

The Ecosystem Revolution: Co-ordinating Construction by Design

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Abstract

Platform Ecosystems have emerged in the information technology sector to disrupt a range of business types, the most high-profile examples being: high street retail (Amazon); hotels (AirBnb); and taxis (Uber). These 'industry-wide' platform ecosystems hold network effects potential and are progressing beyond the tech-sector to disrupt more traditional business domains. Industry-wide platforms emphasize value creation from connectivity and collaboration, as well as the generation and use of data to inform and drive decision-making.

Construction industry business models rely on interaction to generate value. These interactions are commonly considered to occur along a linear, additive, 'pipeline' value chain. Professional expertise is typically contained within domains aligned to project phases. These domains form boundaries that inhibit and limit value creating interactions. Integration is sought as a means of providing a 'thread' through these project phases and between the professional domains. However, this thread creates further professional specialization requiring significant project management.

This paper proposes that the thread of integration can be a role that emphasises and uses the principles of design-thinking. This paper will articulate this potential and show that instead of managing project-value along a pipeline, design holds the ability to co-ordinate value interactions on an industry-wide platform.

Case studies look at emerging construction ecosystems, and this paper considers what a broader platform ecosystem for the whole construction industry may look like. The paper will focus on the questions: How are platform ecosystems emerging to redefine value generation in construction? How might a design-led industry platform ecosystem emerge in construction?

The principles of platform ecosystems stand to fundamentally alter integration removing layers of management and connecting actors more immediately. This paper reveals that an industry-wide construction industry platform ecosystem can benefit from utilising design as co-ordinator and integrator of actions in order to drive value generation.

Introduction

Platform ecosystems are emerging across a range of industries to fundamentally alter business models and redefine the nature of value generation, distinct from the linear value chain of traditional business, to derive value from interactions.¹ Well-known platform ecosystems, such as eBay, Uber, and AirBnb have disrupted traditional approaches to e-commerce, transport, and accommodation. The construction industry has yet to witness the emergence of these holistic, industry-wide platform ecosystems, yet through four industry case studies, this paper demonstrates how their principles are emerging as niche, focused concerns within specific sub-domains of construction. From these studies, this paper outlines the potential that design can play in co-ordinating a future industry-wide construction ecosystem at the strategic-level of business model design.

Scope and Methodology

Construction's traditional research focus has been described as supplier-led, that is, not focused on quality and function from the perspective of a broad grouping of stakeholders.² Research that is supplier-led typically contains clear, commercial

demands with measurable outcomes based on financial or technical performance. On the other hand, research that is concerned with a customer-focus, commonly requires a qualitative approach, with outcomes that are harder to anticipate or to justify before research has been conducted. Design holds the potential to bridge these perspectives, to discover unknown factors, unlock true innovation, and subsequently offer this to the commercial marketplace for competitive advantage.³ Yet design is commonly considered a qualitative pursuit when applied to topics such as business models. This contrast between the stable, knowable research terrain of technical performance, and the unknowable, speculative nature of qualitative market-demands, is especially true of strategic, business issues such as value creation and the structure of the construction industry. As platform ecosystems emerge in other business sectors, the onus is on the construction industry to embrace speculation in order to propose alternate modes of business for the future that deliver greater customer *and* business value. This paper thus utilises design as an *exploratory tool* to understand changes that are occurring in industry and to speculate on new pathways forward.⁴

This paper seeks to answer the research questions:

- How are platform ecosystems emerging to redefine value generation in construction?
- How might a design-led industry platform ecosystem emerge in construction?

To respond to these questions, the paper combines a literature review with short, descriptive company case studies. These studies, developed from marketing information, presentations, and whitepapers, show platform ecosystems to be emerging in support of the existing construction industry's structure without redefining the industry as a whole. Each responds to a sub-domain of the construction industry, that this paper identifies as: *service*, *production*, *compliance*, and the *customer*. They reveal new approaches to business are emerging and hint at the potential for a comprehensive industry-wide ecosystem to emerge, one that binds these disparate sub-domains together. At the core of this vision for a future construction industry is design. Design can generate radical innovation, while providing an holistic perspective that balances the context of people and place that is critical for successful construction,

Redefining the Business Model

Business models are essentially “stories that explain how enterprises work”, as Joan Magretta noted in contrast to the connotation that the word *model* invokes — that there is some definitive and replicable formula at play.⁵ The rise of the internet, saw business models studied more formally, defined by Amit and Zott as the “design of transaction content, structure, and governance” in order to generate value.⁶ Importantly, here is the use of the word design, suggesting that business models are not scientifically formulaic, but instead reliant on the context of a commercial operation to inform a unique solution. Business model change is fundamentally problematic. Christensen et al. described how business models become more fixed over time and are designed not to change. Three stages of a business model were mapped out: market *creating* innovation, innovations that *sustain* progress, and finally a focus on innovation that promotes *efficiency*.⁷ These three stages are important when re-considering construction's business model, as it

has not ever experienced fundamental change and goes some way to explain why so much of construction's research and development has a strong emphasis on technical and production innovation corresponding to the final, efficiency phase of Christensen et al.'s business model stages.

Traditionally, construction's business model has relied on a *value chain* approach, as defined by Michael E. Porter.⁸ This linear creation of value has suited construction' and is reinforced by project templates and plans, such as the RIBA's 'Plan of Work'.⁹ This traditional perspective sees projects managed in a chronological manner, drawing expert inputs, client interaction, and involving contracting parties at specific points in the lifecycle of a project. This approach has suited the project-based thinking that has dominated construction, and allowed responsiveness to unique sites, yet it has not been conducive to a product-oriented vision of the industry, one that prioritises integration, early consultant involvement, and multiple lines of communication for clarity and responsiveness in order to meet stakeholder expectations. Stehn, Brege, and Nord presented the potential of an adapted business model for the construction industry, one specific to industrialised house building (IHB).¹⁰ This adapted business model built on the traditional aspects of business models: the market position, offering, and operational platform, and ascribed elements specific to IHB for each of these.¹¹ Höök and Stehn also found benefits for construction participants in handling a portfolio of business models that could assist in handling standardisation and customisation, as well as managing strategic organisational change.¹²

Noted, has been the tendency for business models to suggest a replicable suite of processes, market choices, and offerings, around which the operations of a company can organise. There is debate as to business models' application in the creative industries.¹³ Construction is fundamentally a creative industry with design, and subsequent making, at its core. Construction's existing business model is traditional, largely static, repetitive, and finds itself exposed to potential disruption. To fend off this disruption, organisations are turning to design-thinking for its ability to generate value through an empathetic engagement with human existence, and thus deliver greater value to a broader range of stakeholders.¹⁴ Peter Rowe considered design to be reliant on gut instinct, rather than purely motivated by scientific fact.¹⁵ From a business model perspective this means that design's impact on a future construction business model could result in greater flexibility and response to the context of engagements and changing stakeholders.

Business model innovation was proposed by Ibarra et al. to be conducted in four ways that either tend towards a traditional view of business and that seek *incremental* improvement, or that alternatively seek new business models through *radical* innovation.¹⁶ In this latter category are platform ecosystems that leverage smart, connected, products and services. Design has been shown to be a critical factor in the generation of innovation, particularly when it comes to the unlocking of new markets and the creation of radical innovation. Roberto Verganti found that design can transcend both technological and market-driven forms of innovation through its ability to generate new ideas that could not have otherwise been predicted.¹⁷

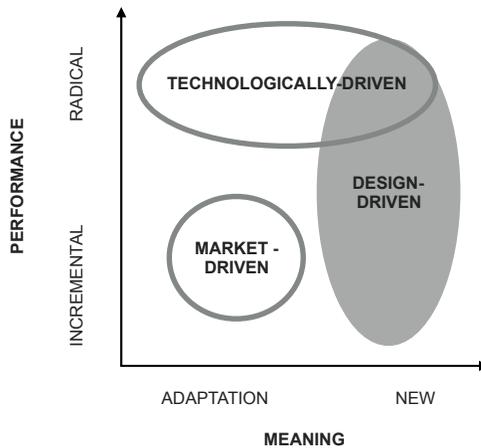


Figure 1: Roberto Verganti's identification of design as a tool to generate new and radical forms of innovation.¹⁸

Anticipating Revolution

Construction has traditionally looked to manufacturing for lessons of progress, the advances of the internet-driven information-age of the past decade have brought a suite of possibly avenues of change. Other sectors are undergoing fundamental and profound business model change brought about by the internet and together both construction and manufacturing are exposed to this potential for disruption.

A range of emerging concepts and disruption in other industries are sowing the seeds of a potential revolution in construction. These concepts, such as *Industry 4.0* herald a new era for manufacturing specifically, considering what role production in the future will play when connected to a network of intelligent systems. Industry 4.0 promises a more connected, accountable, and flexible modes of production.¹⁹ Alongside the emergence of new modes of production have been concepts such as the *Internet of Things* (IoT) that not only underpins Industry 4.0, but also promises greater social, cultural, and design implications as cities become 'smart' with buildings that harvest and communicate data about users, occupancy, and modes of living, through connected urban and building services, appliances, and devices.²⁰ As a means of tracking these interactions and ensuring their credibility alongside these rapid technological developments, *Blockchain* has emerged. Blockchain creates a public ledger to track peer-to-peer value generation and seek opportunities for the elimination of non-value adding transactions.²¹ This kind of tracking leads to calls for example, within construction projects, for the elimination of real estate agents as they do not add significant value but instead occupy the role of on-seller.²² This example can be considered just the first of many changes brought about by the potential of disruptive platform ecosystem business models that are underpinned by greater accountability from blockchain and increased data generated by the internet of things. Added to these disruptive seeds are demographic and cultural shifts that are seen in the principles of the *sharing economy*.²³ The sharing economy, of which Uber and AirBnb are prime examples,

utilise *platform ecosystems* to distribute resources more efficiently than legacy industries.

A Construction Ecosystem

Industries around the world are being subjected to fundamental and radical change brought about by the emergence of the information-age. Service industries in particular, are being transformed by internet-enabled technology. The past decade has seen the emergence of e-commerce platform ecosystems such as Amazon and eBay that connect retailers with customers with either a high degree of physical infrastructure as is the case of Amazon or as is the case with eBay a largely virtual infrastructure that is focused solely on connective seller and buyer. This concept, the efficiency connection of parties, lies at the heart of platform ecosystems. These connections lead to value generation from interactions which provide data to the platform owner, as well as immediacy, a sense of control, and new forms of knowledge to exist between the service provider and user. Further to e-commerce, the well-known platform ecosystems that deal in transportation, such as Uber, or accommodation, such as Airbnb have arrived. These platform ecosystems, however, are not just about software-based tech-sector 'apps', instead they represent a fundamentally different way of working and approaching value generation.²⁴

The value of an ecosystem approach to business was first proposed by James F. Moore in 1993. Moore considered innovation to be the only sustainable competitive advantage, and that true innovation required inputs from outside of a business' internal structure, to create a "co-operative network".²⁵ Moore viewed the ecosystem as a collection of businesses working between sectors that progressed through phases of: "birth, expansion, leadership, and self-renewal" in so-called evolutionary phases.²⁶ Moore was writing at a time prior to the wide-spread penetration of the internet, and as such was simply predicting what could happen based on observation of companies during the preceding decades, noting that business ecosystems had always been in existence. Mohanbir Sawhney considers platform-thinking to be an extension of portfolio-thinking. Where portfolios express a company's activities and their offerings, to Sawhney platform-thinking broadened this perspective to include a more holistic picture of their brand, process, customers, and global network.²⁷

Thomas and Autio found business ecosystems to be an extension of network theory. In their terms, ecosystems explicitly focus on value generation, allowing a collection of actors to create value that would not be possible if they were acting in isolation.²⁸ Thomas and Autio furthered that ecosystems consist of three characteristics: a network of participants; a structure of governance; and shared-logic. Similarly, Choudary et al. considered that platform ecosystems operate at three levels, that of the *networked community* that connects producers and consumers, with the support of *infrastructure* that supports these exchanges, that in turn creates *data* to support future interactions.²⁹ The author's PhD thesis mapped these levels of ecosystems against the assets of manufacturing product platforms as defined by Robertson and Ulrich, proposing a direct link between the physical domain that product platforms operate in, co-ordinating design and production, with the virtual domain of platform ecosystems that co-ordinate value creation.³⁰ This work built on the research of Gustav Jansson who had proposed product platforms' adaptation for industrialised house building, as well as Annabelle Gawer and

Michael Cusumano who proposed a spectrum of platforms from the internal platforms that businesses use to co-ordinate their operations, to supply-chain platforms that exist to work with other companies, through to industry-wide platforms that can be considered the platform ecosystem of a company’s broad network of participants.³¹ For this reason, this paper now proposes that an industry-wide platform ecosystem contains the potential to fundamentally transform the business model of construction, especially if design-led, in line with Ibarra et al. and Verganti’s previously discussed findings.

Distilling Complexity

Construction’s ecosystem is undoubtedly complex. Bröchner noted that the industry of construction is essentially service-based, though is not typically thought of as such due to its “heavy physical element”.³² Construction must not only deal with the constraints and inputs of traditional manufacturing, but also the aforementioned peculiarities of site-based assembly, temporary project-teams, and uniquely designed products. Yet this complexity creates significant opportunity to generate value from the multiple sources of interaction that occur between the range of stakeholders involved.

In order to distil this complexity, for clarity this paper considers four case studies within what are categorised as four sub-domains of construction (figure 2): *Service*, *Production*, *Regulation* and the *Customer*. These case studies reveal how platform ecosystems are emerging to shift thinking around business models in the construction industry. These sub-domains relate to the dominant stakeholder groupings that have impact on construction projects. Consultants that typically provide a *service*, *customer* user groups, stakeholders concerned with *production* of the built artefact, and stakeholders concerned with *compliance* whether at the technical or town-planning levels.

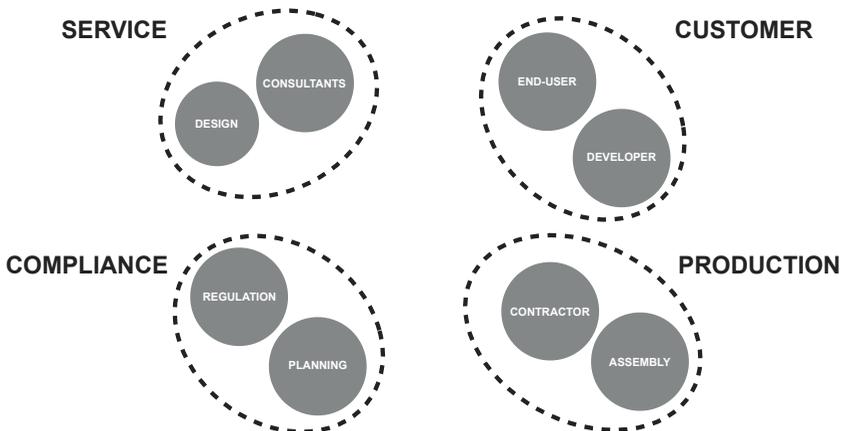


Figure 2: The four, distilled, sub-domains of construction to emerge from construction ecosystem case studies.

Researchers in Finland have sought to learn from ecosystems that have emerged across a range of sectors, to learn the lessons that exposed Nokia to disruption in the early 2000s by the platform ecosystems established by Apple's iPhone and Google's Android. This research has led to calls for an holistic construction platform ecosystem to emerge, and sought to outline how such an ecosystem might appear, though from the somewhat traditional perspective of the central construction contractor.³³ However, this papers' case studies show that platform ecosystems are emerging across the sub-domains of construction to solve specific problems and capture new forms of value from interactions internally. From their description and analysis is revealed a missing perspective, that of an holistic ecosystem that this paper positions, in contrast to the research from Finland, could be design-led rather than production-based, to derive and capture value from interactions between these sub-domains rather than within.

The Case Studies

Service: Productxchange

Productxchange is a cloud-based tool for designers and consultants to gather construction product data, ensure standards compliance, and deliver product models into a central BIM model.³⁴ A four-step process underpins the Productxchange platform. The client and contractor *set* product requirements, the platform allows participants to *collect* product data from manufacturers, this information is then *checked* on the platform to validate the product against the project deliverables established at the first stage. This information is the *delivered* into the BIM model from the Productxchange platform across a range of formats for example PDF export of safety data sheets at the project's end.

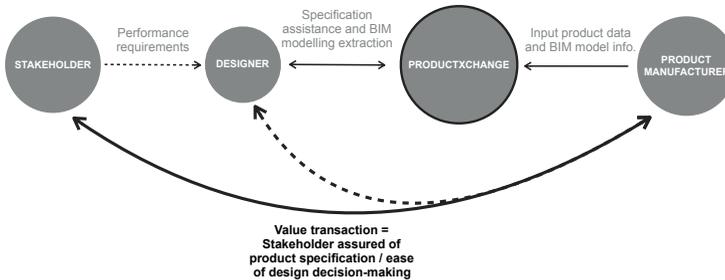


Figure 3: Productxchange's platform ecosystem, linking product manufacturers with project stakeholders

Customer: Ehab

Ehab is a finance-based approach to the creation of a construction ecosystem.³⁵ Promising to create new ways of tackling the growing problem of housing affordability, Ehab uses the principles of crowdfunding paired with blockchain technology to provide accountability, tracking, and assurance of investment. Ehab demonstrates the potential to remove non-value adding entities from construction's value chain, for example digitising and storing property deeds, digitised development payments, and the possibility of 'tokenising' property ownership in

order to increase fluidity and open the potential for easy multiple ownership. Ehab shows the potential that digitisation to alter the conventional property financing narrative that is dominated by banks and real-estate agents.

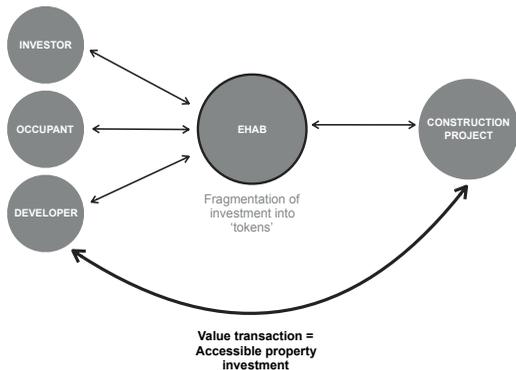


Figure 4: The Ehab platform ecosystem, connecting purchasers with construction projects

Compliance: CitySwipe

An online planning tool, City Swipe has been described as like Tinder, but for urban planning.³⁶ Developed by the local authority, residents to the Santa Monica area are shown images, and asked questions, to which they respond with a simple swipe right for yes, or swipe left for no.³⁷ Images range in content, from building appearance, questions about parking, forms of landscaping, and urban art. The tool, at this stage is very simple, yet it highlights that in this simplicity is an ease of use that avoids time consuming street-based questionnaires or complex online form filling that attracts motivated respondents. Instead there is the potential for City Swipe to evolve into an active tool of design participation that generates design feedback for local authorities to create more relevant and responsive city plans.

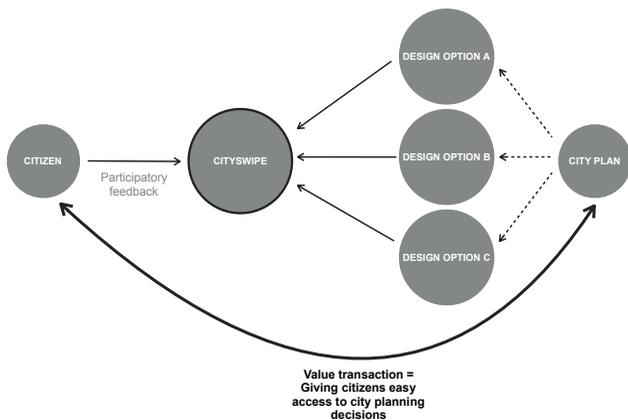


Figure 5: CitySwipe's ecosystem connects citizens with local authorities

Production: Keepsite

A construction management approach to envisioning a platform ecosystem for construction.³⁸ Keepsite delivers a ‘software as a service’ application (cloud-based software that is accessed through a subscription) focused on merging construction project management with a portfolio approach to business.³⁹ Keepsite provides the tools that traditional approaches to project management rely on (managing risk, documentation, responding to issues) creating a network of jobs that integrate to form a portfolio approach to business (one that harvests field data, and provides solutions for task and knowledge management) in turn this drives value between projects through the capture and use of data and knowledge between projects that exist on the platform.

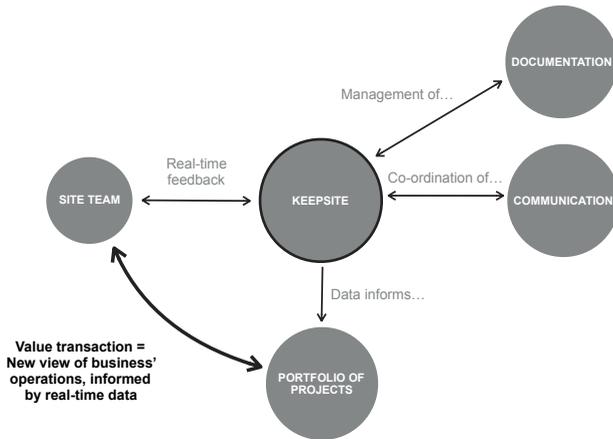


Figure 6: Keepsite allows construction business' a new view of their operations

Conclusion

These case studies reveal that while ecosystems are emerging to address specific issues within the sub-domains of construction, there are not coherent, ‘industry-wide’, ecosystems emerging yet.⁴⁰ An industry-wide ecosystem for construction would not only drive value from the interactions within the sub-domains as these case studies do but would also generate new forms of value from interactions between the sub-domains (figure 7). This value would be of use to the sub-domains to improve their internal processes, but also increase the value of the built product as well as the efficiency of processes that underpin its design and construction, thus increasing value for the end-user.

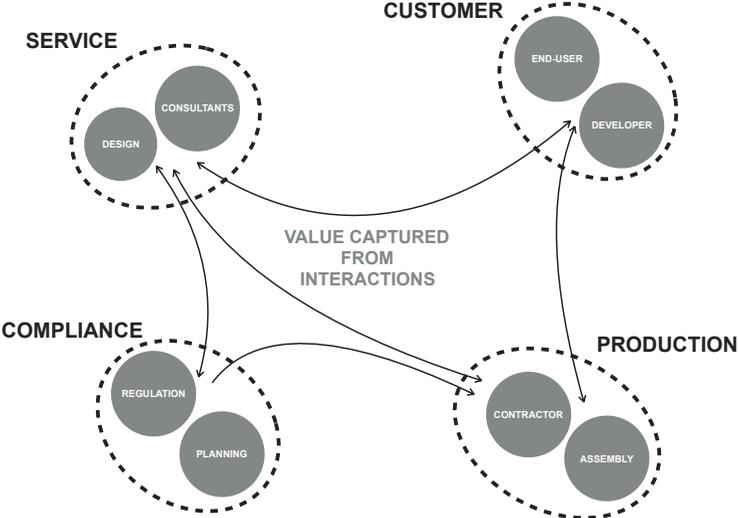


Figure 7: New forms of value could emerge from increased interactions between participants.

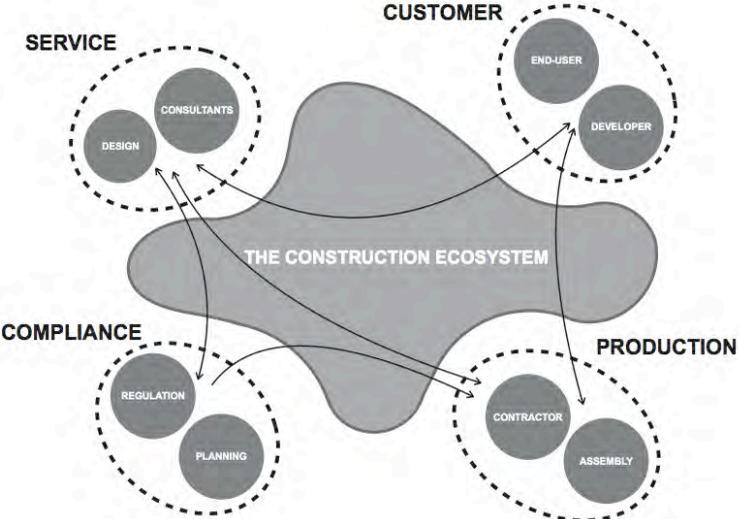


Figure 8: The potential domain of an industry-wide construction platform ecosystem.

Creating an ecosystem for construction that generates increased interactions between sub-domains and increases the value of interaction, would also improve the integration of construction’s sub-domains, by linking previously disconnected parties through the ecosystem to create a more efficient and responsive design

environment (figure 8). A construction ecosystem of the future would benefit from a design-perspective due to design's ability to operate holistically across issues. This design-led approach would seek to generate the new forms of business model required by construction to avoid future disruption from new entrants to the sector from other industries.

This paper, in conclusion, returns to its initial research questions in order to summarise the discussion. The principles of platform ecosystems have been discussed, while it has been shown that design, as an act of synthesis that is beneficial in seeking innovation, is well placed to enhance and extend these principles when applied to the unique and peculiar context of construction. A design-led platform ecosystem would mediate the territory of construction that exists between its stakeholder domains and the context of projects, ultimately helping achieve integration between parties by generating value from interactions between participants.

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