defined as strategic partners in this study, focus on intangible gains such as innovation levels. Corporate Venture Capitals support startups financially and strategically, differentiating themselves from traditional VCs by their ability to understand the needs of the construction industry and pilot products. The study provided practical insights for construction firms and startups, enhancing their decision-making and understanding of each other's needs. However, the limited interview sample might limit generalizability. Future research aimed to address this limitation and delve deeper into collaboration dynamics and innovation strategies in construction.

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